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# How Technology Teachers and Coaches Use Digital Tools in Instruction

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This is to certify that the doctoral dissertation by

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Walden University
2021

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## Abstract

While technology teachers and coaches have successfully integrated digital tools into their schools' curricula, many classroom teachers still struggle with that integration. Not enough is known about how technology teachers and coaches plan and implement instruction using digital tools, and this knowledge may be useful for classroom teachers. This basic qualitative study explored some digital tools such as interactive whiteboards (IWBs), desktop computers, iPad devices, and apps used in instruction for pedagogy and content. The Technology Pedagogy and Content Knowledge (TPACK) was the study's conceptual framework. The purpose of the study was to determine how using digital tools in instruction may enhance pedagogy and content for building learning experiences and facilitating learning styles. Nine participants were recruited via social media from Grades 3 through 8 technology teachers and coaches from the northeastern United States. Telephone interviews were used to collect data and the audio was digitally recorded and transcribed. Data were coded for categories, then themes and patterns using inductive analysis. The key results showed that digital tools enhanced learning styles such as visual, auditory, and kinesthetic. Participants disclosed that they relied on the internet for digital resources. Participants combined learners' background experiences and knowledge for lesson planning and digital tools choices of apps and learning platforms. The positive social change implications include the potential for improving classroom teachers' ability to incorporate digital tools into instruction to encourage class participation and learning.

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# Dedication

This dissertation is dedicated to my daughter Shelly-Ann Nicola Mittoo, who became my inspiration in this journey. Her joy of knowing my academic pursuits was exuberating, and her happiness was tied to my educational attainment. Sadly she passed before I could complete this Ph.D. journey.

Acknowledgments

I take this opportunity to acknowledge the people who were significant to my success during my Ph.D. journey. First, I thank my dissertation committee members; I salute Dr. Bauder and Dr. Tyrrell for their untiring guidance and encouragement along the way. Thank you, Dr. Dawidowicz, for ensuring my work met the prescribed academic standards. I thank my immediate family for their support and relentless bearing on my absence, both mentally and physically. They understood my untiring commitment to focus on fulfilling the requirements of this dissertation. I would be remiss if I did not thank my mother, Evelyn Jackson-Mittoo, whose encouragement and support laid a good foundation of educational values in my childhood school days. Sadly, she passed, but my educational journey was steadfast. I thank my father, Cephas Augustus Mittoo, for his backburner support in understanding and recognizing that I could conquer my academic desire. Sadly, he passed as I near the end of this study. Finally, I thank my friend Yasmin Stewart, educator, for her encouragement in completing my study.

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# Chapter 1: Introduction to the Study

This qualitative research study explored digital tools used in instruction in Grades 3 through 8. In some schools, Grades 3 through 8 teachers with specialized knowledge about digital tools uses are employed as technology teachers or coaches. The Office of Educational Technology (2017), a government-based source in the United States, identified a social-educational problem for Grades 3 through 8 educators to use digital technology for improving 21st-century instruction and learning. Grades 3 through 8 technology teachers and coaches coordinate with classroom teachers across subject areas to familiarize students with digital tools uses and teach different subjects across the curriculum with various digital devices. Grades 3 through 8 technology teachers and coaches work in technology-equipped classrooms or labs and facilitate students' learning using digital tools to encourage participation. Technology teachers and coaches have used digital tools to improve pedagogy and lesson content to enhance instruction and performance (Craciun, 2019; Jiang et al., 2017; Pattillath et al., 2018). The researchers cited above revealed that technology teachers and coaches at different grade levels used digital tools to promote students' learning. Grades 3 through 8 technology teachers and coaches know about digital tools' uses and may provide expert knowledge regarding creative use. Researchers revealed the necessity for explaining the process of integrating digital tools' use into instruction (see Alavi et al., 2016; Albion et al., 2015; Dooley et al., 2016; Jiang et al., 2017; Starkey, 2020).

The United States federal government expressed concern for classroom teachers prioritizing digital technology to improve instruction and learning. The Office of

Educational Technology (2017) pursues advancing digital technology use, promoting instruction and learning approaches between educators and students, and encouraging digital learning experiences. According to the Office of Educational Technology, classroom teachers should learn about digital tools to improve 21st-century education. This concern came from students' poor performance in the state standardized exam and their reason for classroom teachers' poor performance (Office of Educational Technology, 2017). Some classroom teachers lacked knowledge of combining digital tools into their subject areas to enhance their teaching and improve students' learning (Starkey, 2020; Wijaya & Djasmeini, 2017). Wijaya and Djasmeini (2017) noted that many classroom teachers used traditional teacher-centered instruction for students to write notes taken from a blackboard or whiteboard. Without integrating digital tools to enhance learning practices, students could lack active class participation and performance (Starkey, 2020). Starkey (2020) indicated that traditional teaching and learning methods might not be satisfactory to cope with the education system's challenges to deal with a technologically driven society. Starkey (2020) noted that classroom teachers must become competent users of digital technology.

Several researchers revealed that technology teachers and coaches used digital tools in technology-equipped environments (Al-Abdullatif et al., 2019; Hoffmann & Ramirez, 2018; Mustafina, 2016). Hoffmann and Ramirez (2018) indicated that technology teachers and coaches used digital technology for pedagogy, content, and student-centered instruction. Still, researchers did not present enough about how Grades 3 through 8 technology teachers and coaches integrated digital tools to enhance pedagogy

and content (Hoffmann & Ramirez, 2018). Instruction and learning with digital tools used in meaningful ways may contribute to student-centered education to achieve learning goals (Al-Abdullatif et al., 2019; Mustafina, 2016).

This research study was needed to learn how Grades 3 through 8 technology teachers and coaches integrate digital tools used for pedagogy and content, which could help educators better understand and support instruction and learning (see Office of Educational Technology, 2017). This research study revealed Grades 3 through 8 technology teachers' and coaches' best practices to encourage digital tools application methods in 21st-century education. The findings of this research study could benefit administrators, classroom teachers, and students knowing how to use digital tools to expand and enhance instruction and learning.

Chapter 1 shows the background information about educational technology knowledge areas and briefly describes the challenges and benefits of incorporating digital tools into teaching. The problem statement relates to understanding how Grades 3 through 8 technology teachers and coaches integrate digital tools into instruction. The subsequent sections of this chapter include the purpose of the study, the research questions, the conceptual framework, and the nature of the study. The terms used in the study are defined to clarify meanings and assumptions. The limitations and delimitations are discussed. I discussed the significance of the research study and the social impact.

## Background of the Study

This study explored how Grades 3 through 8 technology teachers and coaches integrate digital tools into instruction to enhance pedagogy and content. Educational

technology research shows limited information about digital tools' creative use by technology teachers and coaches (Engeness & Edwards, 2016; O'Connor et al., 2018). Some studies (Dooley et al., 2016; Jiang et al., 2017; Starkey, 2020) showed that some technology teachers and coaches across upper elementary and middle schools used digital tools in instruction. Digital tools knowledge could be helpful to classroom teachers who are learning to use digital tools to improve teaching. Digital tools use knowledge remains fragmented, needing a better understanding to compose different methods and show creative application (Alavi et al., 2016; Albion et al., 2015; Dooley et al., 2016; Jiang et al., 2017; Starkey, 2020). The data collected in this research study may add new knowledge in the educational technology field, better understand how Grades 3 through 8 technology teachers and coaches used digital tools, and show new ways to enhance students' learning and instruction for greater class participation.

The complex nature of teaching and learning presented challenges when incorporating digital tools (O'Connor et al., 2018). Engeness and Edwards (2016) highlighted the importance of educators' need to be proactive in integrating digital tools into pedagogy and content to improve their performance and students' learning experiences. Hoffmann and Ramirez (2018) indicated that technology teachers and coaches might share how digital tools uses in meaningful ways. Because my research study explored digital tools used by Grades 3 through 8 technology teachers and coaches, the literature review was essential to expose what's known about digital tools use, the benefits of digital tools used in the classroom, barriers, and risks in using these tools. The information could give me more profound insights into current issues, and trends

regarding digital tools use, require more in-depth study, and identify areas where not much is known.

**Benefits of Digital Tools Use in the Classroom**

The internet is used in classrooms to expand instruction and learning, enabling educators to download programs, develop their lessons, simplify complex material, and make tasks more understandable and accessible to students (Kale, 2 018; Tan et al., 2018). The internet, Wi-Fi, and website connectivity are 21st-century technology tools used by technology teachers and coaches for integrating digital tools use, which is much more than the regular use of physical technology devices (Altawil, 2016; Tan et al., 2018; Yagci, 2015). Tan et al. (2018) indicated that institutions should have a technology policy that allows teachers to access the internet and connect to social media to expand the classroom's activities and learning opportunities. Tan et al. (2018) noted that teachers who are naïve to the resourceful ways that digital tools could enhance pedagogy and expand content are using these tools merely for the utility purposes of preparing their lessons and not integrating the tool's use for meaningful instruction. Kale (2018) noted that although some teachers have digital tools in their classrooms, they experience challenges incorporating them into the lesson. Incorporating digital tools into the class may go beyond their utility for research and typing lessons and into the knowledge of digital tools used for pedagogy and content (Kale, 2018).

Flewitt et al. (2015) believed that teachers must learn to use digital tools and apply them to engage students in developing the reading skills suited through K-12. Hutchison and Colwell (2015) indicated a necessity for more research to understand how

to use apps, learning platforms, and digital hardware to enable interactive instruction and learning. For example, Spooner et al. (2015) revealed that iPad 2 could allow students with severe learning disabilities to improve understanding using apps for interactive learning. Spooner et al. (2015) indicated a need to investigate further how the internet-digital tools can enable students' meaningful learning practices.

Teachers using IWBs in lesson presentations may facilitate students' learning and challenges. Researchers found that teachers may integrate the IWB use in various ways to encourage class participation and learning (Cabus et al., 2017; Giannikas, 2016; Young et al., 2017). The researchers indicated that using the IWB should transform theoretical knowledge into practical learning. Teachers should consider how students learn with digital tools and plan lessons that involve students' interests and participation. Alavi et al. (2016) and Chu et al. (2015) indicated that teachers' training should include computers and tablets for assistive and interactive learning. Alavi et al. (2016) suggested that teachers should be familiar with the computer for step-by-step application in instruction, which could help expand and enhance learning. According to Alavi et al. (2016), teachers should review the traditional approach to education and focus on students' learning modalities of visual-display thinking to help cognitive process ideas based on the lesson's objective. Educators should know how to select among the different digital tools for facilitating students' learning styles and use these tools to improve students' understanding and performance (Alavi et al., 2016). Without students' involvement in using digital tools, teachers may be withholding new skills and knowledge that could help students expand their performances (Alavi et al., 2016).

**Digital Tools Use Integrated Into Instruction**

Studies showed that some teachers used digital tools for instruction without applying creative methods and strategies; therefore, there is still limited knowledge about integrating digital technology uses in pedagogy and content (see Craciun, 2019; Jimenez & Moorhead, 2017; Pattillath et al., 2018). Jiang et al. (2017) noted that some teachers lack the knowledge to incorporate digital tools to improve pedagogy and content. Web 2.0 tools are available on the internet, and many preservice teachers have digital tools awareness (Craciun, 2019). However, teachers using digital tools in formal education to enhance pedagogy and content becomes challenging for them to do so (see Craciun, 2019; Jiang et al., 2017). Without the teachers' knowledge of digital tools' uses and knowing how to involve students' participation in using these tools, the teachers and students may not experience creative and meaningful class participation (Kurt et al., 2019).

Some teachers indicated having positive perceptions regarding digital tools (Kurt et al., 2019) but used digital tools only to prepare instructions and substitute for teaching. Dube and Scott (2017) indicated that teachers using digital tools in instructions showed positive teaching results when they knew how to engage students in active participation. Raji and Zualkernan (2016) noted that digital tools knowledge could enable teachers to manage their changing roles of becoming facilitators in the classroom. Teachers needed the training to learn how to use these tools for student-centered instruction more meaningfully (Raji & Zualkernan, 2016). Some teachers were adapting digital tools but

needed training about promoting teaching and meaningful learning (Konokman & Yelken, 2016).

Researchers noted that teachers who combined a positive attitude and had experience using digital tools could better integrate digital devices to improve multimodal and interactive instruction (Dube & Scott, 2017; Palladino & Guardado, 2018). Palladino and Guardado (2018) reported that teachers trained to integrate digital tools were motivated to enhance multimodal instruction. Konokman and Yelken (2016) noted that teachers needed to have prior knowledge regarding students' social learning styles. This knowledge can enable the selection of digital tools and planning instructions for maximizing students' learning. Öman and Sofkova Hashemi (2015) noted using digital tools in multimedia to improve teaching and enhance student-centered approach and interactive learning. Güneş and Bahçivan (2016) indicated that the constructivist approach in education showed that students could use digital tools to accomplish learning tasks. On the other hand, Öman and Sofkova Hashemi (2015) observed that some teachers were familiar with cooperative learning in instruction but lacked knowledge in using digital tools.

Researchers (Güneş & Bahçivan, 2016; Konokman & Yelken, 2016; Öman & Sofkova Hashemi, 2015; Palladino & Guardado, 2018) showed meaningful results regarding the approach and integration of digital tools use. However, Lembke et al. (2017) stated that teachers needed to assess digital tools' usage and share their knowledge. Kalonde (2017) noted that some teachers were familiar with using computers and IWBs, iPads, and tablets. However, they lacked knowledge of digital tools use

procedures that could enable them to enhance instruction and further help students to use these tools to improve greater class participation.

**Barriers and Risks in the Integration of Digital Tools**

Barriers to using digital tools in instruction and learning included schools without a technology policy inclusive of technology infrastructure, training, and digital tools in teaching and learning (Rabah, 2015). Rabah (2015) reported that teachers with insufficient technology training had limited technical knowledge and experience integrating digital technology into instruction. Rabah (2015) noted that school administrators needed to have training policies for the use of digital tools, mandatory for teachers, and training for them to meet 21st-century education. The lack of technology infrastructure and teachers' training is a significant barrier to integrating digital technology in schools (Rabah, 2015).

Tachie (2019) noted that studies have indicated that some teachers were not encouraged to use digital tools in instruction, and students were experiencing difficulty applying these tools to improve their learning. Bodsworth and Goodyear (2017) revealed that many senior teachers had training in their profession that did not include integrating digital technology in education. According to Bodsworth and Goodyear, classroom teachers needed to do additional skills training to improve their competence in integrating digital tools. Hsu (2016) indicated that it was essential for teachers to keep abreast of new digital tools and integration practices. Zyad (2016) noted that some teachers were not aware of their school community's digital technology practices. Teachers should become aware of their schools' digital tools policy practically. Zyad (2016) noted that teachers

must integrate digital tools into instruction to improve their performance. Because teachers must take responsibility for their technology learning and development, it is fitting for teachers to demonstrate the right attitude and commitment to take on the challenges of integrating digital tools into instruction (Dooley et al., 2016). Dooley et al. (2016) indicated that the participatory method of using digital tools exceeded students' passive learning and should enable them to experience the creativity and joy in learning with new projects. Dooley et al. (2016) noted that researchers could explore diverse learning styles that teachers may learn how to facilitate students using digital tools. Digital tools' uses for improving pedagogy and content is an opportunity to examine how technology teachers use digital tools to improve instruction and encourage active class participation.

**Risk-Taking in Digital Tools Use is Dependent on Teachers**

Some teachers experienced challenges using digital tools to enhance their lessons (Goodwin et al., 2015). Goodwin et al. (2015) noted that risk-taking that might impact technology teachers' practices in incorporating digital tools to maximize students' learning, and cognitive development are worth exploring in future research studies. Xu and Chen (2016) noted that experienced technology teachers might show proficiency and effectiveness in using digital tools. Xu and Chen (2016) indicated a need for technology environments and a school technology policy. The personal barriers identified by researchers required further investigation on how technology teachers may manage challenges in using digital tools (see Bodsworth & Goodyear, 2017; Voogt & McKenny, 2017).

This study addressed the gap of not enough is known about how Grades 3 through 8 technology teachers and coaches select and use digital tools in instruction (see Bingimlas, 2018). Grades 3 through 8 technology teachers and coaches have used digital tools to teach across the curriculum. My research study shared participants' knowledge and experience regarding meaningful digital tools used in instruction (see Sensoy & Yildirim, 2018). Grades 3 through 8 technology teachers and coaches revealed how they integrated digital tools to enhance learning for 21st-century education (see Demirbas & Timur-Ogut, 2020). My research study uncovered the knowledge gap for selecting and incorporating digital tools to understand instructional strategies and learning challenges. Digital tools use enhanced students' prior knowledge, teaching and learning methods, and the process of combining digital tools to engage students in step-by-step procedures to improve their learning experiences.

This research study investigated Grades 3 through 8 technology teachers and coaches integrating digital tools to enhance pedagogy and content and added new knowledge to benefit classroom teachers, students, school principals, and administrators. The knowledge gained from this research study regarding digital tools use may clarify some teaching strategies and students' learning styles to allow for creativity in lesson planning using digital technology. The background in this study showed technology teachers-participants integrating digital tools use into instruction. My research study explored a deeper understanding of how nine participants from Grades 3 through 8 technology teachers and coaches use digital tools and share their knowledge of how these tools may improve pedagogy and content.

During the recent COVID-19 pandemic, educators saw the need for digital tools to enhance blended learning. This study revealed significant instruction and learning methods using digital tools in blended learning. School principals and stakeholders may become aware of digital technology infrastructure to improve teaching and learning. This study may create a platform for researchers to explore additional digital tools and provide educational technology and social development knowledge.

## Problem Statement

The problem addressed in this research study was that not enough was known about how Grades 3 through 8 technology teachers and coaches integrate digital tools into instruction to enhance pedagogy and content. Demirbas and Timur-Ogut (2020) examined digital tools used to facilitate learners' needs and expectations and revealed that a knowledge gap existed to understand better the use of these tools. Digital tools integration is not fully understood, and there is a need to explore the creative use of digital tools for 21st-century education (see Demirbas and Timur-Ogut, 2020). Bingimlas (2018) noted that the lack of a better understanding of technology tools integration created complex learning conditions for diverse content sources. Aflalo et al. (2018) espoused that not knowing how to integrate digital tools for meaningful instruction prevented classroom teachers from planning student-learning experiences. The lack of new knowledge of digital tools used by classroom teachers to engage students in learning experiences fails to improve their academic ability and performance (Tseng, 2018). Kale (2018) indicated that technology teachers and coaches kept abreast of technology, but some teachers still had a knowledge gap in digital tools use.

Chapter 2 literature revealed digital tools use but limited knowledge of the instructional and learning strategies necessary to address new and creative learning outcomes with these tools. The literature also showed the lack of understanding of regular classroom teachers selecting and applying digital tools. Grades 3 through 8 technology teachers and coaches integrated digital tools to enhance pedagogy and content. In this research study, they are the source to discover more about using digital tools to improve pedagogy and content.

## Purpose of the Study

The purpose of this basic qualitative research study was to investigate Grades 3 through 8 technology teachers' and coaches' methods of selecting and integrating digital tools into instruction to enhance pedagogy and content. The TPACK framework enabled a lens for a better understanding of incorporating digital tools to improve teaching (see Sensoy & Yildirim, 2018). Exploring Grades 3 through 8 technology teachers' and coaches' methods of selecting and integrating digital tools into instruction revealed new knowledge for enhancing pedagogy and content. Grades 3 through 8 technology teachers and coaches demonstrated new ways to incorporate digital tools to improve differentiated instruction. Kirikcilar and Yildiz (2018) noted that classroom teachers are responsible for knowing how to use digital tools to enhance their technical competencies and improve students learning for 21st-century education.

The 21st-century educational challenges require suitable and qualified educators to integrate digital tools (see de Silva et al., 2016). Ultimately, it was necessary to explore how digital tools could facilitate students' learning modalities with more meaningful

teaching and learning experiences. Montebello (2017) noted there was concern about the proper use of digital tools and that classroom teachers should learn how to integrate digital pedagogy to cope with a 21st-century education. Grades 3 through 8 technology teachers and coaches revealed how digital devices could improve pedagogy and content, lead to classroom teachers' improvement in lesson planning, and improve their performances and effective teaching practices (see Montebello, 2017). In this research study, candidates were purposively selected and asked to share their knowledge regarding the use of digital tools. Montebello (2017) noted that the digital age requires all teachers to know about digital tools use, facilitate learning styles, and plan lessons that incorporate digital tools.

## Research Questions

The primary research question and sub-questions are as follows:

RQ: What are the different ways Grades 3 through 8 technology teachers and coaches integrate digital tools into instruction?

SQ1: What instructional needs do Grades 3 through 8 technology teachers and coaches fulfill by integrating digital tools into instruction?

SQ2: How do Grades 3 through 8 technology teachers and coaches use digital tools to enhance pedagogy and content to create learning experiences?

## Conceptual Framework

The phenomenon of interest is understanding how Grades 3 through 8 technology teachers and coaches used digital tools to enhance pedagogy and content and create meaningful learning experiences. Grades 3 through 8 technology teachers and coaches

facilitated students' learning modalities of complex learning materials, including selecting digital tools specific to students' learning levels, styles, and environmental experience. The conceptual framework underpinning this study is TPACK (see Koehler et al., 2017). Koehler and Mishra (2009) formulated the TPACK framework, which is an extension of Shulman's (1987) pedagogy content knowledge (PCK). Technology knowledge (TK) connects in different ways with content knowledge (CK) and pedagogical knowledge (PK). TPACK is a framework that researchers use to understand digital technology use in instruction for pedagogy and content (see Feride, 2015; Lehiste, 2015; Lin et al., 2015; Sheffield, & Dobozy et al., 2015). Some researchers indicated that the TPACK lens might enable teachers to understand digital technology integration (Dong et al., 2015; Pamuk et al., 2015).

Educators who are knowledgeable about applying the TPACK framework may share their best practices for integrating digital tools' use into instruction (see Millen & Gable, 2016; Mishra, 2014). The TPACK framework provided a lens with different subsections to better understand how to integrate digital tools into teaching and how best practices may improve the quality of 21st-century education (Xiong & Lim, 2015). The TPACK framework allowed me to understand how Grades 3 through 8 technology teachers and coaches used best practices to integrate digital tools into teaching (see Scherer et al., 2017).

I selected the TPACK framework for a lens to help me better understand the research problem and formulate critical research questions for digital tools use. The literature review revealed significant ways the TPACK framework enhanced digital

technology, which later enabled me to identify themes relating to integrating digital tools into instruction. After data collection, I used the TPACK framework lens to analyze and clarify the data to find patterns in teaching (see Maxwell, 2013; Mishra & Koehler, 2006). I discuss the TPACK framework more thoroughly in Chapter 2.

The data collection instrument was the interview protocol designed to answer the research questions. I used the TPACK framework to analyze the data collected and identified patterns in integrating digital tools into pedagogy and content. I used color codes to identify data patterns for categories in digital tools uses.

The TPACK framework subsections include:

- Pedagogy Knowledge (PK)
- Content Knowledge (CK)
- Pedagogy Content Knowledge (PCK)
- Technology integration with Content Knowledge (TCK)
- Technology integration with Pedagogy Knowledge (TPK)
- Technology Pedagogy and Content Knowledge (TPACK)

I identified data patterns for digital tools use and inspected alignment with the TPACK framework and sub-sections. I used color-coding and identified similar data patterns to connect the TPACK framework or subsections indicated above. I grouped the color-coded data patterns and examined them for TPACK categories. I discussed each subsection (i.e., TK, PK, CK, PCK, TPK, and TCK) for data patterns using digital tools connected with themes identified in the literature review. I discuss more on the data collection instrument and analysis in Chapter 3.

## Nature of the Study

I had proposed this research approach for a case study. However, the case study was not possible due to the lack of cooperation by the proposed institution's IRB to collect data and the COVID-19 pandemic. Instead, I used the basic qualitative study approach to investigate how Grades 3 through 8 technology teachers and coaches integrate digital tools to enhance pedagogy and content in instruction and learning. Patton (2015) indicated that the basic qualitative research explored deeper insights into real-world problems and that the interview could provide knowledge on the social situation through interaction with others. The basic qualitative study approach was not restrictive and bound to a particular data collection methodology as with other qualitative methods (see Kahlke, 2014). Percy et al. (2015) noted that the data collection process should not make the candidates feel restricted in sharing their knowledge. When candidates give information based on their experience and perspective, the data may be trustworthy (Percy et al., 2015). My data collection choice was the informal interview.

I pursued recruiting volunteers for my research study using social media. I posted my electronic invitation flyer advertising for volunteers to participate in my research study. First, I advertised on Facebook. I also registered with Walden University's participant pool website. If I had encountered challenges finding volunteers, I would use professional technology organizations such as LinkedIn and the Association for Educational Communications and Technology (AECT). If I continued to have difficulty identifying and recruiting volunteers using those organizations, I planned to use the Userinterviewer online recruiting services.

I used the informed consent form that included the inclusion criteria, checked by Walden's IRB, for choosing purposeful and potential candidates. I used the Interview Protocol for telephone interviews and recorded the data collecting discussion with participants' permission. I selected potential candidates using the inclusion criteria discussed in Chapter 3.

I recruited Grades 3 through 8 technology teachers and coaches for sharing their knowledge regarding the use of digital tools in instruction. I selected nine candidates from Grades 3 through 8 technology teachers and coaches and used the interview protocol to guide me through the data collection process. I arranged with potential candidates for interviews, either by telephone or zoom calls. The interviews were semi-formal structured using open-ended questions to facilitate candidates' telling their experiences and giving examples of integrating digital tools into instruction. I recorded the discussion with the permission of each candidate. I discuss the interview protocol in Chapter 3.

For the data analysis, I searched for patterns and used color codes to find similarities and differences in data patterns to answer each research subquestion. I identified data patterns for SQ1 and SQ2 interview questions that matched TPACK subsections for TK, PK, CK, TPK, and TCK. I used inductive analysis to determine data pattern themes to connect with literature review themes to answer RQ. I discuss data collection and analysis in Chapter 3. This research study's findings should interest classroom teachers unfamiliar with the use of digital tools. Bolstad (2017) indicated that

classroom teachers should broaden their scope to use digital tools to encourage class participation.

## Definitions of Key Terms

This section defined the key terms and phrases for this study.

***Content knowledge (CK).*** Content knowledge refers to a teacher's comprehension of the subject matter they teach (Scherer et al., 2017).

***Digital Technology/Digital Tools/Digital Devices.*** Web-based 2.0 instructional tools include mobile devices, tablets, computers, projectors, laptops, and interactive whiteboards. These tools support teachers in guiding all students to accelerate progress (Gates & Gates, 2015).

***Information Communication Technology (ICT).*** These are digital technology tools including computers, PCs, Macs, tablets, iPods, mobile phones, internet, digital cameras, interactive whiteboard, and videos incorporated in the syllabus to improve learning (Pombo et al., 2017).

***Instructional Gap.*** In this study, the instructional gap refers to poor classroom practices using digital tools or ineffective use of digital tools in 21st-century teaching and learning (Yaki & Babagana, 2016).

***In-service Teachers.*** Classroom teachers are familiar with their school's environment and pedagogy practices to deliver the subject content that enhances and fulfills the curriculum goals as a priority (Maddamsetti, 2018).

***Integration Process.*** The integration process uses teachers' ideas to match the learning objectives, facilitate instruction, and find viable solutions to teaching and learning with digital tools (Scherer et al., 2017).

***Pedagogy Content Knowledge (PCK).*** PCK refers to teaching practices to include strategies that suit delivering the subject matter connecting the content knowledge and the pedagogical knowledge (Scherer et al., 2017).

***Pedagogy Knowledge (PK).*** PK is the teacher's knowledge of the teaching requirements, philosophies, and methods required to direct their instruction and structure their curriculum (Scherer et al., 2017).

***Preservice Teachers.*** The preservice teachers are inexperienced educators in training or new to the classroom environment to acquire knowledge of the teaching profession (Cuhadar, 2014).

***Technology Coaches.*** Technology Coaches are experienced certified teachers who have taken their desire for technology at the next level and become specialist coaches for instructional technology using digital tools (Holtz, 2018).

***Technology Content Knowledge (TCK).*** TCK refers to understanding how the subject content understudy can be better communicated (taught) with the use of technology (Scherer et al., 2017).

***Technology Integration.*** Technology integration is the use of computers and other resources for technology-based practices with digital tools. Technology can enable students to learn complex concepts more readily, resulting in meaningful students' outcomes (Davies & West, 2014).

***Technology Knowledge (TK).*** TK involves understanding how to use conventional and digital technology for enhancing instruction (Scherer et al., 2017).

***Technology Pedagogy Knowledge (TPK).*** TPK is about using technology to communicate informational knowledge, philosophies, and methods. Students' learning and cognitive development may improve with the effective use of digital tools (Scherer et al., 2017).

***Technology Pedagogy and Content Knowledge (TPACK).*** TPACK expertise refers to educators using digital tools concerning the intricate relationship between technology, pedagogy, and content. TPACK may enable the selection and use of digital tools in successful teaching practices (Scherer et al., 2017).

***Technology /Tech Teachers.*** Technology/tech teachers are professional educators who participate in technology courses and technology workshop training and activities. The focus is on developing their technical abilities and skillsets to use digital tools and processes in a lab or classroom (Roland, 2015). For this study, technology teachers have experience using digital tools in a technology-equipped classroom or lab.

## Assumptions

The candidates in my research study were from Grades 3 through 8 technology teachers and coaches integrating digital tools used into instruction to enhance pedagogy and content. I have assumed that candidates were using digital tools in distinctive and meaningful ways for improving and expanding students' learning. I also believed that the candidates would share their digital tools knowledge and give examples. I assumed that candidates would be transparent and honest in their responses to the research questions,

as I asked for no personal information. I hoped their answers would reveal technological knowledge and practices in integrating digital tools into instruction. Grades 3 through 8 technology teachers and coaches incorporating digital tools into instruction could indicate how they select and use these tools to enhance pedagogy and content in complex teaching situations and facilitate students' learning styles (see Sousa et al., 2017).

## Scope and Delimitations

My research study candidates were Grades 3 through 8 technology teachers and coaches who used digital tools to enhance instruction and learning across their schools' curriculum. Using the internet-online medium and social network for seeking volunteers opened the opportunity to recruit from a broad educational technology field, which enabled me to secure potential candidates indicating they were willing to participate in my research study. The candidates were Grades 3 through 8 technology teachers and coaches, suggesting using technology-equipped labs or classrooms. I did a purposive selection of candidates, using an Inclusion Criteria tool to avoid bias and solicitation. I did not recruit school administrators, classroom teachers, and students to participate in this research study.

A candidate who did not satisfy all the selection criteria but showed having experience in digital tools was selected to participate in this study. The years of experience using digital tools were essential in revealing candidates' digital tools' knowledge. I conducted this research study during the COVID-19 pandemic, and technology teachers and coaches might have adjusted their digital tools uses methods to

accommodate a blended learning curriculum for remote teaching. These changes may allow me to recommend future studies for online education or blended learning.

## Limitations

My research study findings will not hold generalizability for closed-boundary school communities due to the broad mix of candidates with diverse experiences drawn from a wide cross-section of Grades 3 through 8 technology education fields. The data collection was online, and the COVID-19 pandemic prevented in-person interviewing, observation, and sites visits. Not all Grades 3 through 8 technology teachers and coaches might work diligently to use digital tools in instruction; however, I relied on the inclusion criteria to determine suitable candidates. I used nine candidates for this research study, which has limitations for generalization. I was the sole researcher analyzing data, which may have limited my insights to identify and reveal more detail of digital tools used in instruction.

I might hold biases based on the literature review and my prior knowledge of digital tools integration into instruction. However, I applied non-attached measures using my journal to avoid biases impacting this research study by maintaining an open mind and a neutral stance of my opinions and any knowledge of digital tools used in instruction (see Miles et al., 2014). My diary helped me avoid my biases and keep clear of any preconceptions. I audio-recorded each candidate's response to interview questions and compared them with my written notes immediately after the interview to avoid inaccuracies and ambiguities. I made several references to the audio-recording during data analysis, which was time-consuming but necessary to ensure the accuracy of details.

## The Significance of the Study

This qualitative research study explored how Grades 3 through 8 technology teachers and coaches integrated digital tools into instruction, and nine candidates were purposively selected using the selection criteria. My research study findings could provide new instructional technology knowledge to enable classroom teachers to improve their teaching and performance. Jones (2017) conducted qualitative research in four public schools with technology teachers regarding integrating digital tools into instruction and noted that integrating digital tools into education associated with the subject taught for selecting meaningful digital devices and applying strategies to improve pedagogy and content. My research study may contribute new digital technology knowledge to the technology field for classroom teachers and students' academic and positive social development.

Researchers have indicated that technology teachers and coaches integrated digital tools use into instruction in various ways (Bodsworth & Goodyear, 2017; de Silva et al., 2016; Geiger et al., 2015; Koh et al., 2015; Lee & Kim, 2014). However, even with the many different ways indicating digital devices use in instruction, there was a gap that the literature did not adequately cover (see Geiger et al., 2015; Hoffmann & Ramirez, 2018). The research gap called for a more in-depth investigation of integrating digital tools and a clear description of the process (see Geiger et al., 2015; Hoffmann & Ramirez, 2018).

The significance of theory and practice has provided greater insight for classroom teachers and administrators to integrate digital technology use across the curriculum to

enable meaningful learning and positive social change. While classroom teachers will benefit from grade Grades 3 through 8 technology teachers and coaches shared digital tools knowledge, students will benefit from digital tools to enhance their learning, understanding, and performance. The best part of this research regards the potential that classroom teachers will better understand how to use devices to enable positive social change in education from the knowledge gained and expand students' life-long learning.

## Summary and Transition

Grades 3 through 8 technology teachers and coaches may experience changed instructional roles, becoming facilitators for students using digital tools to encourage class participation and active learning. The literature review revealed a gap that showed limited information to understand digital tools use in instruction. There is a need for this research study to explore digital tools for clarity in use and better understanding in improving classroom instruction (see Bodsworth & Goodyear, 2017; de Silva et al., 2016; Geiger et al., 2015; Koh et al., 2015; Lee & Kim, 2014). This research study explored how Grade 3 through 8 technology teachers and coaches integrated digital tools.

Chapter 2 restates the problem, and the purpose of this study is to give information on the procedure for finding relevant literature. The literature review presents fragmented and sparse ways to incorporate digital tools uses in teaching. The conceptual framework, TPACK, underpins digital tools use discussion in instruction and provides the lens for understanding how integrating digital tools use into instruction may enhance pedagogy and content. Finally, this summary leads into Chapter 2, which transitions into Chapter 3, 4 and, 5.

## Chapter 2: Literature Review

The problem addressed in this research study was that not enough was known about how Grades 3 through 8 technology teachers and coaches integrate digital tools into instruction to enhance pedagogy and content. The purpose of this basic qualitative research study was to investigate Grades 3 through 8 technology teachers' and coaches' methods of selecting and integrating digital tools into instruction to enhance pedagogy and content. Demirbas and Timur-Ogut (2020) examined digital tools to facilitate learners' needs and expectations and revealed that a knowledge gap existed for digital tools use, which is not fully understood and indicated a need to explore the creative use of digital tools for 21st-century education. The TPACK framework for incorporating digital tools could help classroom teachers, administrators and stakeholders understand how technology may improve instruction (Sensoy & Yildirim, 2018). Grades 3 through 8 technology teachers and coaches know how to use digital tools, and sharing their knowledge could be helpful for other educators. Some classroom teachers might not know enough about selecting and integrating digital tools to improve instruction and encourage class participation. The knowledge gained in this research study can be beneficial to classroom teachers in planning their lessons, incorporating digital tools into instruction, and encouraging students' participation and learning.

Chapter 2 presents the literature search strategies for finding essential peer-reviewed research to integrate digital tools into instruction. The conceptual framework is discussed further in support of its relevance to the problem for this research. Chapter 2

reveals literature reviews for fundamental concepts, variables, and themes. The key literature review areas are:

- Benefits of Digital Tools Use in the Classroom
- Integrating Digital Tools Use Into Instruction
- Barriers and Risks in Integrating Digital Tools Use

Chapter 2 closes with a summary and transitions into Chapters 3, 4, and 5.

## Literature Search Strategy

The primary source for my literature review was the Walden Thoreau search engine for multiple database online libraries. The databases included ERIC, EBSCOHost, and Sage Premier in connection with the Google Scholar search engine. Scholarly articles on the integration of digital tools use into instruction were from national and international institutions. I selected literature for peer-reviewed journals published between 2014 through 2020. Peer-reviewed studies included qualitative, quantitative, and mixed approaches across different educational technology levels.

I searched for relevant research using descriptive technology terms in two or more databases. Some applicable search terms included: *integrating the use of digital tools*, *digital media in instruction*, *technology teachers' best practices*, *technology tools selection*, *barriers to the use of digital tools*, *and TPACK impact in education*. I selected literature that included research in the United States, Canada, Europe, and Asia for K-12 use of digital technology. I narrowed my choice of research literature to peer-reviewed articles and best practices in K-12; digital tools use training for pre-service and in-service teachers and integrate digital tools into classroom instruction. The research approaches

included qualitative, quantitative, and mixed methods. I reached a saturation point of selecting articles by reading through the abstract, focusing on digital tools application in instruction and the conclusion and recommendation of each research. I did not see many types of research on technology teachers integrating the use of digital tools. Several studies related to classroom teachers using different digital technology in their classes. However, these studies provide essential resource information contributing to my study.

## Conceptual Framework

The phenomenon of interest is understanding how Grades 3 through 8 technology teachers and coaches used digital tools to enhance pedagogy and content and create meaningful learning experiences. As indicated in Chapter 1, the conceptual framework that underpins this basic qualitative study is TPACK (see Mishra & Koehler, 2006). This framework provided a context to study the integration of the use of digital tools into instruction. The TPACK conceptual framework is an extension of Shulman's (1986) PCK theory. According to Shulman (1986), CK referred to understanding ideas and facts in the learning material. PK is related to methods and strategies to improve the students' learning experiences and enhance their cognitive development, understanding of concepts, and memory development (Shulman, 1986).

Shulman's (1986) seminal work in education introduced PCK for improving instruction and learning quality. The application of digital technology showed different ways to expand content knowledge and enhance teaching (Koehler & Mishra, 2009). TPACK is an innovative concept that Grades 3 through 8 technology teachers and coaches could use in lessons to enable student-centered learning (Harris & Hofer, 2016).

Mishra and Koehler (2006) noted that TCK was significant for content discovery and organization. Koh et al. (2015) revealed that the TK, PK, and CK relationship needed further exploration to understand how TPACK could enhance instruction. Researchers (Koehler & Mishra, 2009; Montebello, 2017; Sailin & Mahmor, 2018) have indicated that integrating digital tools in education might improve pedagogy and content. Instruction that included digital tools could improve teachers' performance and enhance their understanding of intricate knowledge. Mishra and Koehler's (2006) TPACK concept incorporated Shulman's (1986) PCK theory that holds the potential for showing different ways to integrate the use of digital tools into instruction.

Mishra and Koehler (2006) noted the possibility of enhancing pedagogy and content by interweaving three sources of knowledge: technology pedagogy and content. However, Mishra and Koehler (2006) pointed out that teachers needed to understand the complex relationships for technology, pedagogy, and content to integrate digital technology into teaching. Mishra and Koehler (2006) noted that TK, CK, and PK gave the complex terms of TCK and TPK, which combined further in TPACK.

In this research study, I used TPACK as a lens to better understand how Grades 3 through 8 technology teachers and coaches are using digital tools for improving pedagogy and content in instruction and learning. Bingimlas (2018) noted using the TPACK concept to understand the integration of technology tools to simplify the presentation of complex learning material from different content sources. Lu et al. (2017) observed the use of TPACK for integrating iPads into instruction. According to Lu et al. (2017), incorporating iPads in teaching enables students to memorize concepts and

improve their spelling and vocabulary. Joo et al. (2018) noted an improvement in pedagogy with multimodal learning tools that increased the content to enhance students' learning of complex material. Tseng (2018) emphasized that the TPACK concept enables digital tools to correspond with learners' interests and interactive experiences for hands-on learning. Kalonde (2017) used TPACK to plan instructions with digital tools for helping students with different learning challenges in student-centered learning classes.

**Technology Coaches in Schools**

The Office of Educational Technology (2017) indicated that educators needed to become familiar with digital tools for incorporating in 21st century Education. Holtz (2018) noted that technology coaches in schools were valuable for training classroom teachers. Researchers indicated that classroom teachers should learn to use technology tools in instruction from technology coaches (see Bakhshaei et al., 2020; Peterson et al., 2020; Segal & Heath, 2020).

Bakhshaei et al. (2020) indicated that technology coaches knew digital tools use and diverse ways of applying these tools in instruction. Bakhshaei et al. (2020), Peterson et al. (2020), and Segal and Heath (2020) noted that school administrators, technology coaches, and classroom teachers must have a shared interest in incorporating digital technology education. Segal and Heath indicated that integrating digital tools into teaching was sometimes not a transparent process, and different methods were tried until there were meaningful results. Segal and Heath noted that the TPACK model was valuable to incorporate digital tools and understand how digital tools impacted education.

Bakhshaei et al. (2020) used mixed-method research to examine the effects of technology coaches' training of classroom teachers during 2017-2018 and 2018-2019. Bakhshaei et al. (2020) used a pre-survey and a post-survey to measure teachers' performance using technology tools with students. Two groups of teachers participated in the study, the target group for coaching and the control group not coached. The subject areas taught by participants were English, Math, Science, and Social Studies. The content measured by the pre-survey and the post-survey was teachers' ability to use technology tools with their students to implement 21st-century education.

On the other hand, technology tools used by the control group measured 56% of in-class time and 58% used by students. Technology tools were used by teachers and students 48% in the subjects. Bakhshaei et al.'s (2020) study revealed that technology coaches positively affected classroom teachers' performance using technology tools. According to Bakhshaei et al. (2020), classroom teachers need to trust tech experts' technology coaches. Bakhshaei et al. (2020) also noted that technology coaches and classroom teachers needed to create a partnership to build rich classroom technology.

The COVID-19 crisis impacted K-12 schools across the US, and some schools were closed beginning March 2020. A study conducted by Peterson et al. (2020) examined technology coaches' success with teachers for emergency remote teaching (ERT) related to pedagogy and content for online education. The ERT temporarily shifted instruction and learning from face-to-face to online. Peterson et al. used the case sampling method to determine technology coaches' effect in training teachers for ERT with several schools in a single state. The ERT situation called for collaboration among

school administrators, technology coaches, and classroom teachers to ensure a rapid shift to online instruction. The technology coaches were former teachers and supported teachers in using blended technology tools in pedagogy. The schools that prepared teachers for using ERT were model schools first involved in the coaching program. Technology coaches worked in professional development workshops and individual coaching for teachers. Due to the ERT needs, all schools in the district were adopting technology tools.

Segal and Heath (2020) researched teacher education in technology competencies (TETCs). They showed that technology coaches prepare classroom teachers for remote teaching during the COVID-19 pandemic, which included an urgent push to instruct teachers in LMS technology. They classified the process as the "wicked problem" Segal and Heath, 2020, p. 1. The "wicked problem" of technology and teacher education: Examining teacher educator technology competencies in a field-based literacy methods course), sighting challenges to integrating technology in a content literacy course. Segal and Heath (2020) noted that designing an integrated technology program was rare. However, technology education can be more effective when teachers incorporate technology knowledge with pedagogy and content knowledge. Segal and Heath (2020) noted that technology coaches face complex challenges in preparing teachers in the pedagogy and content area for accommodating technology knowledge, skills, and attitudes. Segal and Heath used the TPACK framework for a case study about two technology coach participants at a college of education implementing a Cognitive Apprenticeship Model (CAM) for developing TETCs in English, History, Science, and

Math. One participant who had low familiarity with technology tools revealed that pedagogy knowledge (PK) and content knowledge (CK) were critical to integrating technology and, most importantly, deciding what technology tools to use. The second participant was familiar with the TPACK framework and indicated that technology tools simultaneously prepared teachers for pedagogy and content, as technology is relevant to all teachers across disciplines. Segal and Heath (2020) found that the technology coaches supported teachers to help students use apps to personalize their use of technology tools and take ownership of their learning. The training included recorded video and tutorials to quickly prepare teachers to meet the COVID-19 crisis and online learning. School administrators and classroom teachers were forced to adapt and cope with blended or wholly online teaching.

**TPACK Framework in Research and Digital Tools Use**

The TPACK framework could apply in whole or sub-sections such as TK, PK, CK, TPK, TCK, or PCK to understand digital tools used in instruction (Sensoy, & Yildirim, 2018). Doukakis and Papalaskari (2019) indicated that educators, researchers, and practitioners use the TPACK framework to structure and refine their activities when applying digital tools. My proposed research investigated Grades 3 through 8 technology teachers and coaches' use of digital tools in instruction. I used the TPACK framework, which allowed me to better know the applications of digital tools, as in the studies discussed below.

Bingimlas (2018) used the TPACK framework to assess how 245 middle and secondary school teachers integrated digital tools into their curricula. Using the TPACK

framework, Bingimlas (2018) found that teachers with less experience lacked an understanding of using digital tools in pedagogy to introduce concepts and expand the content. Bingimlas (2018) revealed that TK, CK, and PK enabled assessment of how teachers used digital tools to simplify complex material in meaningful instruction. Bingimlas (2018) noted that the TPACK framework showed that teachers who had more experience using digital tools used them in instructional strategies that matched students learning challenges and expanded digital learning resources. I used TK to seek how fluent Grades 3 through 8 technology teachers and coaches used digital tools for trends and best practices and further understand how they used them to source learning materials. On the other hand, I examined their use of PK to learn about the strategies for simplifying complex learning material so that diverse learners could cope with a lesson. Durdu and Dag (2017) pointed out in their study the importance of using the TPACK framework sub-sections TK, CK, and PK to understand how each knowledge area connects with selecting and using digital tools in differentiated instructions.

In the studies discussed above, applying the TPACK framework in assessing teachers' performances showed that teachers using differentiated instructions could simplify complex learning material by applying pedagogical strategies (Bingimlas, 2018). In Jones's (2017) study, the TPACK framework enabled teachers' assessment using digital tools. Jones (2017) revealed that some teachers used differentiated teaching methods with digital tools for PK and CK to enhance student-centered instruction. Jones used the TPACK framework and showed that teachers who did not use digital devices for

student-centered guidance and preparing lessons experienced PK and CK's challenges to improve students' participation and learning.

Alqurashi et al. (2017) combined PCK and TCK to assess how teachers were fluent in using digital tools for connecting pedagogy and content simultaneously in a lesson. I used the TPACK framework for PCK and TCK to understand how Grades 3 through 8 technology teachers and coaches were applying digital tools to present learning experiences in ways that could facilitate advanced learning. Alqurashi et al. (2017) and Jiang et al. (2017) used the TPACK framework to evaluate teachers' use of digital tools in instruction. Alqurashi et al. (2017) used the TPACK framework sub-sections to understand and simplify these tools' step-by-step use. Alqurashi et al. (2017) noted that TPACK allowed for understanding the effective use of digital tools for pedagogy and content.

Jiang et al. (2017) used the TPACK framework to evaluate teachers' performance using digital tools during training. Jiang et al. (2017) revealed that the TPACK framework showed that teachers used iPads to impact instruction significantly in STEM labs and technology-equipped classrooms. Jiang et al. (2017) indicated that the TPACK framework enabled researchers to develop the knowledge required to assess integrating the usage of digital tools in engineering and math (STEM) programs. The schools hired technology experts for the training assignment (TOSA), and the trainers also included the TPACK concept in training the teachers to use iPads. The study examined K-8 teachers in training from three schools.

Bingimlas (2018) shared similar views to Alqurashi et al. (2017) and Jiang et al. (2017) regarding the practical use of TPACK to understand further how digital tools enhance pedagogy and content. The researchers used the TPACK framework to understand the usage of digital tools for pedagogy and content. Bingimlas (2018) revealed that the TPACK framework applied to evaluate teachers' performance using digital tools showed that digital devices helped student-centered teaching.

My research study focused on how Grades 3 through 8 technology teachers and coaches integrated digital tools into instruction. I used the TPACK framework sub-sections in similar ways noted by Alqurashi et al. (2017) for integrated instructions. Using the TPACK lens of PCK, TCK, and TPK allowed me to explore how Grades 3 through 8 technology teachers and coaches used digital tools to enhance and support pedagogy and content. Examining the use of the TPACK framework subsections enabled me to better understand how digital devices are used for pedagogy and content.

I used the TPACK framework and examined how Grades 3 through 8 technology teachers and coaches used digital tools to facilitate instruction, whether for cooperative learning style, teacher-centered with digital tools add-on, or student-centered with technology. The considerations applied by Grades 3 through 8 technology teachers and coaches in selecting digital tools for pedagogy and content were of interest to determine meaningful ways in using the TPACK framework. Durdu and Dag (2017) used the TPACK framework to analyze GeoGebra software use for math content in a lesson on polygons. I used the TPACK framework and examined digital tools for both pedagogy and content and building learning experiences. Jiang et al. (2017) used the TPACK

framework to evaluate teachers' performance and revealed that teachers gained a higher conceptual understanding in applying digital tools after training.

Durdu and Dag (2017) used the TPACK framework to understand how pre-service teachers used digital tools in training with polygons' GeoGebra software. The researchers used the TPACK framework for content analysis at the beginning and the end of training for identifying categories and themes for comparing pre-service teachers' knowledge acquisition regarding digital tools use. The assessment used the TPACK framework sub-sections TK, PK, and CK to formulate and apply TPK, TCK, and PCK to determine teachers' use of digital tools. In my research study, the participants were Grades 3 through 8 technology teachers and coaches who used digital tools in instruction. I used the TPACK framework sub-sections PK, CK, and TK to understand digital tools use better. Jiang et al. (2017) used the TPACK framework, which allowed researchers to learn essential teaching strategies using digital tools. The TPACK framework enabled me to identify teaching strategies used by Grades 3 through 8 technology teachers and coaches to facilitate learning at different levels, to empower students who also learned to use these tools.

On the other hand, Durdu and Dag (2017) used the TPACK framework in their study. They discovered that pre-service teachers vaguely understood using digital tools to enhance pedagogy and expand the content. According to Durdu and Dag (2017), pre-service teachers' lesson presentations with digital tools lacked clarity of concepts about polygons, which showed a weakness in pedagogy knowledge.

Alqurashi et al. (2017) used the TPACK framework to assess how teachers from two countries, group "A" and group "B," integrated digital tools into instruction. Alqurashi et al. (2017) noted that group A used digital tools but had no formal training, while group B teachers had formal training. Alqurashi et al. (2017) pointed out that group B teachers did not have training but learned by trial and error regarding selecting digital tools that worked well in instruction. Alqurashi et al. (2017) indicated that the TPACK framework enabled a deep understanding of the teachers' performance using the digital tools in pedagogy for concepts and theories during instruction. Alqurashi et al. (2017) noted that although teachers in both groups learned how to use digital tools differently, they showed high performances. In Durdu and Dag's (2017) study, the TPACK framework enabled the researchers to evaluate how pre-service teachers applied digital tools, revealing that the pre-service teachers did not demonstrate competence in using digital tools in pedagogy and content. Using the TPACK framework in my research allowed me to assess Grades 3 through 8 technology teachers' and coaches' digital tools' quality in instructions.

In my research study, how Grades 3 through 8 technology teachers and coaches acquired their digital tools skills is less important. The emphasis is on selecting and applying these tools in meaningful ways to enhance pedagogy and content and facilitate learning differently. Alqurashi et al. (2017) indicated that the TPACK framework enabled a better understanding to assess integrating the use of digital tools into pedagogy and content. Alqurashi et al. (2017) did not indicate if teachers applied PCK and TCK differently in their groups. The TPACK framework helped evaluate the teachers' use of

digital tools. The studies on using the TPACK framework revealed significant ideas for how the sub-sections may be applied to assess digital tools use in instruction (Alqurashi et al., 2017; Bingimlas, 2018; Durdu & Dag, 2017; Jones, 2017). My research study used the TPACK framework sub-sections of TK, PK, CK, and integrated TPK, TCK, and PCK and enabled me a broad understanding of digital tools to use by Grades 3 through 8 technology teachers and coaches.

## Literature Review Related to Key Variables and Concepts

The key concepts and variables that defined this study for investigating Grades 3 through 8 technology teachers and coaches integrating the use of digital tools into instruction included the following areas of the literature review.

- Benefits of Digital Tools Use in the Classroom
- Integrating Digital Tools Use Into Instruction
- Barriers and Risks in Integrating Digital Tools Use

### Benefits of Digital Tools Use in the Classroom

Researchers identified several benefits of incorporating digital tools into instruction for K-12, noting that there are various ways that digital tools facilitate learning in the classroom (see Cabus et al., 2017). The internet provides broadband and Wi-Fi connections to enable digital technology available at the school. Because of internet availability, several digital tools for mobile technology have become ubiquitous and can extend learning after class (see Sousa et al., 2017). Aflalo et al. (2018) indicated that digital tools included the internet, apps, websites and network, iPads, desktop

computers and laptops, and the interactive whiteboard or smartboard that enabled teachers to facilitate pedagogy strategies and complex learning materials.

For meaningful results of integrating digital tools into teaching, teachers need to understand the benefits of using said tools (Koehler et al., 2017). According to Aflalo et al. (2018), integrating digital tools enabled teachers to transform their instructional practices for students' learning. The new instructional direction increases teachers' opportunities to plan for students to customize and take responsibility for their education (Sousa et al., 2017). Digital tools are used in many classrooms to enable interactive learning methodologies. The new instruction method with digital technology may increase teachers' need to learn new content and apply learning concepts in new applications and problem-solving (see Aflalo et al., 2018).

### *Internet Use in the Classroom*

The internet enables social networking to connect across all spheres of society. Tan et al. (2018) investigated the ways teachers used the internet to broaden the scope of instruction and revealed that both teachers and students expanded the lesson content to research new information. The researchers indicated that teachers relied on the internet for instructional and learning material and incorporated digital tools into teaching (see Altawil, 2016; Tan et al., 2018; Yagci, 2015).

Teachers can use the internet to access media technology for expanding instruction and learning. Altawil (2016) used mixed-method research in 20 high schools to determine how teachers used the internet to access media technology for teaching students the English language. The digital technology devices were smartphones and

tablets connected by the internet to websites that included Facebook, Twitter, and YouTube. Teachers used the apps for the social network to instruct their class in the English language.

Altawil's (2016) study revealed that teachers helped students surf the internet and use apps on their computers to download learning material to improve their vocabulary skills and broaden their understanding of word meaning. The Altawil (2016) study revealed that the internet was an essential classroom resource for integrating online classes to bring new learning to students. Altawil's (2016) study indicated that the social network enabled teachers to expand classroom instruction.

Internet availability in the classroom enables mobile technology that teachers use to expand instruction and learning. These mobile technologies include smartphones, iPads, and android tablets for educational games and research surfing the web. Tan et al. (2018) investigated teachers' use of the internet and Wi-Fi for interactive and audience response systems installed on mobile technology. Tan et al.'s (2018) study revealed that the internet and Wi-Fi-equipped classroom enabled teachers to integrate digital technology to improve their instructional efficiency, effectively manage their class, and motivate students' active interest in real-time learning and interactive response. The Altawil (2016) study also revealed that teachers used the internet to engage their students' interest in classwork. Tan et al.'s (2018) study showed that teachers encouraged students to use their home internet and Wi-Fi for networking and continuous learning. The internet has become a 21st-century educational resource that allows teachers to encourage continued learning using the iPad to expand instruction and learning.

### *IPad Use in the Classroom*

IPads are mobile technologies that many schools adopt to improve and facilitate flexible learning opportunities inside and outside the classes. Yagci (2015) indicated that teachers should learn how to fix internet connections to avoid losing class time, encouraging them to use teacher-centered instruction and prevent technology use. Researchers explored how incorporating iPads into education enabled several applications that gave teachers choices and convenience in enhancing teaching and learning quality (Kale, 2018). There are benefits to derive from the use of mobile technology. Teachers needed to be aware of the services and practices to use these digital tools so students can experience said benefits (Kale, 2018).

The ubiquitous use of iPads, calls for all users to become experts using these technologies for meaningful educational purposes (Kale, 2018). Kale (2018) used quantitative research with a quasi-experimental design to examine the utility value of iPads with middle school teachers in training at a university in the United States. The visual display of content on iPads enabled teachers to use and manage students' learning and time (Kale, 2018). Kale's (2018) study revealed that the teachers learning how to use the iPads' sophisticated design were motivated to demonstrate their versatility in lesson planning, integrating the apps' use to practice class participation in the field. According to Kale (2018), teachers become motivated to demonstrate their capabilities to help students learn in and out of classrooms with mobile technology.

Students' social learning styles are essential for teachers to know to help students develop competency using iPads. Flewitt et al. (2015) found that the apps on iPads allow

teachers to access learning materials for pedagogy and content to enhance students' learning and open new opportunities to build their learning experiences. Flewitt et al. (2015) studied how teachers and their class with disability students benefitted from using the iPad at three schools in the British Commonwealth. The teachers interacted with students individually on their iPads to apply new learning strategies. Flewitt et al. (2015) examined early literacy, a knowledge area essential for developing early reading skills suited through K-12. The students and the teachers used the iPad to explore new learning methods with the apps.

Flewitt et al.'s (2015) research result indicated that students who had academic difficulties used iPads to find their level in interactive learning programs and materials. Flewitt et al. (2015) stated that high performers and less academically challenged students were motivated by positive learning with iPads. Flewitt et al. (2015) did not reveal iPad methods to facilitate students' disabilities. However, the researchers noted that the iPad was useful because both teachers and learners benefited from its use.

The small compact size of the iPads makes them very popular as both teachers and the students become familiar with the technology available. Although there is technical training in digital technologies, most researchers do not cover how they process the learning material and present it for application. Hutchison and Colwell (2015) pointed out that some iPads had apps known as a poppet that enabled recording students' stories converted to digital format for playback and sharing. The researchers reviewed qualitative studies that explored how fifth-grade teachers integrated iPads and apps to teach literacy. The benefits of using the iPad included recording the student's telling

stories and converting it to digital format for playback learning and correcting until the quality was worth sharing. Hutchison and Colwell (2015) indicated that the iPads used Wi-Fi technology with E-reader apps that allow students to access podcasts, blogs, wikis, and I-movies. Teachers used the poppet apps to manage their learning time, work progress, and participate in online group projects (Hutchison & Colwell, 2015). The adaptable use of iPads makes them very popular as both teachers and the students become familiar with the iPad (Hutchison & Colwell, 2015).

Another version of the iPad 2 carries the functions that enable students at different levels to access internet programs and apps for educational purposes with their teachers' guidance. The iPad2 allowed teachers to enhance early literacy instruction in shared storytelling (Spooner et al., 2015). Spooner et al. (2015) used a qualitative research case study and multiple probes to investigate how one teacher with a class of five students from Grades two through to six at an elementary school in the United States used the iPad2 for early literacy and shared storytelling.

Spooner et al. (2015) revealed that the iPad2 allowed for step-by-step instruction with versatile digital controls for multimedia learning. Spooner et al.'s (2015) study showed that the iPad 2 had features enabling students with severe learning disabilities to use apps for interactive learning. The iPad2 enabled auditory cues, pictures, and text converted to voice output (see Spooner et al., 2015). Spooner et al. (2015) indicated teachers could work with students with autism and limited verbal ability. Spooner et al. (2015) suggested that teachers used a step-by-step process to present instruction to promote students' meaningful learning. The researchers did not give an example of

teachers' step-by-step knowledge to enable a learning phase of early literacy (Spooner et al., 2015).

Hutchison and Colwell (2015) noted that incorporating iPads into instruction enabled students' creativity in digital storytelling, using multimodal effects. Flewitt et al. (2015) showed that teachers integrated iPads into teaching to engage students in interactive learning programs. According to Flewitt et al. (2015), teachers could use iPads to download apps and learning materials used in lesson planning. The apps on iPads enabled users to access different kinds of multimodal programs that allowed for interactive learning suitable for addressing students with varying styles of learning (see Flewitt et al., 2015). Teachers could help students by using iPads to manage their learning challenges and the time spent on specific programs (Kale, 2018). According to Kale (2018), there was a need to understand more about integrating iPads to enhance instruction that may assist student-centered learning.

***Computers Use in the Classroom***

Computers are digital tools in schools and are used in various ways to do a wide range of instructional and learning tasks. Jones (2017) noted that many teachers had at least a computer in their classroom in the United States and needed to plan for technology-focused lessons. Computers enable integrating digital learning material to include educational software and online programs that allow teachers to improve and deliver instruction and enhance students' education (Alavi et al., 2016). Some teachers use the computer to prepare lesson plans. However, it has much more educational value for complementing instruction and learning in student-centered or cooperative education

(see Alavi et al., 2016). Literacy and English language is a standard core curriculum subject that computers in the classroom use for research and developing writing skills with interactive programs (Alavi et al., 2016).

Alavi et al. (2016) did qualitative research with 34 instructors and 641 undergraduate college students to investigate how they used computers to build users' skills and learn English as an additional language for an academic training program. Students learning how to use computers can enhance their knowledge when a teacher is familiar with the technology and access learning materials to benefit from a study program. Alavi et al. (2016) reported that students considered themselves reasonably proficient in using computers without formal training. Although students believed they were fluent in computer use, Alavi et al. (2016) found that they were not experienced and needed further training. Alavi et al. (2016) noted students lacked the necessary computer hands-on skills that would enable them to use the computer-assisted language learning program.

On the other hand, many educational institutions train teachers to use computers in student-centered and cooperative group learning. Chu et al. (2015) indicated teachers need to be abreast of technology trends to make their instruction current with emergent technologies. Chu et al. (2015) used mixed-method research to explore how nine teachers in training at a college used computers and tablets to learn complex drawing and designing skills in preparation for classroom instruction. Their study program included technology application for hand-sketches with a digital pen and observing the development of digital objects and intricacies on the screen. Chu et al. (2015) indicated

that teachers should become familiar with the computer and tablet to access online design programs to promote digital technology in doing drawing plans.

Chu et al.'s (2015) study showed that the computer and the tablet allowed visual thinking to manipulate objects in abstract form. As students change their work, they develop their knowledge (Chu et al., 2015). The visual display of their work on the computer reflects the cognitive processing of ideas based on the lesson's objective (Chu et al., 2015). Alavi et al. (2016) also noted that the computer visual display enabled students to develop their fine motor skills. The visual display-thinking on the computer screen could help students make design changes that showed a concretized result displayed on the screen (see Chu et al., 2015). Chu et al. (2015) indicated that teachers using computers could access drawing programs to share creative ways to expand teaching and learning in different ways. Chu et al.'s (2015) study indicated that integrating computer and tablet use allowed students to learn meaningfully step-by-step.

Computer training can enable students to improve their keyboard skills and use interactive learning programs for enhancing learning. Alavi et al. (2016) noted that some English language learners experienced a learning gap using computers to research and make presentations. Teachers need to teach students how to use digital technology while integrating the lesson's subject material (Alavi et al., 2016). Chu et al. (2015) indicated that teachers' college training should include competence training for using computers and tablets and how to use them for assistive and interactive learning for students. Technology teachers using computers and tablets may share their software and computer programs' experiences to improve students' cognitive ability.

There is an effort to make available public school computers for improving science and computer skills in the United States. Game-based programming using the computer showed success in the K-12 school curriculum. Allen (2018) did a case study with 43 participants to determine how middle school teachers' online module professional training development improved their proficiency to use computers to teach Grades 6-8. A pre and post-attitude survey measured teachers' attitudes, the usefulness of computer science programs, teachers' confidence, and motivation to use computers for science programs.

Allen's (2018) study revealed an improvement in the participants' attitudes after training. According to Allen (2018), teachers' attitudes improved as the training included coding and robotics. Von-Wangenheim et al. (2017) indicated that computer science demands the education system in multidisciplinary classes. Teachers must prepare students to be able to have hands-on skills and actively use the computer. Von-Wangenheim et al. (2017) conducted a case study to investigate training for in-service teachers regarding how knowledgeable they were in pedagogical content knowledge for computing. The teachers were exposed to a robotics workshop with hands-on training to enhance digital tools to use visually. Von-Wangenheim et al.'s (2017) study revealed that hands-on training was essential to build teachers' attitudes and motivation to use these tools in classrooms. The training equipped teachers to think about strategies to apply computers and software across the multidisciplinary curriculum.

Teaching with computers across the curriculum involves any subject that the school learning program included, and teachers must know about using these digital

tools. Tachie (2019) indicated that many math teachers using computer technology experienced technology challenges using a step-by-step procedure to help students understand complex materials presented in abstract format. Tachie (2019) did a case study with five teachers and five public school learners to explore teachers' and learners' opportunities and challenges using computers. Tachie (2019) considered network technology administration one of the skills teachers and digital tools used for instruction. Von-Wangenheim et al. (2017) agreed that teachers having practical training using computers could show competence using these digital tools to instruct in their classes. Allen (2018) supported the idea that teachers needed to become skilled in using K-12 education computers.

The K-12 curriculum is driven by language learning, and proficiency is needed to learn other subjects across the curriculum. Karim et al. (2019) used social media to collect data to investigate online language teaching and cognitive loading. Social media enabled teaching the English language for information acquisition. The flexible approach to learning using computers has become a widespread and significant innovation in education. Karim et al. (2019) used Facebook as a prime example of language learning. The researchers noted that online learning comes with extraneous cognitive loads and understanding by carrying many tasks for processing simultaneously. Therefore, the teacher must guide students to select tasks to create the needed knowledge to reach the desired understanding level. Allen (2018) indicated that teachers using online learning should be interested in using the computer with the right attitude and motivation.

However, Allen (2018) did not reveal that teachers must also work with students to avoid extraneous overloading of tasks, as Karim et al. (2019) pointed out.

### *Interactive Whiteboard/Smartboard Use in the Classroom*

The inclusion of IWB in instruction may improve learning in strategic ways. Cabus et al. (2017) revealed that teachers integrating the IWB could differentiate instructions for students with various learning needs. Giannikas (2016) indicated that teachers needed to build their competence using the IWB to present complex lessons in easy learning ways. Experienced technology teachers integrating IWBs may share how these digital tools enhance teaching and encourage students' participation. Cabus et al. (2017) noted a need for future research with technology teachers integrating IWBs into instruction to improve pedagogy and content with best practices.

The IWB is a widely used technology in most urban schools; teachers must become familiar with its components to enable the creative presentation of lessons (Cabus et al., 2017). Giannikas (2016) noted that teachers were responsible for refocusing their instruction to capture their class's interest using the IWB. The IWB may be utilized for teacher-centered preparation and involve students' participation to use the IWB to demonstrate their learning. The IWB enables learning by visual, hearing, and touching. Teachers may use the IWB in new and innovative ways to present the subject material. Cabus et al. (2017) noted that teachers integrating the IWB could differentiate instructions for students with various learning needs.

Cabus et al. (2017) did a quantitative study with a group of teachers and 199 Grade seven students using a quasi-experimental approach to discover the benefits of

integrating the IWB for math for six weeks. The IWB enabled teachers to improve pedagogy strategies to motivate students' learning, focus, and interactive participation. Cabus et al. (2017) revealed that the IWBs had digital controls that allowed math teachers to present content, concept, and application to facilitate group learning and practice. However, there was no indication of how the teachers used the IWB for creative learning (Cabus et al., 2017).

The creative use of the IWB may enable teachers to enhance their performance and allow a higher achievement level for learners. Young et al. (2017) investigated the use of IWB applying a quantitative-experimental study approach for math with eight teachers and 1,572 students at a middle school in the United States. The control and treatment groups did the same math topic—the treatment group used the IWB. According to Young et al. (2017), the treatment group used the IWB to enhance pedagogy strategies. The teachers that taught the treatment group were not familiar with using the IWB. However, the teachers had the full participation of students (Young et al., 2017). The treatment group teachers applied interactive learning strategies and used the IWB to positively impact students' learning and performance.

Young et al. (2017) indicated that the IWB had technology that enabled patterns for simulating the problem-solving and reflective application of concepts. Teachers could switch screens to quickly review concepts during the lesson and show similar applications and problem-solving solutions. Young et al. (2017) revealed that the treatment group's post-test result was higher than the control group. Young et al. (2017) did not indicate the treatment group teachers' pedagogical strategies in their lesson plan.

Using the IWB effectively required teachers to become familiar with its built-in programs and instruction (Young et al., 2017).

Using the IWB may require planning lessons that use pedagogical strategies that enhance content presentation in various ways to hold students interested, motivate, and encourage their participation. Giannikas (2016) noted that teachers could build their experience and confidence in integrating IWBs. Young et al. (2017) noted there were multiple ways that IWBs may maximize learning. Less experienced teachers with high confidence levels could quickly use the IWB to improve classroom instruction (see Giannikas, 2016).

Giannikas (2016) used a qualitative study with a semi-structured interview to discover how five language arts teachers and 50 students aged nine to sixteen shared using the IWB for instruction and learning at a private education institution. The teachers used the IWB for interactive language teaching and learning and included online programs. Giannikas (2016) indicated that teachers had experience using IWBs and planned instruction to integrate IWB to teach with interactive games. However, Cabus et al. (2017) and Young et al. (2017) suggested that the IWB had digital features that teachers must become familiar with to develop their user competence. Some teachers continued to improve their ability to use the IWBs by using the built-in digital technology-designed features. Giannikas (2016) noted that IWB was a necessary technology that enabled cooperative learning. Teachers needed to develop their lesson plans to encourage students to participate in the relevant learning content and integrated learning experiences.

## Integrating Digital Tools Use Into Instruction

Researchers reviewed several studies and concluded that preservice teachers showed interest in using Web 2.0 tools for improving their teaching ability; however, they lacked the practice to enable their competence in using these tools in formal education (Di Bella & Williams, 2015; Sadaf et al., 2015). Livingstone (2015) noted that Web 2.0 tools were the second generation of internet tools worldwide (WWW). Web 2.0 tools included blogs, wikis, podcasts, video sharing sites, instant messaging, and social networks. Digital tools provide users with new methods that enhance information processing (Livingstone (2015). Teachers familiar with integrating Web 2.0 tools in different ways may improve their instructional practices (Di Bella & Williams, 2015; Sadaf et al., 2015).

### *Web 2.0 Tools Use in Instruction*

Since Web 2.0 tools require interactive users, teachers need to be abreast of these technologies and learn how they apply in education. Di Bella and Williams (2015) conducted qualitative research using surveys to determine the impact of integrating Web 2.0 tools into instruction with 79 preservice teachers in college and were preparing for public school education. Di Bella and Williams (2015) examined how teachers in training integrated different Web 2.0 tools to apply in future classrooms to improve their performance.

Di Bella and Williams' (2015) study revealed that preservice teachers were aware of Web 2.0 tools' pedagogical value. The researchers noted that preservice teacher training integrating Web 2.0 tools should go beyond theoretical understanding to ensure

competence. The exercise involved integrating blogs, Storybird, web quests, and online multimedia programs. According to Di Bella and Williams (2015), web programs positively impacted teachers improving their lesson presentations, and they showed confidence in their training and the knowledge gained.

Teacher training programs are integrating web 2.0 tools for new methods in learning. Sadaf et al. (2015) explored Web 2.0 tools in preservice teachers' training in using these tools. Sadaf et al. (2015) used a mixed-method design to determine how 189 preservice teachers integrated the use of Web 2.0 tools into instruction. The Web 2.0 tools included blogs, wikis, social media, and video and online office programs. The data collection process was a two-stage survey with open-ended questions and semi-structured interviews. Sadaf et al.'s (2015) study revealed that preservice teachers showed a basic understanding of integrating Web 2.0 tools into classroom instruction. Using web 2.0 tools for social networking was less challenging compared to educational use in the classroom. On the other hand, preservice teachers showed positive intentions for using Web 2.0 tools for content delivery and coping with students' technology learning needs. Sadaf et al. (2015) indicated that the preservice teachers showed theoretical knowledge and needed to practice more in their new classrooms.

### *Digital Tools Use in Instruction*

Sousa et al. (2017) noted that using digital tools in education allowed teachers to access web-based programs. Since students benefit from teachers using digital tools in instruction, a more in-depth look into how students learn can help teachers plan for using digital tools to encourage students' participation. Konokman and Yelken (2016) and

Öman and Hashemi (2015) indicated teachers needed to understand students' meta-knowledge concerning their background when integrating the use of digital technology. Konokman and Yelken (2016) reported that meta-knowledge describes the social context of how students learn and allow teachers to plan for incorporating the usage of digital devices into instruction. Öman and Hashemi (2015) noted that teachers need to apply different teaching methods using multimodal tools in a step-by-step process to facilitate students' different learning styles. Dube and Scott (2017) noted that the various techniques to incorporate digital tools into teaching showed positive results when students became familiar with the learning material and participated in-class activities.

Konokman and Yelken (2016) conducted experimental research using questionnaires with 50 preservice teachers to determine how they used digital tools for storytelling lessons. The two groups of teachers involved in the study knew how to use the inquiry-based approach in instruction. The treatment group teachers used the computer, video camera, and voice recorder. On the other hand, the control group teachers applied an analytically based teaching approach.

The findings of Konokman and Yelken's (2016) research revealed that the treatment group used students' learning styles to integrate meta-knowledge in lesson planning. Students' learning styles allowed teachers to have a positive approach to integrating the use of digital technology. The treatment group applied prior knowledge for inquiry-based learning and a positive attitude for incorporating digital tools into instruction. On the other hand, the control group was less optimistic. This inclusion of

meta-knowledge allowed for innovative teaching that included selecting and using digital tools based on students' learning styles (Konokman & Yelken, 2016).

Using digital tools in strategic ways could enable students' multimodal learning. Öman and Hashemi (2015) used case-study research to determine how teachers integrated digital tools into instruction to create film production that would support multimodal learning. The data collection was with semi-structured interviews and purposively selected teachers and 29 students in an urban school. Öman and Hashemi (2015) noted that some teachers used the traditional approach in instruction for print-based material constructions, which did not encourage students' active participation as other teachers who incorporated digital tools to enhance multimodal teaching effects.

Some teachers encouraged students to use digital tools in their classes at different learning levels. The skills included integrating digital tools for screen-based activities with software and information from websites and wikis for new expression and meaning in creating digital advertisement films on planets in the solar system. Öman and Hashemi (2015) indicated that although digital tools were available for students to use, some teachers were not using them, and their class showed a lower performance. On the other hand, Öman and Hashemi (2015) indicated that teachers using digital tools improved multimedia instruction with a student-centered and interactive learning approach. The teachers who used digital tools were able to expand interaction in their class to enable cooperative learning.

The constructivist approach in teaching applying digital tools involves students actively using them to enhance their learning (Öman & Hashemi, 2015). The

constructivist approach to instruction can enable teachers to structure their lesson plans to plan for students and integrate digital tools. Güneş and Bahçivan (2016) used mixed-method research and a convenience sample of 976 preservice teachers training in science education in public schools across 13 universities in the United States. The study examined preservice teachers' relationship integrating digital tools and social issues that may impact instruction planning using digital tools. Güneş and Bahçivan (2016) revealed that preservice teachers used a constructivist approach to incorporate digital tools. The constructivist model for integrating digital tools enabled lesson planning to impact students' learning (Güneş & Bahçivan, 2016).

Digital tools use has become a focus of teacher training institutions. University instructors who make full use of technology availability may offer high-quality training (Dube & Scott, 2017). Dube and Scott (2017) conducted quantitative research with 100 prospective teachers in group learning to know how training impacted their attitude toward using digital tools. Öman and Hashemi (2015) indicated that the teachers shared their knowledge using digital tools in the constructivist approach during training. The digital tools included Facebook, Twitter, Google docs, WhatsApp, and search engines to support learning through technology practices. Dube and Scott's (2017) study indicated that training enabled teachers to remember different tools.

Knowledgeable University instructors trained teachers to integrate digital tools in interactive ways (Dube & Scott, 2017). The digital tool's design for multimodal learning may appeal to students' learning domains, mainly for seeing, hearing, and touching. Palladino and Guardado (2018) conducted qualitative research applying the case-study

approach using semi-structured interviews with two teachers and two students at a community college. These digital tools included audio instruments, videos, images, and other sensory modality tools available online. Palladino and Guardado (2018) revealed that teachers used multimodal instruction to improve their teaching methods by creating new learning content to facilitate diverse learners enabling their engagement and motivation. On the other hand, Lembke et al. (2017) indicated that instruction quality needs assessment through students' performance.

Integrating digital tools requires assessment to determine the quality of instruction. Many teachers use digital tools for utility value in planning instruction (Lembke et al., 2017). Lembke et al. (2017) used quantitative research to examine the use of a curriculum-based measure (CBM) model for evaluating the quality of teachers' instruction in a middle school with 202 sixth-grade students. Students' performance using the CBM connects to teachers' instructional quality. The CBM was not a digital testing tool, although its design used multiple choice answers for questions. Lembke et al. (2017) indicated that the CBM model was valid, ranking high with other assessment models to evaluate reading and comprehension for multiple choices and extended responses. The CBM model was used for social studies and was a state-administered test using a criterion measure for students' performance.

Raji and Zualkernan (2016) indicated that the learning technology intervention (LTI) tool related to technology standards for assessing suitable technologies for integration in a learning environment for future use benefits and reliability. Raji and Zualkernan (2016) conducted qualitative research using a multi-criteria decision

framework for future use and an analytic network process for developing a learning technology intervention (LTI) tool with 12 expert advisors, stakeholders, and professors, school teachers, and principals. They used the LTI tool to assess several digital technologies and selected one that suited the current purpose and sustainability. Raji and Zualkernan (2016) indicated that the main criterion for choosing the digital tool was mobility for schools in the district. The school-on-wheels showed suitability compared to mobile phones and educational televisions.

The assessment criteria did not include determining the quality of the selected technology model's use, as Lembke et al.'s (2017) study indicated. Raji and Zualkernan (2016) noted that the school on wheels showed mobility benefits to support different schools for conventional learning but not for student-centered instruction. According to Raji and Zualkernan (2016), mobile technology-enabled teachers and students integrated ICT lessons in science and was comparable to the technology on wheels project in the rural United States. The choice of school on wheels facilitated technology for several schools without technology labs. However, teachers lacked training for student-centered learning with technology that could occur for traditional education (Raji & Zualkernan, 2016).

Traditional education involved teacher-led instruction, and the teachers were the primary holders of knowledge. On the other hand, an interactive technology program to include multimodal learning (Palladino & Guardado, 2018) may improve digital devices' integration for more significant learning opportunities and benefits. Raji and Zualkernan (2016) noted that there was one laptop per child program in some schools. These digital

tools are for instructor-led programs and not for interactive learning that could enhance a student-centered technology environment (Raji & Zualkernan, 2016). Raji and Zualkernan (2016) did not reveal the criteria for selecting the appropriate technology for their purpose. Adopting Lembke et al.'s (2017) CBM model could also enable students to use the learning technology. However, the idea is that criteria evaluation is essential for selecting digital tools and using these devices. Raji and Zualkernan (2016) revealed that the digital tool choice was the school on wheels, chosen as available digital technology and suitable for future sustainability. Güneş and Bahçivan (2016) noted that teachers might also use the constructivist approach to encourage students to share the digital skills they will acquire using these mobile tools. Evaluating the suitability of digital tools for learning environments concerns the benefits of the learner.

### *IPads and PC Tablets Use in Instruction*

Some educational institutions use iPads to enhance teaching and learning in different ways. Researchers revealed that teachers need to become familiar with downloading apps to engage students in interactive learning experiences (Kaur et al., 2017; Lu et al., 2017; Monem et al., 2018). Since iPads are essential digital tools equipped with learning apps, teachers can apply these digital technologies to improve class learning in various ways.

Design features may enhance these tools, and teachers using these tools may share their experiences and benefits derived. Kaur et al. (2017) explored the use of iPads in the classroom as additional digital tools for teaching math to students with learning disabilities. The researchers used a qualitative approach and exploratory design with ten

teachers teaching at different schools levels from early childhood, elementary, and middle school, training at a southern state university in the United States. The themes identified with using iPads in instruction included:

- Intentional assessment
- Improvement of visual learning
- Progress in understanding the content
- Students improvement for engagement
- iPads enabling individualized instruction
- Improvement for students' independent learning

Kaur et al.'s (2017) research findings showed that incorporating the use of iPads improved pedagogy and content when teachers plan their lessons to involve the themes above. Teachers using teaching strategies with digital tools can simplify complex learning materials in processes that make learning possible for students with disabilities (Kaur et al., 2017). However, Kur et al. (2017) did not reveal the method of using iPads in the study. Some teachers use digital tools for supplemental learning of traditional teacher-centered instruction and modify their teaching styles. Students may be motivated to use digital tools, and the teacher must ensure that educational values are top priorities (Kaur et al., 2017). Monem et al. (2018) indicated that teachers developed their instructional plan to motivate students to use iPads in specific ways to address their learning needs and advance their performance.

Monem et al. (2018) applied quantitative research using the experimental alternating treatment design to discover and compare the effects of supplemental learning

with the integration of iPads and the interactive notebook for teacher lead instruction to engage active students' responses who have specific learning disabilities. The teachers were middle school language teachers teaching English as a second language.

The students were not fluent in the English language, and they had specific learning disabilities. Teacher-centered instruction minimizes the learning advantages to students (Öman & Hashemi, 2015). Therefore, teachers are encouraged to adapt student-centered instruction using iPads (Monem et al., 2018). Monem et al. (2018) revealed that students felt they were in control of their learning by using the iPads with the Quizlet apps. The teachers believed that the iPads and the interactive notebooks were both useful for supplemental instruction. Students were motivated to use the iPads and indicated using the Quizlet apps to interact with the lesson through prompts, feedback, and color-coding to reveal correct and wrong answers. These digital tools allowed them to have a clearer understanding of the lesson content, which was more meaningful and complete.

***Computers and Software Use in Instruction***

The computer is also available with upgraded programs that may enable lessons that suit multimodal teaching. Preparation in complex tasks for meaningful learning experiences is significant for in-service teachers to keep abreast with new learning technology (Ardıç & İşleyen, 2018). Ardıç and İşleyen (2018) used a quasi-experimental design study for investigating in-service teachers integrating the use of computer algebra systems (CAS) software programs in teaching math across 145 middle and high schools. The dynamic materials included CAS worksheets with operational information necessary for computer-aided multimedia integration (CAMI). The teachers used computers and

interactive multimedia software to facilitate for students' diverse learning styles (Ardıç & İşleyen, 2018).

Students were able to improve their learning with technology-enhanced methods for solving math problems using CAS. Ardıç and İşleyen (2018) reported that in-service teachers' digital technology knowledge enabled them to integrate the use of computers for using dynamic-materials in instruction that enhanced their math lesson. According to Ardıç and İşleyen (2018), in-service teachers used computers and software to improve teaching to enable students' class participation and learning better. Understanding students' distinct learning styles require teachers to understand students' background in selecting suitable teaching programs. On the other hand, Yang (2016) revealed that using multimedia tools in instruction improves students' cognitive processing of information and encourages students' participation.

Yang (2016) used quantitative research to investigate the use of digital tools in multimedia learning and the impact on students' ability to process information regarding how the heart functioning during blood flow. The study participants were 169 undergraduate students enrolled in a foreign language program preparing for teaching in public schools at a science and technology international university. The data collection tool was Felder and Solomon's (1997) index of learning style questionnaires regarding computers and software in a multimedia lesson presentation in science. Yang (2016) used digital software similar to which was used by Ardıç and İşleyen (2018) for simplifying complex teaching material and aided in problem-solving to encourage class participation.

Yang (2016) used a cognitive testing program that involved four learning loads. Three of these cognitive loads were intrinsic loading, extraneous loading, and performance loading. The fourth cognitive load was the combination of all three. The fourth cognitive load test was for students who showed acceptable performance for the first three loads. Yang (2016) revealed that the four cognitive load development tests showed that all students experienced intrinsic loading during learning using computers and software. The learning load was evident through the computer-network assimilated circulation program. Both Yang (2016) and Ardıç and İşleyen (2018) found that students developed their cognitive ability during learning and applying content information. The researchers noted that digital technology's interactive use could enable students to do a higher learning level.

### *Interactive Whiteboard (IWB) Use in Instruction*

Teachers may integrate technology and learning models into their lesson plans using the IWB for presentation to learn new concepts and content. Researchers de Silva et al. (2016) conducted qualitative research to investigate teachers integrating the IWB into teaching at a donor-funded school with six foundation phase teachers. The study involved ongoing interaction with teachers in discovering how they used the IWB in instruction and encouraged students' participation. The teachers used the IWB for dialogic engagement with students and expanded their curriculum to promote cooperation and higher-order thinking skills. De Vita et al. (2018) supported the use of IWB for improving lesson presentations and avoiding traditional chalkboard use.

Researchers De Silva et al. (2018) used qualitative ethnographic research for 18 months to examine how six foundation-phase teachers integrated the IWB to enhance students' learning. The researchers revealed that teachers used the IWB more for teacher-centered instruction instead of incorporating the IWB for improving pedagogy and content. On the other hand, De Vita et al. (2018) emphasized that meaningful use of the IWB must include lesson designs that facilitate student-centered learning to encourage their class participation.

The findings of de Silva et al.'s (2016) study revealed that teachers had dialogs with students regarding their learning challenges and maintained their participation in active learning with the IWB. However, de Silva et al. (2016) acknowledged that teachers using the IWB needed a holistic approach to students' participation in visual learning pedagogy and encouraged full class participation. A holistic approach to integrating digital tools into planning instruction included students' learning styles to facilitate their learning and engagement.

De Vita et al. (2018) conducted qualitative action research using the interpretative modes of inquiry to determine teachers' meaning, purpose, and intention for using the IWBs with a small group of teachers and two 48 students in two groups attending a middle school. Two parallel case studies examined integrating the IWB and its advanced lesson organizer for problem-solving in math. The first study involved teachers and students using the IWB. Both teachers used the IWB to do problem-solving activities in math with geometry software. In the second study, teachers used the IWB as a notepad with an advanced organizer for retrieving solution patterns in math, which helped

reinforce concepts, meaning, and procedures (De Vita et al., 2018). De Vita et al.'s (2018) research findings showed that the IWB played an essential role in students' active participation in student-centered learning.

Planning instruction using digital tools must follow a creative and step-by-step process for meaningful learning (De Vita et al., 2018). A strategic approach for integrating the use of the IWB is student-centered learning. Students-centered education differs from teacher-centered instruction practiced by de Silva et al. (2016). Although de Silva et al. (2016) indicated that teachers had dialogs with students to focus, students could not use the IWB to enhance learning in digital tool practices.

Instruction using the IWB should serve a class's best interest in learning, and their performance indicates how the IWB may enable teachers to enhance teaching. Tunaboylu and Demir (2017) used the pre-experimental design quantitative research with pre-test and post-test to examine how a teacher and a class of 58 Grade 7 students used the IWB to improve math practices and solve equality equations. Tunaboylu and Demir's (2017) study revealed that teachers used the IWB interactive design that made students curious to learn and increased their attention. De Vita et al. (2018) noted that when the IWB is used to be a notepad, and students are allowed to participate and use it, they adapt their learning style to iPads for show and tell. The IWB's interactive design was also demonstrated by De Vita et al. (2018) using the IWB as a notepad for storing solution patterns in learning.

Tunaboylu and Demir's (2017) research findings revealed that using the IWB significantly impacted students' learning and performance. The math teachers knew how

to use the IWB, and the results of students' performance were higher than those taught by teachers using teacher-centered instruction without supplementing learning with the IWB. Tunaboylu and Demir (2017) and De Vita et al. (2018) demonstrated the versatile use and resourcefulness of the IWB for instruction and learning.

The IWB opens new directions in learning methods engaging students in active learning. The interactive whiteboard (IWB) is ubiquitous to digital classroom technology that replaces the chalkboard. De Vita et al. (2018) indicated teachers need to know how to incorporate the IWB to improve cooperative and student-centered learning. Tunaboylu and Demir (2017) noted that teachers experienced with the IWB integrate class active participation and demonstrate their knowledge to show and tell. However, teachers needed to become familiar with IWBs to learn different steps that appeal to students' interest in classroom instruction and teaching (de Silva et al., 2016).

**Barriers and Risks in Integrating Digital Tools Use**

Researchers have explored the barriers to integrating the usage of digital tools into instruction, indicating that the difficulties have impacted teachers' interest, motivation, and training (Bodsworth & Goodyear, 2017; Dooley et al., 2016; Ghavifekr & Rosdy, 2015; Voogt & McKenny, 2017). External barriers that affect the integration of digital technology use include the lack of technology infrastructure, school policy and broken digital tools, and stakeholders' input (Ghavifekr & Rosdy, 2015; Mayes et al., 2015). The barriers to digital devices were significant obstacles to classroom teachers in delivering interactive learning experiences. These digital tools may have facilitated students' learning needs and enabled meaningful instructional practices (Mayes et al., 2015). Raji

and Zualkernan (2016) indicated that digital technology investment needed stakeholders, school teachers, and principals to plan how to use them to improve instruction. These digital tools should serve current classroom needs and future sustainability. Dalal et al. (2017) indicated that the lack of technology infrastructure and resources prevented teachers from integrating digital technology into instruction regardless of teachers' knowledge and skills in using said tools.

### *Infrastructure Barriers to Include Technology Devices Use and Policy*

Without digital tools and support, the competitive nature of digital tools training becomes a challenge. Rabah (2015) indicated that digital technology in the education setting required the collaborative participation of school leadership, stakeholders, classroom teachers, board members, and information technology consultants. Rabah (2015) conducted qualitative research using interviews with 23 teachers and education consultants purposely selected from seven school boards. Three focus groups contributed to the investigation regarding challenges in integrating digital tools for the inquiry-based teaching model for English language learners.

Rabah's (2015) research revealed a need to improve the school's technology infrastructure to enable digital technology access. According to Rabah (2015), digital tools in schools would enhance the teaching and learning process. Vatanartiran and Karadeniz (2015) noted that teacher roles would change to multifaceted functions. These changes may allow teachers to help students integrate ICT digital tools to expand their learning. Rabah's (2015) study revealed that the technology environment needed more

space to enable teachers to incorporate digital tools into instruction. Schools need to take responsibility for creating technology environment infrastructure and training teachers.

Teachers who lack adequate technology skills have difficulty incorporating digital tools into instruction to improve pedagogy and content. Vatanartiran and Karadeniz (2015) used mixed-method research in an online survey to investigate teachers' barriers in integrating digital tools into instruction. The study data included 844 K-12 public school teachers answering questions about the accessibility of digital tools and their challenges in incorporating these tools.

Vatanartiran and Karadeniz's (2015) research findings revealed teachers had low technology ability due to insufficient training. Added to these challenges was the lack of technology management at school. Vatanartiran and Karadeniz (2015) indicated infrastructure issues, low technology learning environment, and insufficient digital devices. Rabah (2015) noted that infrastructure issues contributed to teachers' lack of interest in digital tools training in a similar study. Vatanartiran and Karadeniz (2015) indicated that the schools that did not have a technology policy would not take responsibility to train their teachers in digital technology.

Barriers to incorporating training for teachers in integrating digital devices may be the lack of digital resources and the schools' not having a technology policy. Ghavifekr et al. (2016) did qualitative research, investigating 100 public school teachers' experiences and problems incorporating digital tools into instruction. Ghavifekr et al. (2016) used a self-developed cross-sectional five-point Likert scale survey for teachers'

personal information, tools support, accessing digital devices, knowledge in using digital tools, and teachers' opinions of learners' performance.

Ghavifekr et al.'s (2016) research findings revealed digital technology resource problems such as the lack of digital tools and limited instructional planning time. The main barrier to teachers using digital devices was the lack of technical assistance in the classrooms. However, teachers showed a firm belief in incorporating the computer at the school. Barriers such as limited instructional technology planning time and technical assistance may need administration intervention. Vatanartiran and Karadeniz (2015), in a similar study, noted that schools with technology infrastructure and a lack of digital tools could not encourage teachers to become technology users. Teachers need to have the necessary training and exposure to become competent digital tools users.

### *Personal Barriers to Include Teacher's Training*

Senior teachers may be knowledgeable about using various instructional methods for pedagogy and content, and with digital technology, training could impact 21st-century education. Bodsworth and Goodyear (2017) were college-trained teachers who could apply the cooperative learning model in teaching. However, they did not have the training to integrate the use of technology devices into instruction.

Teachers using the cooperative learning model for students with different learning challenges should know how to integrate iPads into teaching. Bodsworth and Goodyear (2017) were researchers conducting action research with their class to identify technology barriers and manage them but had no training in the use of iPads. The researchers taught physical education to 36 students at a co-educational independent day school. Bodsworth

and Goodyear (2017) and their class were not familiar with iPads in instruction and learning. However, they applied teacher-led instruction to introduce iPads to students.

Teachers may not have the skills to use digital technology for new instruction and learning without experience or training. Bodsworth and Goodyear (2017) revealed that their lack of digital technology knowledge was a barrier to teaching students to use iPads. Students showed differences in their learning expectations.

On the other hand, the school had technology restrictions, and the class was unfamiliar with using digital tools. Rabah (2015) and Vatanartiran and Karadeniz (2015) noted that schools without a technology policy might not encourage teachers' digital tools training. According to Bodsworth and Goodyear (2017), students' unfamiliarity with technology tools and low-quality group learning and cooperation were the most significant barriers. Bodsworth and Goodyear (2017) may have expected students to develop the necessary digital technology skills in their social environment. Bodsworth and Goodyear (2017) noted that they could not teach students to use digital tools without a school's policy and did not feel responsible for teaching students how to use digital tools.

Lack of teachers' positive attitude in response to training becomes a barrier to their competency in using these instruction tools. Teachers may have to become proactive and take the necessary steps to prepare themselves for 21st-century education using digital tools. Zyad (2016) did quantitative research to investigate 56 secondary school teachers' attitudes towards integrating ICT tools and the barriers they encountered. A

five-point Likert scale and semi-structured interviews enabled data collection to incorporate ICT tools for teaching English as a foreign language.

Zyad's (2016) research revealed that most teachers believed they needed more training to improve their performance. Zyad (2016) indicated that teachers used computers but had inadequate training; their computer skills were only personal. According to Zyad (2016), when teachers become aware of the need to be technically competent, they can also take the necessary steps to train. Dooley et al. (2016) suggested that teachers may need to change their attitude in acquiring training and become proactive in instructing students to use digital technology in meaningful and productive ways. Zyad (2016) indicated that teachers had challenges in integrating ICT tools.

Another example of teachers experiencing personal barriers to using digital tools in instruction was Hsu's (2016) research. Teacher's encountered obstacles that included the lack of digital technology training, limited time to integrate digital technology into teaching, and poor technical support. Hsu (2016) used mixed-method research to investigate teachers' beliefs, practices, and barriers in integrating digital technology into instruction. The participants were 152 language arts teachers in K-6 education and were in partnership with an elementary teacher education program at a large university in the Midwestern United States. Data collection was an online survey, interviews, and observations. The study used McCrory's (2006) framework for high-level learning in integrating digital technology into instruction and the constructivist approach in teaching.

Hsu (2016) indicated that teachers could not integrate digital tools to enhance students' interactive learning for knowledge building due to a lack of interest and

training. Likewise, Dooley et al. (2016) noted that teachers who lacked interest in training lacked the necessary skills for using computers to improve students, learning. Hsu (2016) reported that teachers held a constructivist belief in applying pedagogy. Using the constructivist approach in pedagogy may require teachers to know the class's social and learning styles.

Teachers committed to their technology learning may develop creative ways using digital tools to enhance pedagogy and content. Dooley et al. (2016) used qualitative participatory research for two case studies to determine how eight Grades 4 through 6 teachers integrated digital tools for technological pedagogical knowledge to encourage students to design content-focused projects. The digital tools were computers, smartphones, and video games to foster creative thinking and develop habits. Dooley et al. (2016) identified a weakness for teachers not committed to the rigors of training for integrating digital tools leading to poor quality instruction. Rabah (2015) and Vatanartiran and Karadeniz (2015) also indicated that teachers required training to use digital tools effectively.

The challenges of integrating digital tools prevented teachers from doing participatory group learning in collaborative and innovative ways. Hsu (2016) also indicated that teachers had a significant role in displaying the correct attitude for digital tools training. Dooley et al.'s (2016) research revealed that teachers had difficulties using suitable methods for integrating digital tools in literacies. Some teachers used online learning programs that predetermined instructions and did not pursue a more creative approach to participatory pedagogy.

### *Risks-Taking and Use of ICT Digital Tools*

Integrating digital tools into instruction may need teachers to try different methods and create new strategies to change traditional teacher-centered facilitating learning for diverse learners. Goodwin et al. (2015) indicated that risk-taking depended on the participants' background knowledge and experience. Xu and Chen (2016) reported that teachers needed to have the self-confidence to try new methods in using digital tools. Goodwin et al. (2015) used quantitative research for investigating teachers' use of digital tools for cognitive playfulness and academic self-concept with 450 undergraduate preservice teachers in a post-graduate diploma program.

Goodwin et al. (2015) used Marsh's (1992) self-description questionnaire for online data collection regarding participants' digital tools, digital tools competence, and academic self-concept. The cognitive playfulness data was collected separately online using Tan's (2009) questionnaire. Goodwin et al. (2015) indicated that teachers had a positive attitude regarding their cognitive playfulness and self-concept for academic learning. According to Goodwin et al. (2015), risk-taking mediated cognitive playfulness for digital tools' significance. Risk-taking may include failure in a particular method; however, the learning that comes with it may open new insights into applicable processes (see Goodwin et al., 2015).

Teachers may need to further their technical skills to keep abreast of instruction trends and digital tools learning. Xu and Chen (2016) conducted quantitative research using surveys to investigate how preservice teachers used digital tools in information literacy to promote teachers' efficiency. The training participants were 288 teachers

selected from 12 universities and preparing to go into the public schools. The study focused on first-line teachers who had challenges integrating computers and software to improve their information literacy skills for enhancing teaching.

Xu and Chen (2016) indicated that teachers integrated digital tools to enhance information literacy, correlated with effectiveness. Their confidence in using digital tools was significant in risk-taking for using digital devices (Goodwin et al., 2015). Xu and Chen (2016) revealed that teachers showed a firm belief in developing their ability to integrate digital tools. Those teachers who had more exposure to incorporating digital tools indicated a positive attitude toward digital tools.

The low quality of school leadership and technology management may be due to the lack of technology policy. Rabah (2015) and Vatanartiran and Karadeniz (2015) noted that the lack of proper technology infrastructures, including school leadership and technology management, were barriers to teachers accessing digital resources. Voogt and McKenny (2017) indicated a need for future studies to investigate how the lack of digital tools and policies impacts instructional technology. Ghavifekr et al. (2016) noted that personal challenges, on the other hand, included the lack of teachers' technology knowledge. This internal barrier prevented teachers from integrating digital tools (Bodsworth & Goodyear, 2017; Voogt & McKenny, 2017).

Voogt and McKenny (2017) indicated that teachers' roles could change by integrating digital tools into instruction. Bodsworth and Goodyear (2017) noted that teachers' colleges that offered technology training needed to have policies that ensured training for K-12 teachers to enable all teachers to combine technology, pedagogy, and

content. Hsu (2016) noted that teachers who lacked training in integrating digital technology and did not have classroom technical support faced challenges in combining the use of digital tools into instruction.

## Summary and Transition

Chapter 2 showed three significant literature review areas from which I identified themes for examining data and answering the research questions. These include:

- Benefits of Digital Tools Use in the Classroom
- Integrating Digital Tools Use Into Instruction
- Barriers and Risks in Integrating Digital Tools Use

The advantage of exploring digital tools helps me to understand how integrating these tools into instruction could improve pedagogy and content, teachers' performance, and students' learning. Incorporating digital tools into teaching and best practices could improve social and academic knowledge. However, there are barriers to integrating the usage of digital tools that may be personal or environmental. The literature review included the TPACK concept to enable me to understand the integration of digital technology better. The literature review shows a clear link between the TPACK concept and digital tools in instruction. The literature review revealed a need to explore further how digital tools apply in teaching.

This research study addresses a gap identified in the literature review to know more about using digital tools for improving pedagogy and content. The integration of digital tools explores different devices used, challenges, and benefits in learning and points to a need for classroom teachers' understanding of using digital tools in creative

ways in instruction(Hillmayr et al., 2020). Selecting and integrating digital tools could address students' learning challenges and facilitate their learning modalities (Chin et al., 2019). This research study explores how Grades 3 through 8 technology teachers and coaches use digital tools to enhance pedagogy and content and reveal knowledge for digital tools training, professional development, and teaching (Karlsudd, 2018).

Chapter 3 provides an overview of this research study's methodology and significant sections, including the research design, sample selection, the data collecting instrument, and the data collection procedure. Chapter 4 discusses the groundwork for collecting and analyzing data for this research study. Chapter 4 is the actual collection of data using instruments, methods, coding, a compilation of data, and using the data analysis templates; the significance and trustworthiness, the findings, conclusion, and transition into Chapter 5. Chapter 5 presents a brief introduction; interpret the results, limitations, recommendations, implications, and determination.

# Chapter 3: Research Method

The purpose of this basic qualitative research study was to investigate Grades 3 through 8 technology teachers and coaches' methods of selecting and integrating digital tools into instruction to enhance pedagogy and content. Chapter 3 includes the purpose statement, the research questions, the central phenomenon, the researcher's role and any professional relationship, and bias control. There is a description of the methodology and rationale for the chosen research study, the population, the selection criteria for candidates, and the rationale for sample size. This chapter further describes the instrumentation and data collection procedures, and data analysis includes patterns identification, the coding process and deriving themes, and the trustworthiness of this research. Finally, Chapter 3 notes the description of securing ethical standards according to Walden's Institution Review Board (IRB), then the summary and introduction to Chapter 4.

## Research Design and Rationale

The primary research question and sub-questions are as follows:

RQ: What are the different ways Grades 3 through 8 technology teachers and coaches integrate digital tools into instruction?

SQ1: What instructional needs do Grades 3 through 8 technology teachers and coaches fulfill by integrating digital tools into instruction?

SQ2: How do Grades 3 through 8 technology teachers and coaches use digital tools to enhance pedagogy and content to create learning experiences?

The phenomenon of interest is understanding how Grades 3 through 8 technology teachers and coaches used digital tools to enhance pedagogy and content and create meaningful learning experiences. The sharing of technology teachers' and coaches' expertise and knowledge regarding the best use of digital devices may enable educators to improve teaching by integrating digital tools uses. The field of educational technology may expand with the sharing of digital tools knowledge. The knowledge gained should also benefit students through learning to use digital tools to optimize learning opportunities.

**The Research Tradition**

I used the basic qualitative research study tradition that holds practicality for exploring digital tools used in instruction. The basic qualitative research uses interviews to explore real-world problems for deeper insights using the interview to have a one-on-one discussion with selected candidates with digital tools knowledge of instruction and learning situations (Patton, 2015). Further, the basic qualitative research study approach enabled me to understand candidates' reasons, choices, experiences, and digital device use. Patton (2015) indicated that using open-ended interview questions could allow the investigator to understand candidates' behaviors, values, beliefs, and practices.

**The Rationale for the Chosen Tradition**

A review of different research traditions for exploring digital tools use and interviewing candidates led me to select the basic qualitative research study, compared to other qualitative research approaches. Wall and Dunne (2012) pointed out that ethnographic research facilitates the researcher to engage full-time and in-person with

candidates. I was the sole researcher and was not able to engage full-time with participants. According to Wall and Dunne (2012), the ethnography approach allows researchers to interact with candidates over an extended period to collect data through observation and interviews. According to Wall and Dunne (2012), the ethnography approach allows researchers to interact with candidates over an extended period to collect data through observation and interviews. Therefore, the ethnographic approach was not my choice.

Miles et al. (2014) noted that narrative research enables the researcher to study participants' lives and experiences in their environments through stories. This study's focus was to have a broad understanding of integrating the use of digital tools. The narrative approach allows the researcher to have a continuous relationship with candidates and document their work to include their opinions (see Miles et al., 2014). Due to the COVID-19 pandemic, the procedures I used for my research study were doing telephone interviews, collecting qualitative data that I analyzed, free of my opinion. Therefore, the narrative approach was not my choice.

Khan (2014) indicated that a phenomenological study enables the researcher to understand life's process and meaning using group interviews and observations. According to Khan (2014), candidates could provide relevant information, which might not represent a specific event but their overall lived experiences. The data could be in-depth but cover an individual or group's belief (Khan (2014). My interest in using digital tools connected with candidates' experience and knowledge, not merely their beliefs. I did not use the phenomenological approach. Instead, I used the basic qualitative research

study that revealed candidates' knowledge based on their expertise in integrating digital tools uses. I sought data with examples that related to the direct use of digital tools.

The grounded theory research would be time-consuming and is used to examine the everyday use of digital tools to build a theory over an extensive period (Dalal et al., 2017). My research study was not about developing a theory. The basic qualitative approach was about explaining the phenomenon of using digital devices in instruction. The basic qualitative research approach would be suitable for using the TPACK framework to examine descriptive data using digital tools for pedagogy and content (Dalal et al., 2017). The basic qualitative research study enabled me to collect descriptive data on how digital devices impact teaching quality.

Researchers indicated that quantitative research could apply for digital tools use investigation (Chigona, 2017; EL-Daou, 2016; Sensoy & Yildirim, 2018). Chigona (2017) indicated that quantitative research used numerical data in the form of a test score or Likert scale ranking of candidates' beliefs regarding a process or activity. The predetermined answers for data collecting could be from a large population or selected group using surveys or questionnaires (Chigona, 2017). EL-Daou (2016) pointed out that a quantitative research approach failed to present candidates' direct knowledge describing a process. The quantitative method would be inconsistent with the descriptive data needed for my research study. Sensoy and Yildirim (2018) noted that quantitative data analysis lacked essential human expertise for in-depth knowledge of the problem. Therefore, I did not select a quantitative research approach, and this basic qualitative research study allowed me to manage both theory and practice for this investigation.

This research study's topic was exploring how Grades 3 through 8 technology teachers and coaches used digital tools in instruction. Because of my plans to collect detailed narration and descriptive data, the quantitative Likert scale survey-type questions would not be suitable. Percy et al. (2015) noted that traditional qualitative methodology (ethnography, case study, grounded theory, phenomenology, narrative, or historical) might restrict candidates' subjective way of stating their knowledge. The basic qualitative research study was a generic approach, and there was no allegiance to a single established methodology (see Percy et al., 2015). In this research study, I used semi-formal interview questions to understand using digital tools, which allowed the candidates' autonomy to provide experiential knowledge.

The basic qualitative research approach was not bounded to a particular data collection methodology compared to other qualitative methods (Kahlke, 2014). This approach in data collection was known to be generic, and there was no allegiance to a single established methodology. I recruited knowledgeable candidates from a global population using social media. Kahlke (2014) noted that the advantage of using the basic qualitative research approach was the freedom of general assumptions of the knowledge that is needed, the adoption of a theoretical framework, using no single methodology for collection of data, and a suitable technique for the analysis of data. My research study used an interview protocol to collect in-depth knowledge, and I analyzed data connected with the TPACK framework and not restricted by other qualitative research methods. Consequently, the basic qualitative research study allowed me to manage data collection and analysis without a restrictive approach.

## Role of the Researcher

In this research study, I was not an observer or participant or a contributor to data or opinions. I was the sole researcher for recruiting candidates using social media, and ensured they were suitable and qualified. I arranged for interviews, collecting and analyzing data that I compared with literature themes and presented the research findings and results. I did not have relationships with volunteers for the research study. The social media recruitment using flyers allowed volunteers to choose if they wanted to participate or not. I did not have any power position or social media influence on candidates' behavior to use digital tools in instruction.

### Controlling Researcher's Bias

Maxwell (2013) pointed out that the researcher's background, knowledge, and identity could distract candidates from relating personal experiences. I was aware of my background knowledge in integrating digital tools into instruction. I kept a diary that reminded me of issues and trends and managed my biases by maintaining a neutral behavior during data collection. Curry et al. (2009) indicated that the researcher should be passive and focus on the phenomenon of interest. I maintained neutrality and ensured objectivity in the data collection procedure (see Miles et al., 2014). Before I conducted each interview, I reviewed the interview protocol and avoided directing candidates towards choice words or hypothetical examples to answer research questions. I controlled my voice tone to avoid indicating to candidates an expected answer for a question.

### Other Ethical Issues

If there were a need, then I would use an online recruiter service (The user interviewer) for professionals to recruit candidates. Only after my study institution gave IRB approval, I recruited candidates for my research study. I ensured ethical behavior and did not influence any candidate to be a part of my research study in exchange for favors. I did not promise my loyalty to any candidate for participating in this research. I maintained focus, objectiveness, and accuracy in data collection and kept data secured.

## Methodology

An original plan for this research study was the case study design. However, due to challenges posed by the COVID-19 pandemic, I revised the approach to use the basic qualitative research study. The population in this research study was Grades 3 through 8 technology teachers and coaches who integrate digital tools use into instruction. The recruitment process was using the internet and an invitation flyer on social media. Volunteers who responded to my invitation did so by email or telephone (my email address and telephone numbers stated on the invitation flyer). On receiving a volunteer's response, I immediately emailed the informed consent form with the inclusion criteria for completing and returning by email.

### Participant's Selection Logic

The recruitment population was Grades 3 through 8 technology teachers and coaches noted on the invitation flyer. As soon as volunteers responded to my invitation to be a volunteer, I emailed each of them the informed consent with the inclusion criteria for reading, completing, and returning by email. I used my personal computer to access

emails. As soon as I received the returned informed consent, I checked for signatures, contact information, and volunteers' digital tools information on the inclusion criteria. I used the detached inclusion criteria to copy each volunteer's digital tools information and inspect for suitability to become potential candidates (see Appendix A for the Detached Inclusion Criteria). The inclusion criteria showed the following questions:

1. What teaching title best describes you for using digital tools in instruction? Circle your response:

a. technology teacher

b. technology coach

c. both technology teacher and coach

2. Indicate your grade level/s using digital tools in instruction. Circle the grade level/s: 3 4 5 6 7 8

3. How many years' experience do you have using digital tools in instruction? ___

4. Do you practice student-centered instruction including the use of digital tools? If yes, how many years? Answer: ___

5. Do you develop your lesson plans, including the use of digital tools in instruction? If yes, how many years? Answer: ___

6. Do you use formative assessment for the quality of use of digital tools? If yes, how many years? Answer: ___

7. Do you use digital tools in the lesson guided by a curriculum? If yes, how many years? Answer: ___

The candidates must answer all questions to enable a suitable selection. I prioritized selecting candidates who answered yes to questions 4-7 and those who totaled the highest number of years' experience for questions 3-7. The inclusion criteria questions were listed in order of importance. Volunteers should practice student-centered instruction, use lesson plans infused with digital tools, do a formative assessment for assessing teaching quality and lessons guided by a standard core curriculum. Candidates' years of digital tools use experience significantly enhanced their background knowledge and expertise in instruction and learning. I purposively selected nine candidates qualified with the most years of experience using digital tools. I contacted each candidate by email and arranged for an audio-recorded interview. I also communicated with other volunteers who responded to be likely candidates, but other obligations or preferences did not. I thanked them for their interest in my research study.

**Rationale for the Number of Participants**

I used the studies discussed below to model my research study and purposively selected eight candidates. The rationale for the number of candidates stems from a review of different qualitative research studies (Jones, 2017; Kılıçkaya, 2019; Kirikcilar & Yildiz, 2018; Munguia, 2017; Palladino & Guardado, 2018; Ya-Huei-Lu et al., 2017). The mentioned research showed digital tools in instruction with interview protocol for data collection as my proposed research. The cited researchers used a sample size of between two and six candidates. The instruments used included the interview protocol, document review, and observation. These instruments provided data that the researchers indicated to satisfy data saturation.

Kirikcilar and Yildiz (2018) used a case study mixed-method research to investigate four middle school teachers integrating computer-assisted activities into instruction for GeoGebra software and in-depth knowledge of teachers' use of the TPACK concept. Data collection was by two semi-structured interviews and observations. Kirikcilar and Yildiz (2018) used the first interview to collect data to assess teachers' expected behavior during their lessons. The researchers' first data enabled understanding of the teachers' behavior during the lesson delivery, and then the researchers used the second interview to understand the GeoGebra software. Data analysis included qualitative and quantitative methods using codes to identify patterns.

Ya-Huei-Lu et al. (2017) used a case study research to explore the use of iPads and apps with four teachers. Data collection was done by interviews and observations of teachers using iPads in literacy instruction. Ya-Huei-Lu et al. (2017) did two classroom observations of each teacher's activity during the lesson and a semi-structured interview with each teacher. Ya-Huei-Lu et al. (2017) used four teachers with three data sources per participant.

Palladino and Guardado (2018) used a case study research to explore how four participants, two teachers and two students at the junior and high school levels, integrated computers, blogs, and wikis in their heritage language class after the teachers underwent professional development. Palladino and Guardado (2018) collected data using semi-structured interviews regarding participants' digital tools use experience and the benefits and challenges of using these tools. The data analysis utilized themes identified and

coded from the data patterns in an inductive process, checked for consistency, and then compared with themes from the literature review.

Jones (2017) used qualitative research to investigate four teachers' beliefs regarding technology use in their application of TPACK in instruction. The teachers attended a two-year professional development TPACK training. Data sources included interview transcripts, class observation, and a review of lesson plans, including case summaries of the teachers' interviews and the researchers' perception of teachers' profiles. The data source included six interviews, one lesson plan, and 10 class observations.

Kılıçkaya (2019) conducted case study research with four English language teachers from middle and high schools. The research focus was on the benefits of using technology in class after participants attended several technology workshops. Data collection was by semi-structured interviews and reviews of participants' journals regarding the use and challenges of using these tools.

Munguia (2017) used case study research to examine multiple perspectives on the support systems used in two schools to enable the academic achievements of English language learners. The participants purposively selected were two principals and four teachers. Data collection was through semi-structured face-to-face interviews, document reviews of schools' reclassification, and participants' lesson plans. In total, there were six participants for interviews and document reviews. Many of the research discussed are case studies and mixed-methods approaches, usually involving multiple data points such as interviews, documents reviews, and observations.

Giannikas (2016) did literature reviews and qualitative studies with semi-formal interviews and explored how five Language arts teachers used IWBs for instruction and learning. Giannikas (2016) indicated using surveys that adequately provided data for assessing teachers' use of IWBs in class. Giannikas (2016) noted that the study data saturation was with five candidates.

Researcher de Silva et al. (2016) conducted qualitative research to investigate six teachers using IWBs in class to enhance learning. Researcher de Silva et al. (2016) collected data using interviews for collecting data, which the study's findings showed that teachers used IWBs for dialogic engagement with students. Researcher de Silva et al. (2016) noted that the study data saturation was with six candidates.

Considering the limitations of collecting data in an unsure academic setting due to the COVID-19 pandemic, I used nine candidates for semi-structured interviews and checked data saturation. The interview protocol carried 15 questions, each with a second part that allowed for examples if needed. I discussed the procedures for identifying, contacting, and recruiting participants in the section for recruitment, participation, and data collection later in this chapter.

## Instrumentation

The literature review enabled me to understand better the problem in this research study. The literature review allowed me to identify digital tools issues and developed the research sub-questions (see Appendix B for the Research Subquestions Development Table). I developed the interview questions to connect to the research subquestions, which were not exhaustive but significant for collecting digital tools uses. Two

technology teacher experts and coaches reviewed the interview questions for authenticity. An experienced senior educator also checked the interview questions for connection with technology curriculum design and digital tools uses. The research dissertation committee reviewed and approved the technology teacher experts' and the university educator's recommendations—the interview questions transferred to the Interview Protocol (see Appendix C for the Interview Protocol). Table 1 shows the research subquestions and the interview questions used for data collection.

**Table 1**

*Research Subquestions for Interview Questions for Data Collection*

| Interview Questions for SQ1 |
|---|
| 1. How do you use digital tools to enhance instruction compared to instruction without using digital tools? |
| 2. How do you use digital tools beyond utility value (typing lessons) to accomplish learning objectives? |
| 3. How do you apply digital tools for teaching concepts, formulas, and problem solving? |
| 4. How do you use digital tools to simplify complex materials for a deeper understanding? |
| 5. How do you use digital tools to facilitate for differentiated learning to cope with students' learning levels? |
| 6. How do your choices of digital tools (apps/online program) engage student in the lesson? |
| 7. How do you use digital tools to facilitate students' for student-centered learning activities? |
| 8. How do you use digital tools to include students' background knowledge (metacognition) in lessons? |
| 9. How do you evaluate digital tools use to ensure adequate quality in instruction and learning? |
| **Interview Questions for SQ2** |
| 1. How do you incorporate digital tools in teaching models/styles/strategies to facilitate pedagogy and content? |
| 2. How do you use digital tools to ensure that pedagogy is facilitating for students with different learning styles? |
| 3. How do you use digital tools for pedagogy and content to search or discover, facilitating new learning experiences? |
| 4. How do you use digital tools for pedagogy and content and enable learning modalities (seeing, doing, auditory)? |
| 5. How do you use digital tools to combine pedagogy and content for concepts, skills, and problem-solving learning? |
| 6. How do you use digital tools for pedagogy and content to empower students for extended learning (homework or assignment)? |

**Sufficiency of Data Collection Instruments**

The literature review was the primary source for developing the primary research question, subquestions, and supporting interview questions. As indicated before, the research dissertation committee reviewed and approved the interview questions. There are two subquestions with a total of 15 interview questions. SQ1 has nine open-ended questions and follow-up questions to clarify with examples of incorporating digital tools' uses into instruction. SQ2 has six open-ended questions to qualify with examples of integrating digital tools' uses into pedagogy and content.

**The Basis for Researcher's Developed Instruments**

As indicated, the researcher developed the data collection instrument with questions based on the literature review—the instrument was checked by digital tools experts and my dissertation committee. In developing the interview protocol, the literature review revealed the challenges and gaps in integrating digital tools' uses into teaching and learning. The primary research question (RQ) is linked to the research problem and answered by SQ1 and SQ2. Each SQ had interview questions for collecting the data.

SQ1 explores Grades 3 through 8 technology teachers and coaches' instructional practices using digital tools in instructions. The literature review revealed the necessity for exploring Grades 3 through 8 technology teachers and coaches digital tools experiences, teaching methods, training, and students' responses to learning with the use of digital tools (Alhassan, 2017; de Silva et al., 2016; Kale, 2018; Motshegwe & Batane, 2015; Sensoy & Yildirim, 2018).

SQ2 explores Grades 3 through 8 technology teachers and coaches integrating digital tools into instruction for enhancing pedagogy and content. The literature review showed that TPACK might help understand how digital tools could improve teaching pedagogy and content. These concerns related to digital tools have been discussed in studies by researchers in the field (Güneş & Bahçivan, 2016; Lu et al., 2017; Monem et al., 2018; Tunaboylu & Demir, 2017; Vatanartiran & Karadeniz, 2015).

**Consistency and Trustworthiness of Data Collection Instruments**

The technology teachers and coaches' experts contributed to reviewing the interview protocol design. A senior educator in the technology field also reviewed the questions for relevance in data collection. The feedback digital tools' experts and the senior educator enabled me to improve the quality of questions and content to facilitate the trustworthiness of the interview protocol. The dissertation committee reviewed the changes that I made and gave their approval for the data collection tool.

## Procedures for Recruitment, Participation, and Data Collection

As soon as I received Walden's IRB approval (11-20-20-0296670), I pursued identifying potential candidates for my research study. The targeted population was Grades 3 through 8 technology teachers and coaches. I used an invitation flyer to recruit volunteers, which I posted on the social media advertising on Facebook. I also planned to address volunteers' recruitment through the Association of Educational Communications and Technology (AECT) professional organization. In addition, I registered with the Walden participant pool. Finally, I planned that I would use the Userinterviewers online paid participants recruitment service if there was a need for recruitment assistance.

Potential candidates responded to my invitation flyer on social media (Facebook). They emailed me regarding their interest in volunteering for my research study, and I emailed each volunteer the informed consent form, including the inclusion criteria. Finally, I asked volunteers to read, complete, electronic sign, and return. I asked each candidate to keep on file a copy of the returned document.

As soon as I received the returned documents, I checked volunteers' digital tools information and suitability, answered questions to become potential candidates, and signed electronic signatures. Then, I emailed each prospective candidate and set up appointments for an audio-recorded telephone interview with their permission. I also emailed those volunteers who responded but could not participate, and I thanked them for their interest in my research study.

**Interviews for Doing Data Collection.**

I collected data using telephone interviews to understand candidates' digital tools uses that may enhance pedagogy and content and improve instruction and learning (see Appendix C for the Interview Protocol). With each candidate agreeing, I did a telephone audio recording. The telephone interviews lasted between 30 and 45 minutes. During the interview, I wrote notes that I later compared with the recorded audio, checking the accuracy of my written script. Several times, I played the audio recordings. I examined the data for similarities of phrases, ambiguity in words used to describe an event or action, and descriptions connected with the interviewed data. I found no discrepancy in the data and eliminated the need for resolving any differences. After checking my scripts

and finding them correct, I contacted the candidates and forwarded their gifts based on their receivable preferences.

**Data Saturation and Candidates' Sample Size.**

I used the two subquestions and generated the interview questions, which were semi-structured to develop a conversational approach to the interview. SQ1 had nine interviewing questions asking for examples of integrating digital tools uses. I recruited nine candidates to participate in this research study. The candidates answered the questions for their digital tools uses and active engagement with students to secure their interest, motivation, participation, focus, build their learning experiences, and constantly evaluate digital tools use quality.

SQ2 had six questions related to lesson delivery for integrating digital tools uses to enhance pedagogy and content. I examined the data collected for SQ2 interview questions for how technology tools may enhance pedagogy and content for improving instruction. Digital tools used for content showed a broad range of learning materials and how learning materials were accessed using the internet and used in lessons. Questions about using digital tools for combining content and pedagogy revealed creative teaching of complex learning materials—the relevance of interview questions allowed for collecting data on integrating digital tools uses. Although there was a limited amount of candidates (9), the candidates enabled data saturation with similar data for interview questions.

### Candidates Exiting the Research Study

None of my candidates left during the research study process. If any candidate wanted to withdraw from participating, I would not prevent them from going. I would not use any data collected from that candidate. I would destroy the data by shredding it. I would have used my backup plan to recruit another candidate, advertised the research study invitation online on social media, or pulled from my candidates' pool created during the recruitment of volunteers. I thanked all candidates for participating in my research study. All candidates completed the data collection process, and each of them was given a thank you gift voucher for their time and participation in my research study.

## Data Analysis Plan

I analyzed the data collected for digital tools used in different ways and technology knowledge associated with TPACK (Durdu & Dag, 2017; Scherer et al., 2017; Tseng, 2018). My analysis of each interview question's data (SQ1 and SQ2) followed inductive reasoning to identify data patterns. First, I interpreted data for SQ1 and SQ2 interview questions, and then I looked for data patterns that I coded and grouped into categories used to derive themes (see Miles et al., 2014). I used a mapping grid to connect each SQ1 data patterns-themes with the SQ2 data patterns-themes (see Table 2 for Mapping Grid). I combined SQ1 data pattern-themes with SQ2 data pattern-themes in categories, which I analyzed using abbreviated codes to determine new themes (see Appendix I for Abbreviation Codes). I used inductive analysis to compare or contrast the new themes with literature themes to answer the primary research question (RQ).

Patton (2015) indicated that finding data patterns are by no means exhaustive. I analyzed the data for patterns related to keywords, practices, connections to using digital tools identified in statements, clauses, activities, and descriptions (Miles et al., 2014). New trends in data emerged during the data analysis of SQ1 and SQ2 interviewing questions, allowing me to see more data patterns connections

Each interview question provided invaluable data. I used the coding types (values code, process code, and descriptive code) to determine the credibility of the data for answering the research question (Miles et al., 2014). I did not interchange the data for each interview question (SQ1/SQ2) to answer another. I kept each question's data related explicitly to understanding digital tools' uses in different ways. For example, I did not use the #3 interview question's data to answer the #6 interview question for SQ1s. I kept the trustworthiness of data answering a precise question. Data interpretation's reliability was significant for collecting accurate data (Miles et al., 2014). Each interview question's data pattern served as a brief description of digital tools' uses in a specific and tangible way, which helped me understand different ways of using digital tools in instruction and learning.

**Procedures for Coding Data.**

Miles et al. (2014) indicated different codes suitable for pattern identification in data. These codes were used for qualitative data and included values, process, and descriptive codes (Miles et al., 2014). The values code is related to a candidate's value, attitude, and belief (Miles et al., 2014). I used the values code to identify Grades 3 through 8 technology teachers' and coaches' attitudes, approaches, and beliefs for

integrating digital tools into instruction. The descriptive system of codes summarizes short phrases, keywords, or jargon (Miles et al., 2014). I used descriptive code to identify Grades 3 through 8 technology teachers' and coaches' instructional routines and strategies for integrating digital tools into instruction. The process code includes conceptual actions or activities, such as gerunds in the data (Miles et al., 2014). I used the process code to identify Grades 3 through 8 technology teachers' and coaches' used digital tools to facilitate or enhance instructional practices.

I used the data patterns that were coded for connecting data patterns and then grouped them into categories. This coding technique allowed me to identify data patterns into categories for the two sub-questions (SQ1 & SQ2) and identify themes by inductive analysis. Patton (2015) indicated that data patterns are not exhaustive, and during the data analysis process, new trends in data patterns could emerge. I analyzed new data patterns, then coded them for categories d themes. Colors codes for data patterns were green for value coding, blue for descriptive coding, and yellow for process coding used for SQ1 and SQ2 data. I used these color codes to derive themes using the data grid where SQ2 interview questions were predetermined to provide data that could connect with each SQ1 research question data (Miles et al., 2014).

**Analysis Procedure for SQ1 Data.**

There were nine interview questions for SQ1 (What instructional needs do Grades 3 through 8 technology teachers and coaches fulfill by integrating digital tools into instruction?). SQ1 research questions ask about using digital tools uses in different ways. I analyzed the data for each research question using deductive evaluation to identify data

patterns, which I color-coded (see Appendix D for SQ1 Interview Questions-Coding Data Patterns/Categories for Themes). Then, I pooled data patterns for each interview question from all nine interview protocols (i.e., all 1s, all 2s, all 3s, through to all 9s). Pooling the data patterns for the same questions across interview protocols allowed me to examine the color code for categories. I used inductive analysis for data patterns and derived themes for SQ1 (see Appendix E for Derived Themes from SQ1 Interview Questions (IvQ) Data). Then, I summarized my findings for SQ1 (see Appendix F for Educational Technology Products Discussed in Teacher Interviews).

**Analysis Procedure for SQ2 Data.**

There were six interview questions for SQ2. The method that I used to answer SQ2 interview questions was similar to SQ1. SQ2 (How do Grades 3 through 8 technology teachers and coaches use digital tools to enhance pedagogy and content to create learning experiences?). SQ2 research questions ask about digital tools' uses for improving pedagogy and content. SQ2 interview questions linked to the TPACK framework sub-sections (TK, PK, PCK, TPK, and TCK). I analyzed the data for each research question using deductive evaluation to identify data patterns (see Appendix G for SQ2 Interview Questions-Coding Data Patterns/Categories for Themes). Then, I pooled data patterns for each interview question (i.e., all 1s, all 2s, all 3s, through to all 6s) from all nine interview protocols. Pooling the data patterns for the same questions across interview protocols allowed me to examine the color codes for categories. I used inductive analysis for data patterns and derived themes for SQ2 (see Appendix H for Derived Themes from SQ2 Interview Questions (IvQ) Data). Then, I summarized my

findings for SQ2 (see Appendix F for Educational Technology Products discussed in the teacher interviews).

**Analysis Procedure for RQ Data.**

For answering the primary research question RQ (What are the different ways Grades 3 through 8 technology teachers and coaches integrate digital tools into instruction?), I used a mapping grid for connecting data patterns/themes from SQ1 and SQ2 interview questions (see Table 2 below for Mapping Grid: SQ1 & SQ2 Interview Questions). It is important to note that some SQ2 interview questions showed links to more than a single SQ1 interview question. I analyzed the value, descriptive, and process codes for short phrases, keywords, or jargon found for data patterns/themes that showed connections for SQ1 and SQ2s (Miles et al., 2014). Then, I developed an abbreviation code, which I used to analyze SQ1 and SQ2 themes by deductive evaluation to derive RQ themes (see Appendix I for Abbreviation Codes). Appendix J shows RQ themes derived from SQ1 and SQ2 themes. I briefly discussed the findings of RQ themes 1- 9 (see Appendix K for Analysis of RQ Themes 1-9).

**Table 2**

*Mapping Grid: SQ1 & SQ2 Interview Questions*

| SQ1: What instructional needs do Grades 3 through 8 technology teachers and coaches fulfill by integrating digital tools into instruction? | SQ2: How do Grades 3 through 8 technology teachers and coaches use digital tools to enhance pedagogy and content to create learning experiences? |
|---|---|
| 1. How do you use digital tools to enhance instruction compared to instruction without using digital tools? | 1. How do you incorporate digital tools in teaching models/styles/strategies to facilitate pedagogy and content?<br>2. How do you use digital tools to ensure that pedagogy is facilitating for students with different learning styles? |

| SQ1: What instructional needs do Grades 3 through 8 technology teachers and coaches fulfill by integrating digital tools into instruction? | SQ2: How do Grades 3 through 8 technology teachers and coaches use digital tools to enhance pedagogy and content to create learning experiences? |
|---|---|
| 2. How do you use digital tools beyond utility value (typing lessons) to accomplish learning objectives? | 3. How do you use digital tools for pedagogy and content to search or discover, facilitating new learning experiences?<br>4. How do you use digital tools for pedagogy and content and enable learning modalities (seeing, doing, auditory)? |
| 3. How do you apply digital tools for teaching concepts, formulas, and problem solving? | 2. How do you use digital tools to ensure that pedagogy is facilitating for students with different learning styles?<br>5. How do you use digital tools to combine pedagogy and content for concepts, skills, and problem-solving learning? |
| 4. How do you use digital tools to simplify complex materials for a deeper understanding? | 3. How do you use digital tools for pedagogy and content to search or discover, facilitating new learning experiences?<br>5. How do you use digital tools to combine pedagogy and content for concepts, skills, and problem-solving learning? |
| 5. How do you use digital tools to facilitate for differentiated learning to cope with students' learning levels? | 3. How do you use digital tools for pedagogy and content to search or discover, facilitating new learning experiences?<br>4. How do you use digital tools for pedagogy and content and enable learning modalities (seeing, doing, auditory)? |
| 6. How do your choices of digital tools (apps/online program) engage student in the lesson? | 2. How do you use digital tools to ensure that pedagogy is facilitating for students with different learning styles?<br>3. How do you use digital tools for pedagogy and content to search or discover, facilitating new learning experiences? |

| SQ1: What instructional needs do Grades 3 through 8 technology teachers and coaches fulfill by integrating digital tools into instruction? | SQ2: How do Grades 3 through 8 technology teachers and coaches use digital tools to enhance pedagogy and content to create learning experiences? |
|---|---|
| 7. How do you use digital tools to facilitate students' for student-centered learning activities? | 2. How do you use digital tools to ensure that pedagogy is facilitating for students with different learning styles?<br>4. How do you use digital tools for pedagogy and content and enable learning modalities (seeing, doing, auditory)? |
| 8. How do you use digital tools to include students' background knowledge (metacognition) in lessons? | 4. How do you use digital tools for pedagogy and content and enable learning modalities (seeing, doing, auditory)?<br>6. How do you use digital tools for Pedagogy and content to empower students for extended learning (homework or assignment)? |
| 9. How do you evaluate digital tools use to ensure adequate quality in instruction and learning? | 1. How do you incorporate digital tools in teaching models/styles/strategies to facilitate pedagogy and content?<br>3. How do you use digital tools for pedagogy and content to search or discover, facilitating new learning experiences? |

## Issues of Trustworthiness

Trustworthiness in this basic qualitative research study ensures reliable means of investigating the problem. These means relate to managing the research to identify and understand the gap, candidates' identification, sample selection, instrument design, and data collection and analysis. The credibility, transferability, dependability, and confirmability determine the quality of trustworthiness discussed below.

### Credibility

I recorded the interview data verbatim and then compared it to the audio recording to ensure accuracy. I recorded my study journal reflections and objectively provided quality data collection using the interview protocol for bias control. I confirmed that candidates answered all interview questions and examined the data for saturation that revealed similar patterns from different candidates. During data analysis, I kept a reflective journal, documented my thoughts, ensured not to interfere with information across candidates' ideas, reviews, and experiences, and avoided data analysis interference.

### Transferability

For this basic qualitative research study, I explored Grades 3 through 8 technology teachers and coaches' methods to integrate digital tools' uses into instruction. I used the interview protocol and collected rich and descriptive data to provide trustworthy findings so that future researchers may compare research studies. I recruited candidates from a broad cross-section of social media. I collected data, which indicated a deep reflection of the candidates' knowledge and experience in technology lab or classroom settings reflecting trustworthiness for transferability. Researchers could see the

information potentially applicable to their locations. I described the process regarding data collection and analysis in detail to allow for duplication by other researchers. Educators may transfer the results of this research study to similar contexts or settings.

**Dependability**

In the documentation of the research procedure, I ensured consistency and repeatability in the method used (Shenton, 2004). In this research, the interview was semi-formal with open-ended questions, which I sought comprehensive data collection and examples to integrate digital tools into instruction. I ensured the research's data collection process was dependable and consistent for repeatable processes. I used the same questions to collect data from different candidates. I reflected on how candidates selected digital tools and integrated them into instruction to enhance pedagogy and content. The documented procedures should allow for research auditing and critique by others.

**Confirmability**

I developed the research sub-question and the interview questions from the literature review. The technology teacher experts checked the interview questions for relevance to the problem and ensured meaningful data collection. I consulted with the dissertation committee, who confirmed the interview questions' significance and connection to the problem under study. I ensured that participants were aware of this research study's purpose and the need for collecting data that reflected practical approaches for integrating digital tools into instruction, which was significant to knowledge building. I managed this investigation and avoided researcher bias by keeping

a diary of my opinions and experience (Patton, 2015; Shenton, 2004). I maintained relative neutrality towards my preference throughout this study and ensured objective findings (Miles et al., 2014). Throughout this study, I maintained consistency in the method applied and used for the intended purpose.

## Ethical Procedures

I applied for Walden's IRB approval, and I attached documents to include my CITI human subjects training certification, informed consent form, attached inclusion criteria, research questions, and invitation flyer. I ensured that I had no issues of ethical importance regarding recruitment, materials, and process included on IRB Forms A and C. Walden University's approval number for this study is 11-20-20-0296670.

As indicated earlier in the participants ' selection logic section, I asked candidates to answer all the inclusion criteria form questions. The inclusion criteria instrument shows the standard used to evaluate candidates based on their expert knowledge and experience. I ensured that candidates answered all questions on the interview protocol in this research study. I responded to candidates regarding their selection, whether they were successful or not.

I used an informed consent document to address the ethical concerns for candidates volunteering to participate in interviews for data collection. Patton (2015) indicated that the researcher must use a humanistic approach to collect data and apply equity, fairness, and mutual respect in human interactions. I explained to candidates the benefits and risks of this study and their rights to withdraw. I assured the candidates that their participation in this study was voluntary. There was no coercion for a candidate to

continue if there was a need for withdrawal. Withdrawal may be for any personal reason or feeling of insecurity and without explanation. I assured candidates that the data collected would benefit and expand classroom teachers' knowledge for integrating digital tools into instruction. I secured the interview data in my office safe, accessible only to me, and I will destroy them after five years by shredding them.

All candidates recruiting were online through social media. I did not collect data at my workplace, nor do I have power over or interest in any potential candidates. I did not influence candidates to provide biased data in this research study. If there was an adverse situation that needed addressing and was not within my capacity to handle, my backup plan was to consult with Walden's IRB for advice or intervention.

## Summary and Transition

Chapter 3 disclosed the methodology for collecting data, identifying the intended online sources, the candidates, IRBs applications and attachments, and the necessary research procedures before and during data collection. I choose candidates by using an inclusion criteria instrument. I used an interview protocol for data collection, with interviewing questions developed from two research sub-questions—the data analysis related to selecting and integrating digital tools used in instruction. I assessed the data I collected for patterns and coding. Data coding enabled me to group data patterns across all interview protocols to determine similarities and differences.

I examined the coded data patterns, then pooled for SQ1 interview questions to answer SQ1. I similarly pooled SQ2 interview questions to answer SQ2. I combined data patterns across SQ1 and SQ2 to derive data themes. I discussed the themes from data

patterns and themes in the literature review to answer the primary research question (RQ). Chapter 3 described the research study activities, data collection procedures, and data analysis planning, leading to Chapter 4. In Chapter 4, the actual undertaking of the groundwork for this research study is provided for data collection for analysis and findings. Chapter 5 will present an overview of the research that led to the investigation's outcomes and results.

# Chapter 4: Results

The purpose of this basic qualitative research study was to investigate Grades 3 through 8 technology teachers and coaches' methods of selecting and integrating digital tools uses into instruction to enhance pedagogy and content. The TPACK framework allowed a lens, which enabled understanding for incorporating digital tools used to improve education (see Sensoy & Yildirim, 2018). This study explored Grades 3 through 8 technology teachers' and coaches' methods of selecting and integrating digital tools into instruction. The following are the research question and subquestions for my study.

RQ: What are the different ways Grades 3 through 8 technology teachers and coaches integrate digital tools into instruction?

SQ1: What instructional needs do Grades 3 through 8 technology teachers and coaches fulfill by integrating digital tools into instruction?

SQ2: How do Grades 3 through 8 technology teachers and coaches use digital tools to enhance pedagogy and content to create learning experiences?

In Chapter 4, I describe the settings and participants' demographics. I identify the different data patterns/categories that I code and derive themes for subquestions 1 and 2, which I discuss later in the chapter. Then, I show the cross-tabulation of SQ1 and SQ2 data patterns/categories and themes, which I discuss for answering RQ later in the chapter. I discuss discrepancies found in the data, and I review the evidence of trustworthiness section. Finally, I present the results related to answering the research questions, a summary of Chapter 4, and lead into Chapter 5.

## Settings

This study was initially planned to take place in a large urban school district. Organizational issues and the COVID pandemic did not allow me to get appropriate permissions from that district on time. Therefore, I changed the setting to recruit participants via social media, not restricted to one school district. The recruitment process is described further in the data collection section below. I confirmed potential participant suitability using the inclusion criteria. Although there were 14 qualified volunteers, I could only set interview times with nine volunteers. I communicated with volunteers using my computer, sending and receiving emails. I spoke by telephone with participants who indicated their contact telephone numbers on the consent form. In addition, I set up my private home office to do all telephone interviews and used Zoom as requested by one participant. My meeting time availability was Monday through Friday from 4:00 PM to 9:00 PM EST and on weekends from 9:00 AM to 9:00 PM EST. My time availability allowed each participant to select their time to do the telephone interviews after work or on weekends in the convenience of their homes or chosen venue. With the permission of the participants, I recorded the telephone conversation on a digital recorder. I could not control participants' privacy from their homes or offices during interviews; however, I did not experience interruptions during telephone interviews. The period for interviews was for 1 month (05/10/21-06/10/21).

## Demographics

All volunteers were from the United States in a tristate region located in metropolitan and suburban areas. Their experiences using digital tools ranged from 2-10

years for different purposes in their classes. I refer to participants using pseudonyms P1 for Participant 1through P9 for Participant 9. There were two males and seven females. Five participants were between the ages of 36-55 years (P1, P2, P3, P5 & P8) and had 4-10 years' experience, and four participants were between 25-35 years (P4, P6, P7 & P9) and had 2- 3 years' experience (see Table 3 below).

**Table 3**

*Participants' Inclusion Criteria Information*

| Participant | Participant's sex | Teaching title | Grade/s level taught | Years of experience |
|---|---|---|---|---|
| P1 | Female | Teacher | 3 & 4 | 7 |
| P2 | Female | Technology Teacher | 3 | 4 |
| P3 | Male | Technology Teacher | 3, 4 & 5 | 5 |
| P4 | Female | Technology Teacher | 4 | 3 |
| P5 | Female | Technology Teacher | 8 | 4 |
| P6 | Male | Technology Teacher | 6, 7 & 8 | 2 |
| P7 | Female | Technology Teacher | 3 | 2 |
| P8 | Female | Technology Teacher | 8 | 10 |
| P9 | Female | Technology Coach | 5 | 3 |

## Data Collection

Because of the COVID- 19 pandemic, I could not collect data from the intended school districts. I had to modify the data collection method to social media and reapplied to Walden's IRB for approval. The new IRB application date for data collection was 04/15/2021. On receiving Walden's IRB approval (11-20-20-0296670), I also had to modify my proposal to indicate the study approach and the new data collection procedures. On approval from my dissertation committee, I posted my invitation flyer on social media on 05/10/2021 to recruit volunteers to participate in my research study. The targeted population was Grades 3 through 8 technology teachers and coaches. I had 17 inquiries from Grades 3 through 8 technology teachers, including one technology coach.

I emailed each volunteer the informed consent, including the inclusion criteria, and asked volunteers to read, complete, electronically sign, and return by email. As soon as I received a signed consent form, I transferred the information to a different inclusion criteria form and checked volunteers' digital tools information and suitability to become potential participants (see Appendix A for Detached Inclusion Criteria). Finally, I emailed each prospective participant and set up appointments for an audio-recorded telephone interview, asking for their permission. I thanked those who were not able to participate.

Eight participants answered yes to questions 4-7 on the inclusion criteria, making them entirely suitable, using digital tools for student-centered instruction, including lesson plans, formative assessment, and lessons guided by a curriculum. All eight participants showed between 2-10 years of using digital tools for different purposes in

their classes. P3 indicated on the inclusion criteria that he did not practice student-centered instruction nor used formative assessment with students to determine the quality of teaching using digital tools in class. However, P3 was qualified for questions 4-7. He was a technology teacher, taught Grades 4, 5, and 6, and had five years' experience using digital tools in instruction. I considered P3 for an interview to know more about his instructional practices. Using all nine participants allowed me to have data saturation.

I prepared my private office at my home with my electronic audio recorder, a Sony portable recorder with four folders, and a total time capacity of 29 hours. P1 preferred a Zoom call, which I facilitated. There was one interview for each participant, and the conversation times lasted between 30-45 minutes. I did not control participants' location or venue, but I encouraged their privacy during the interview. I did not experience any interruption during any of the interviews. I did one interview with each participant.

In doing the interviews, I made a telephone call to each participant using the telephone number provided on the informed consent. I welcomed each participant to the interview, indicating that I found them suitable and qualified to participate in my research study. I read the purpose of the interview to collect data for educational use, outlined that the interview was semi-formal, and asked for their permission to do audio recording, to which each participant gave their consent. I indicated having two interviewing sections. Section one had nine questions about how participants used digital tools in instruction, and section two had six questions related to digital tools used for pedagogy and content. Because some participants were concerned about my interviewing time, I allowed them

to answer questions integrating their examples if preferred. Some participants chose that method, while others were willing to give examples separately. During some interviews, I had to prompt participants to continue the conversation and focus on the specificity of interview questions. Before each interview, after the introduction, I asked if there was any question before I began. Each participant answered no, and I proceeded to ask my first interview question. After a participant responded to a question, I indicated the following question by number to allow the participant to note their progress and hold my focus during the interview.

For the interview, I identified each participant by a number, starting with P1, on the date they had their discussion. I did an audio recording of the interview and took notes on my note pad which I later typed and examined with the audio recording for accuracy and clarity. Participants clarified their responses during the interviews with examples of digital tools applications. All participants indicated that they were doing in-person and online instruction.

## Data Analysis

I analyzed the data from each interview using an inductive qualitative approach to "make sense" of how participants used digital tools in the context of each interview question (see Saldana, 2016). First, I examined the data for patterns, then color-coded in three groups; values coding, process coding, and descriptive coding (Miles et al., 2014). The coding process used was described in chapter 3. Below I give an example of the coding used for data analysis for words, phrases, or activities that may show value coding, descriptive coding, or process coding.

"I use digital tools learning platforms that are interactive and students' friendly to enhance their interest, hold their focus and improve their learning. I use digital tools to download apps that enable different learning levels for differentiated learning, suitable for students' modalities such as auditory, reading, writing, and kinesthetic. For example, I use the IWB for lesson presentations and check students' understanding of concepts" (used from participant 8 transcript for interview question #2 data response).

**Coding of Data**

The value coding (green) words/phrases identified with digital tools, learning platforms, apps, the IWB, and iPads for lesson presentation. The descriptive coding (blue) words/phrases identified with students' social and differentiated learning, modalities such as seeing, auditory, reading, writing, and kinesthetic. The process coding (yellow) is identified with phrases to enhance their interest, hold their focus, and improve their learning, understanding of concepts, formulas, and contents (see Miles et al., 2014)

Tables 4 and 5 below show an example of applying the coding types (value, descriptive, and process) used to identify patterns, which were pooled into categories to derive themes. There were nine interview questions for SQ1. Table 4 shows an example of the coding types applied for identifying patterns in the data collected for SQ1 interview question # 1. The data patterns were pooled into categories and assessed for themes (see Appendix D for SQ1 Interview Questions-Coding of Data Patterns/Categories for Themes). There were six interview questions for SQ2. Table 5 shows an example of the coding types applied for identifying patterns in the data collected for SQ2 interview question #1. The data patterns were pooled into categories

and assessed for themes (see Appendix G for SQ2 Interview Questions-Coding of Data Patterns/Categories for Themes).

**Table 4**

*Example of SQ1-IvQ1 for Coded Data Patterns/Categories & Themes*

| Interview Questions for SQ1 | Coding for Data Patterns | Data Patterns/Categories | Derived Themes from each Category |
|---|---|---|---|
| 1. How do you use digital tools to enhance instruction compared to instruction without using digital tools? | Values placed on digital tools use | Digital tools-the IWB, Desktop computers, and iPad, including learning platforms, and apps-now benefits to learners and myself-the Smartboard has built in design features- use GeoGebra software for math-Near- pod capture students' attention to maintain focus throughout the lesson-SIM substitute for hands on learning | Digital tools variety enhances student-centered learning across different subject areas. |
| | Descriptive use of digital tools | Different models or tasks-enhanced instruction-by exposure to learning material-lesson modified to suit my class-brings life to Geometry-colorful picture- use learning models that show real world immersive experiences- engage the students' attention-use the Read 180 program, and myOn | Digital tools enhance instruction and motivate students for learning |
| | Process of using digital tools | Instruction in simplified ways-fulfil learning expectations-download apps and learning platforms- use for interactive teaching and learning to stimulate learner-use Read 180 | Digital tools are used to enhance learning and facilitate remote classes |

*Note.* SQ1: What instructional needs do Grades 3 through 8 technology teachers and coaches fulfill by integrating digital tools into instruction?

**Table 5**

*Example of SQ2-IvQ1 for Coded Data Patterns/Categories & Themes*

| Interview Questions for SQ2 | Coding types for Data Patterns | Data Patterns /Categories | Derived Themes from each Category |
|---|---|---|---|
| 1. How do you incorporate digital tools in teaching models or styles or strategy to facilitate pedagogy and content? | Values placed on digital tools use | Apps and learning platforms-Flipgrid, Nearpod, Pear Deck, GoNoodle, Brain Pop, Jamboard, and Kahoot-digital platform-presents interactive learning devices include IWB or Promethean Board-for PowerPoint presenting roleplay, skits, speech learning, creating posture, broachers, and writing essays | Apps and learning platforms used to enhance pedagogy and content |
| | Descriptive use of digital tools | Digital devices for pictures and text, and create posters-models lesson in Mathematics by step-by-step process- use computer for research projects facilitating students friendly and interactive learning platforms for learning styles | Digital tools enhance a step-by-step learning process in pedagogy and content |
| | Process of using digital tools | Smartboard for pedagogy and content and demonstrate learning-IWB to model mapping diagram use VR set to integrate content and scenarios-use prompts, and clues to present complex contents-students use their iPads to work in their | Training with digital tools helps to enhance pedagogy and content |

*Note.* SQ2: How do Grades 3 through 8 technology teachers and coaches use digital tools to enhance pedagogy and content to create learning experiences?

**SQ1 Themes Analysis**

Appendix D shows Interview Questions for Coding Data Patterns/Categories for Themes. SQ1 shows nine interview questions used for collecting data regarding how participants used digital tools differently for instruction and learning. I grouped the data patterns into categories for the nine participants to determine themes for SQ1 findings (see Appendix E for Derived Themes from SQ1 Interview Questions (IvQ) Data).

***Example of SQ1 Theme Analysis***

The value theme for SQ1 interview question 1 showed that technology teachers enabled student-centered learning using different digital tools. P1 noted using Google Classroom for instruction, and students used iPads and Tablets to participate in class. P4 indicated using GeoGebra (see Appendix F for Educational Technology Products Discussed in Teacher Interviews) software to bring math to life. P5, P7, and P8 used the read 180 apps and 3000 to include desktop computers and iPads for academic intervention. P6 indicated using SIMS as an excellent substitution for hands-on learning. P9 noted using PowerPoint with the Promethean Board to present lessons and engage students using iPads.

The descriptive theme for SQ1 interview question 1 showed that digital tools enhanced instruction and motivated students for learning. Technology teachers used digital tools to make learning fun using manipulatives to engage students. P2 and P7 noted that instructions were given in simplified ways using different models and tasks. P4 reported using colorful pictures in class with digital tools manipulatives. P6 indicated that he used digital tools to maintain students' attention. Some participants pointed out that

some apps for reading and writing and science challenged students to cope. However, P8 noted that students derived learning benefits and were motivated. P9 indicated that digital tools made lessons more creative.

The process theme for SQ1 interview question 1 revealed that technology teachers used digital tools for interactive learning and facilitated remote classes. P3 indicated that lessons were not teacher-centered due to the COVID-19 pandemic and doing online classes. P7, P8, and P9 stated that they shared teaching with students using the IWB and Promethean Board in doing PowerPoint projects. P4 used the IWB to show colorful manipulatives for problem-solving in math. P5 noted that she used interactive learning models for students to immerse themselves in learning games.

Themes for SQ1 indicated that in Grades 3 through 8, technology teachers and coaches used digital tools to fulfill instructional practices in several ways. Student-centered instruction involved using different digital tools to motivate students learning for in-person classes and remote learning. In student-centered learning, apps and digital learning platforms were relied on for helping with students' learning needs to promote better understanding. In student-centered learning, digital tools facilitated students' learning styles, and technology teachers coached students in using digital tools.

Technology teachers trust using digital tools to enhance learning with learning apps and learning platforms to address student learning modalities. Technology teachers relied on digital tools to teach concepts, formulas and problem-solving across subject areas. Digital tools, apps, and learning platforms were compared for applicable learning methods, selecting different strategies used in interactive ways to simplify complex

learning materials. Technology teachers trusted their choice of digital tools and used the internet to explore the usefulness of digital tools for their classes. Technology teachers used the internet to gather information on students' backgrounds, cultures, and learning styles, enabling the planning of relevant and exciting lessons to motivate students learning. Most technology teachers evaluate the reliability of digital tools for instruction based on students' performance using digital tools for classwork and a*ssig*nments.

**SQ2 Themes Analysis**

Appendix G shows Interview Questions for Coding Data Patterns/Categories and Themes. SQ2 shows six interview questions used for collecting data regarding how participants used digital tools for pedagogy and content for teaching and learning. I grouped the data patterns into categories for the nine participants to determine themes for SQ2 findings. (see Appendix H for Derived Themes from SQ2 Interview Questions (IvQ) Data).

***Example of SQ2 Theme Analysis***

The value theme for SQ2 interview question 1 showed that technology teachers used apps and learning platforms to improve pedagogy and content. Technology teachers noted using several apps and learning platforms to improve pedagogy, including Flipgrid, Pear Deck, Jamboard, the IWB, and Promethean Board. Technology teachers enhanced pedagogy and content using PowerPoint for roleplay, skits, speech learning, and creating brochures. P1 noted attending workshops for learning to use apps and learning platforms to facilitate online classes during the COVID-19 pandemic. P2 stated, "When I do a new topic, I introduce digital media for pedagogy and content for interactive learning." P8

said, "After using learning platforms for pedagogy and content, my students use the student-friendly learning platform to interact and share their work."

The descriptive theme for SQ2 interview question 1 indicated that technology teachers used digital tools to incorporate a step-by-step learning process in pedagogy and content. Technology teachers used digital tools for pedagogy and content to facilitate student learning, using a student-centered model with digital tools in a step-by-step process. For example, students were encouraged in math class using digital tools that enabled learning styles to include visual, auditory, and kinesthetic learning on their iPads. P4 and P5 noted that they used the IWB in pedagogy and content to guide students using iPads in a step-by-step learning process to accomplish learning tasks, allowing them to go into break-out rooms for one-on-one attention. P9 noted using the Edmodo and Schoology apps to deliver pedagogy and content addressing students' learning styles.

The process theme for SQ2 interview question 1 revealed that technology teachers' digital tools use training helped facilitate pedagogy and content. Technology teachers indicated having the training to use the IWBs and the Promethean Boards for pedagogy and content. Technology teachers used digital tools to model mapping diagrams for presenting complex contents. Students modeled their technology teachers' lessons presentation on iPads to demonstrate their learning. P6 noted that he attended workshops for instructions using digital platforms such as the Nearpod, Amplify, Google Suite, and Flipgrid to include pedagogy strategies for content delivery. P8 indicated using the IWB in strategic ways to enhance pedagogy and content for students in answering questions through prompts and cues.

Themes for SQ2 indicated that in Grades 3 through 8, technology teachers and coaches used digital tools to enhance pedagogy and content to create learning experiences. Technology teachers used apps and learning platforms in lessons to improve pedagogy and content to incorporate a step-by-step learning process resulting from training for using digital tools to facilitate pedagogy and content. Technology teachers' digital tools choice enhanced pedagogy and content for learning styles in creative ways, incorporated students' participation in planning, and encouraged their active learning. Technology teachers used the internet to download new digital learning materials for pedagogy and content, utilize apps and learning platforms for creativity, and used search engines to simplify complex learning materials.

Technology teachers used digital tools in pedagogy and content facilitating learning modalities to enhance in-person and virtual learning and enable students to focus and learn. Technology teachers used the internet to improve pedagogy and content to understand concepts and formulas and improve learning methods to understand complex content. Technology teachers coached students to use digital tools for pedagogy and content to enhance students' digital tools uses to improve online learning and enable students to do their assignments online

**RQ Themes Analysis**

RQ themes are aligned with SQ1s from the 9 generated IvQs. The results in Table 6 show the mapping grid for SQ1s-IvQs and SQ2-IvQs themes for developing RQ themes. The SQ2-IvQ themes mapping was determined through inductive analysis examining keywords, activities, and phrases that could make sense to see the connection

with SQ1-IvQ themes (see Miles et al., 2014). The inductive analysis process revealed that SQ2-IvQ themes connected to multiple SQ1-IvQs.

After I analyzed and coded the data patterns for interview questions for SQ1 and SQ2, I grouped the data patterns in categories and derived themes for SQ1-IvQs 1, 2, 3, 4, 5, 6, 7, 8, 9, and SQ2-IvQs 1, 2, 3, 4, 5, 6. As noted before, SQ2-IvQs data-derived themes could connect across SQ1-IvQs. Then, I grouped the themes for each SQ1-IvQs with selected SQ2-IvQs. I generated 9 RQ new themes from the combinations of SQ1 themes with SQ2 themes (see Appendix J for RQ Themes Derived from SQ1 & SQ2 Themes). The RQ generated themes were discussed and compared with literature themes were examined and compared with literature themes (see Appendix M for RQ Themes & Literature Themes for Interpretation of Findings).

**Table 6**

*Mapping Grid showing SQ1 & SQ2 Themes # for Generating 9 RQ Themes*

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| SQ1: IvQ 1 | SQ1: IvQ 2 | SQ1: IvQ 3 | SQ1: IvQ 4 | SQ1: IvQ 5 | SQ1: IvQ 6 | SQ1: IvQ 7 | SQ1: IvQ 8 | SQ1: IvQ 9 |
| SQ2: 1vQ1 & IvQ2 | SQ2: 1vQ3 & IvQ4 | SQ2: 1vQ2 & IvQ5 | SQ2: 1vQ3 & IvQ5 | SQ2: 1vQ3 & IvQ4 | SQ2: 1vQ2 & IvQ3 | SQ2: 1vQ2 & IvQ4 | SQ2: 1vQ4 & IvQ6 | SQ2: 1vQ1 & IvQ3 |

*Note.* RQ: What are the different ways Grades 3 through 8 technology teachers and coaches integrate digital tools into instruction?

Table 7 below is an example of linking themes from SQ1 and SQ2. I used codes (value, descriptive, and process) to identify data patterns, which I pooled into categories to derive SQ1 and SQ2 themes. I combined three themes, one theme from SQ1 and two from SQ2, and through the inductive analysis and using abbreviation codes, I determined new RQ themes (See Appendix I for Abbreviation Codes).

**Table 7**

*Themes identified for SQ1 & SQ2 from pooled data categories using codes*

| SQ & Related IvQ | Value Themes | Descriptive Themes | Process Themes | RQ Themes |
|---|---|---|---|---|
| SQ1-IvQ1 | Digital tools variety enhances student-centered learning across different subject areas | Digital tools enhance instruction and motivate students for learning | Digital tools are used for interactive learning and facilitate remote classes | 1. Enhancing pedagogy and content with digital tools |
| SQ2-IvQ1 | Apps and learning platforms used to enhance pedagogy and content | Digital tools enhance a step-by-step learning process in pedagogy and content | Training with digital tools helps to enhance pedagogy and content | |
| SQ2-IvQ2 | Digital tools choice enhance pedagogy and content for learning styles | Digital tools used to enhance pedagogy and content for students' participation | Students participation in pedagogy and content planning enhance active learning | |

*Note.* Key: SQ-Sub question, IvQ-Interview Question.

Below is an example of the first derived RQ theme (Enhancing pedagogy and content with digital tool) through deductive analysis of SQ1 and SQ2 themes (See Appendix K for RQ Themes Derived from SQ1 & SQ2 Themes). Appendix L shows the Analysis of RQ Themes 1-9. The results section provides understanding of RQ themes.

**Example of RQ Theme Analysis**

Digital tools may enhance pedagogy and content to enable student-centered learning and styles. P8 said," I used the problem-based learning platform for pedagogy and content to facilitate for student-centered learning to solve problems through knowledge acquisition and enhanced group collaboration for content-based learning." Digital tools motivated students to learn using pedagogy in a step-by-step learning process in creative ways for students' participation. P7 noted, "I used digital tools for a step-by-step process to motivate students for learning concepts with games; students were immersed virtually in games as characters for problem-solving and doing research." Digital tools were used in pedagogy and content for interactive learning and also enabled remote classes. Technology teachers indicated having trained to use digital tools to enhance pedagogy and content and encourage active learning. P6 said, "In our professional development training, we incorporated digital platforms with someone having adept knowledge to guide us, and we thoroughly explored the tools to ensure that they were useable."

***Discrepant Case***

One participant's answers showed a discrepancy from the other eight participants. P3 indicated that he did not practice student-centered instruction; he did not teach

students to use digital tools and did not evaluate the quality of digital tools they used. These issues of concern seemed ideal for technology teachers' practices as indicated by eight participants and caused me to look deeper for any explanation by P3. I reviewed the P3 voice recording and transcript. The discrepancy showed that due to the COVID-19 pandemic, P3 was now teaching his classes remotely, P3 was teaching online, using Google Classroom, and his answers reflected the condition of teaching at the time. P3 did not believe that online was ideal for practicing student-centered instruction and could not assess students' quality of digital tools online and at home. P3 noted that students used their iPhones at home as the school did not provide each student with a digital device for online learning during the COVID-19 pandemic. P3 also suggested a digital divide existed among students not having digital tools from school for online education (Correia, 2020). Each student was not using the same kind of digital tools for online education. P3 believed that students were using digital tools, which may empower them to learn, and indicated that he could not do a quality check of students' digital devices.

However, P3 said he trusted using digital tools for pedagogy and content and believed digital tools could improve the educational process. I noted the discrepancies in data analysis due to the COVID-19 pandemic and the new responsibilities of technology teachers doing online education caused by the COVID-19 pandemic. The digital divide indicated by P3 may challenge in-person instruction, enabling student-centered instruction and evaluating how students use their digital tools. P3 noted that the various digital tools used by students created a challenge for direct interaction offering hands-on help in using digital tools.

## Evidence of Trustworthiness

For this qualitative research, the evidence of trustworthiness is significant for social change and knowledge regarding digital tools used in education. Furthermore, the methodology employed in data collection from participants, instruments used, the analysis may ensure the productivity and applicability of the results (Patton, 2015). Consequently, I provide insights into this research study's credibility, transferability, dependability, and confirmability.

### Credibility

To ensure the credibility of this research study, I created three research questions, a primary (RQ) and two subquestions (SQ1 & SQ2). I chose to use the data collected for the two sub-questions to answer the primary research question. I created nine interview questions for SQ1 and six questions for SQ2 and asked for examples of digital tools. The questions were semi-formal and open-ended. Then, I asked experts in the field to review each interview question and suggest improving how I asked these questions clearly and understandably for participants' objective responses. After receiving feedback from the experts, I revised the research questions. I asked my dissertation committee members to check these questions to ensure that the interview questions would answer the subquestions. My dissertation committee reviewed the research and interview questions and gave their approval.

### Transferability

I ensured that the study participants included Grade 3 through 8 technology teachers and a coach. I confirmed the inclusion criteria consistency and context of

selecting participants. I maintained consistency in asking interview questions and documented what was said. Candidates gave a broad spectrum of their experience, but I examined for relevance to the particular interview question asked. The data indicated a deep reflection of the candidates' practices, knowledge, and expertise using digital tools (Saldana, 2016). The data analysis showed detailed and rich use of digital tools, sufficiently and in the context of qualitative research methods to lay the foundations for research in prevailing digital tools environments and similar situations, for researchers to compare these findings with other settings (Shenton, 2004). I provided a detailed description of the data collected from purposively selected participants. Researchers may see that the questions could provide a breakthrough for future studies of relevant applications in similar educational settings (Anney, 2015).

**Dependability**

In conducting this research study, I followed the procedures indicated in the methodology to ensure consistency with selecting the population using the inclusion criteria. I always asked the same numbered interview questions regarding digital tools used in instruction for pedagogy and content. I allowed candidates to give their knowledge in the context of their use of digital devices using the semi-formal interview with open-ended questions. Invariably, I used the same questions with different candidates to collect data in all nine interviews, ensuring objectivity and control (Patton, 2015). There was no interference in the recording playback to suggest outside influence. The methodology for data collection and analysis is consistent with the problem and purpose of this research study (Patton, 2015). Future researchers can use this study as a

platform for in-person or online research for data collection as the procedures hold reliability for auditing and critique (Anney, 2015; Shenton, 2004).

**Confirmability**

In this research study, I ensured that the data collected is independent of my views and digital tools knowledge. I kept a journal that guided an authentic approach and managed this qualitative approach (Thomas & Magilvy, 2011). I used my journal to take notes regarding my feelings and insights. I reflected on my journal notes after an interview and during data analysis to avoid biases. During an interview, I asked only questions on the interview protocol and allowed participants to answer and give examples for clarification. I recorded the interview verbatim in my telephone interviews and compared notes with the audio recording to create an authentic transcript. I ensured transcripts data analysis and interpretation accuracy by providing methodological data processing using codes and inductive reasoning for findings and not fabrications of activities to suit my imagination but derived from the data (Bowen, 2009). I ensured that I did not include my background, perceptions, and interests in my transcript credibility and clarity. I focused on the purpose of doing this study, assessing my integrity and actions, making sure that the interview context with participants and the words or phrases were not my own but reflexive of the participants (Johnson & Rasulova, 2017).

## Results

Table 8 below shows the matrix for the new RQ themes. I combined SQ1 themes and SQ2 themes and used inductive analysis and abbreviated codes to generate the new

RQ themes (see Appendix I for Abbreviation Codes). Appendix J shows the new RQ themes developed from SQ1 and SQ2 themes.

**Table 8**

*Themes Matrix for IvQs - Data for SQ1 & SQ2 - Derive New RQ Themes 1-9*

| Interview questions data pattern/categories analysis for SQ1 and SQ2 themes | Inductive processing of SQ1 and SQ2 themes for derived RQ themes |
|---|---|
| SQ1: IvQ 1<br>SQ2: 1vQ1 & IvQ2 | 1. Enhancing pedagogy and content with digital tools. |
| SQ1: IvQ 2<br>SQ2: 1vQ3 & IvQ4 | 2. Selecting digital tools trusted for quality in teaching. |
| SQ1: IvQ 3<br>SQ2: 1vQ2 & IvQ5 | 3. Relying on digital tools for problem-solving. |
| SQ1: IvQ 4<br>SQ2: 1vQ3 & IvQ5 | 4. Internet availability for learning platforms and apps. |
| SQ1: IvQ 5<br>SQ2: 1vQ3 & IvQ4 | 5. Enhancing learning with learning-platforms and apps. |
| SQ1: IvQ 6<br>SQ2: 1vQ2 & IvQ3 | 6. Digital tools and the internet enhance learning styles. |
| SQ1: IvQ 7<br>SQ2: 1vQ2 & IvQ4 | 7. Digital tools facilitate students-centered learning. |
| SQ1: IvQ 8<br>SQ2: 1vQ4 & IvQ6 | 8. Digital tools facilitate students' learning backgrounds. |
| SQ1: IvQ 9<br>SQ2: 1vQ1 & IvQ3 | 9. Students' performance used in digital tools' quality. |

*Note.* Key: SQ – Sub-Question; RQ – Research Question; IvQs – Interview Questions.

**Theme 1: Enhancing Pedagogy and Content With Digital Tools**

Technology teachers depended on the internet to search for interactive learning platforms and apps to enhance pedagogy and content. Participants discussed using the IWB, internet learning platforms, and Google Docs to connect to the Newsela Online

Education Platform to locate appropriate grade-level content. Some technology teachers explained how the internet coupled with the Promethean Board enabled them to download educational infographics about the content taught. Interview discussions emphasized the importance of selecting interactive apps and learning platforms like Flipgrid, Pear Deck, and Padlet used with internet resources and presented face to face and remotely to students. P2 remarked how internet searches helped her "become familiar with the digital tools such as apps that students can use to do their lessons in online learning programs." P2 emphasized that the selection of tools was compatible with students' learning levels. The availability of digital tools learning platforms on the internet supported technology teachers to enhance their lessons. P6 said, "Digital tools capture the students' attention and supplement virtual hands-on learning that students may not be able to access due to remote learning."

Due to the COVID 19 pandemic, Technology teachers had to make a sudden shift to remote teaching. Technology teachers used the internet to facilitate searches about students learning styles to enable planning for online learning, encouraging students learning modalities in meaningful ways, in step-by-step procedures that allowed continuous learning in online class during the COVID-19 pandemic. Remote teaching requires technology teachers to spend more time searching for suitable digital tools on the internet, new and safe learning materials to use with students. For instance, some technology teachers searched the internet for simulations and learning activities to replace hands-on activities. Lesson searches on the internet located models and sample instructional materials from Google Docs and Slides, Yahoo, Teacher Tube, and Firefox

to discover learning materials. P9 highly recommended Google, Lycos, Yahoo, and Teacher Tube search engines for finding pertinent, accurate, and safe information for new lessons. P8 expressed her use of the internet to find appropriate teaching models and strategies that included pedagogical methods and skills development to suit students' learning styles.

**Theme 2: Selecting Digital Tools Trusted for Quality in Teaching**

Technology teachers selected digital tools trusted for quality in teaching required researching for creditable learning apps and platforms. My discussions with technology teachers showed they demonstrated lessons and guided students in rich learning activities. P4 revealed that before using digital tools, all learning materials related to personal knowledge and preference. However, learning about digital tools allowed download apps and learning platforms to apply pedagogical strategies and modify lessons to enhance learning. Technology teachers reported they trusted using digital tools in various ways to help students to understand concepts, formulas, and problem-solving in simplified step-by-step procedures. P9 indicated using the Promethean Board to engage students in interactive lessons, asking questions, and using prompts to keep students attentive and do word searches using apps for vocabulary development. Students were encouraged to demonstrate their understanding in online classes with technology teachers regarding the use of apps and learning platforms, including the Jamboard, Pear Deck, Flipgrid, and Kahoot for step-by-step learning. P1 indicated using Google Classroom to maximize class participation, remarking, "I prepare my lessons using Microsoft PowerPoint presentation, then I share my screen so that my students can view the learning task.

Some technology teachers noted they used the IWB and the Promethean Board in in-person classes. P5 indicated using digital tools in in-person classes makes lessons exciting and motivates students' participation, stating, "I present my lesson on the IWB using instructional strategies for students' participation to show and tell their work." Using Microsoft PowerPoint in lessons enabled students' participation in both in-person classes and online classes. P1 noted using Microsoft PowerPoint encouraged students to do their assignments on slides for colorful presentations. Technology teachers indicated facing challenges in keeping with the trend in learning technology. P8 noted, "The challenge I face is keeping abreast with technology to ensure that I use new technology to help my students at the appropriate levels for their learning styles." P8 revealed doing continuous research and coaching students in their learning groups to cope with new learning technology. Technology teachers indicated that their continued use of digital learning platforms and apps helped students improve vocabulary and enriched learning activities.

**Theme 3: Relying on Digital Tools for Problem-Solving**

Technology teachers relied on digital tools for resources and strategies to enable problem-solving, simplifying concepts, content and using formulas. In discussions with technology teachers, most reported using the IWBs and Promethean Boards connected to the internet, enabling online software, apps, and learning platforms in classes. P4 noted using the IWB for presentation strategies to guide students according to their styles and learning level. P9 remarked that the Promethean Board is designed with digital aids to search vocabulary using the online dictionary to find word synonyms. Students were

encouraged by their technology teachers to explore apps on iPads to find new ways to accomplish their learning tasks. P3 noted that digital tools' qualities facilitated teaching and learning and relied on digital tools for their design for quality in instruction.

Technology teachers revealed their experience using the IWBs, and Promethean Boards design allowed digital teaching aids, vocabulary searches, and online dictionaries. P4 espoused, "I use the IWB to model lessons for my class, and students to participate using the IWB digital resources in showing what they learn using formulas with templates to find solutions to math problems." In discussions, technology teachers reported using the math software to deliver strategies and solutions to math problems, illustrated with 3D objects and video games. Technology teachers believed that digital tools enhanced their understanding of different kinds of apps and learning platforms. P7 indicated using apps and learning platforms such as Jamboard, Kahoot, and Pear Deck to explore new ways to develop lesson plans involving digital problem-solving tools. In discussions, technology teachers said they used digital tools across subject areas enabling teaching and learning in easy and understandable ways. For example, P1 noted that using the digital tools draw feature to write on slides allowed the presentation of lessons in step-by-step procedures to solve complex problems using colorful aids. Students in online classes used the digital tools drawing features to showcase their work on Google Drive. P7 noted using interactive digital tools to promote students' participation and learning in a step-by-step process simplifying concepts. Students used games that allowed immersing themselves as characters responding to prompts for correct choices in finding solutions to complex problems.

**Theme 4: Internet Availability for Learning Platforms and Apps**

Technology teachers relied on the internet to search for interactive learning platforms and apps to simplify complex content and discover new pedagogical strategies and content material. In discussions, technology teachers indicated making digital tools choices to streamline complex content in lessons moving from elaborate problems to simplified solutions. P7 revealed, "I use apps and learning platforms such as Nearpod, Flipgrid, and Padlet to do annotation of complex content with word games and online dictionaries." Technology teachers revealed that teaching aids with digital tools are visually displayed to make the lesson understandable and more effective in a straightforward form. P9 noted that using voice-over apps for audio-supported learning of complex text or content allowed students to use iPads to do vocabulary searches given cues that asked for synonyms of words, write in text form, and do paraphrasing for easy understanding. P6 noted voice-over apps helped to explain complex formulas or difficult content so students could learn new material or solutions to problems.

Technology teachers assigned students to work in groups, analyze complex tasks, and assemble their presentations using visual-aids, clip art, graphic organizers, and web links with PowerPoint slides on shared screens. P4 indicated using the IWB, integrating learning platforms and apps to model lessons to simplify complex tasks with word games and animations. P4 gave an example of using the NAMOO apps in science class using colorful visuals about a plant's growth and another lesson for teaching climate change. P8 explained a similar use of online resources, noted, "I research concepts using the internet to find learning material for the lesson and use 3D objects to attract students interests in

animated games." P2 indicated using digital tools for problem-solving and discovering formulas displayed in interactive math games to motivate students and hold their attention.

**Theme 5: Enhancing Learning With Learning-Platforms and Apps**

Technology teachers maximized instruction and learning to improve pedagogy and content with apps and learning platforms. Some technology teachers indicated they used PowerPoint in Google Classroom to share screens for online classes, which helped students learn at their own pace and experience virtual real-life situations for accomplishing learning tasks. P1 indicated since COVID-19, her teaching assignment rapidly turned to online classes and indicated, "In Google Classroom, I do small group instruction in break-out rooms for differentiated learning using PowerPoint and Google Docs on a shared screen." According to most technology teachers, students used laptops and iPad for online curricula activities facilitating their learning styles for seeing, auditory, and kinesthetic, enabling differentiated activities in a step-by-step process. P8 indicated the IWB connected to the internet, which helped PowerPoint slides with instructions for complex learning content. P8 explained further that the slides allowed for interactive learning with texts, pictures, and videos. Students were encouraged to contribute to the lesson by sharing their knowledge, adding texts and new images and videos in context. P2 also shared her teaching task, noting, "I used Google Classroom for my lesson created on slides. I download educational information from YouTube videos sharing with the class, asking questions, and giving feedback immediately."

On the other hand, P3 noted that before COVID-19, he used digital tools for differentiated learning. P3 indicated he used digital tools in in-person classes in two contexts; digital tool availability and how students could use desktops, laptops, and iPads. In discussions, technology teachers indicated that students used friendly and interactive apps and learning platforms to simplify complex material facilitating their learning styles. Some technology teachers used the Flipgrid apps to clarify math formulas and use animated procedures to solve problems. P5 indicated engaging students in discussion while supervising their learning on the computer regarding the step-by-step guidelines for writing texts, downloading images, and adding videos for making presentations.

**Theme 6: Digital Tools and the Internet Enhance Learning Styles**

Technology teachers revealed they used different browsers to find relevant learning tools for lessons, which enabled them to work in interactive settings with students facilitating learning styles. P5 shared coaching students to use the browsers on their computers to access apps to help them select information for doing their assignments and homework. P5 explained that students were encouraged to use hashtags to share information on projects from a carousel of clustered activities developed to facilitate students' learning styles. P8 noted sometimes search engines are not reliable, causing interrupting during vital class time.

Internet disconnecting when using apps was also a concern for P3, noting that interruptions break students' focus and sometimes lead to class behavioral issues. Despite experiencing app interruptions, technology teachers make up for lost time and use digital tools for fun learning activities to get students back on track and maintain their learning

interest and focus. P7 indicated using interactive digital games helped students to become engaged at a quicker pace than non-interactive games. According to P7, "I encourage students to use the Kahoot apps for learning games with interactive vocabulary and student-friendly learning platform help them to analyze and simplify learning content." P7 shared using search engines such as Google, Yahoo, and Teacher Tube to discover new trends in technology, encouraging students' engagement in their lessons with the Socrative apps, which allowed them to converse with each other to create content and do assignments. P9 shared students used Pear Deck to enhance understanding of the content that shows multiple-choice questions giving cues for students to make correct choices. The apps make chiming sounds to indicate the right answers to questions. P4 noted encouraging her class to use the Google search engines in research by giving descriptive words in search bars to discover content and pictures applicable to the context of the lesson for doing assignments.

**Theme 7: Digital Tools Facilitate Students-Centered Learning**

Some technology teachers indicated that they coached their students to use digital tools to become independent learners to download apps and learning platforms to enhance their learning. P8 said she supervised her students developing technology skills on the desktop computer in the technology lab to improve academic performance. P8 noted that student-centered learning allowed students to collaborate and take control of their education, engage in learning challenges, broaden their knowledge by exploring learning situations that would otherwise be impossible due to the geographical location and nature of the subject. Technology teachers indicated that students engaged in student-

centered learning used digital tools independently to research and download new content. P2 shared that students are coached at the start of the school year to incorporate digital tools in their learning, knowing about apps and digital platforms and how to use them. P5 indicated coaching students to use digital tools to access websites, apps, and YouTube for educational purposes for leveled content materials to facilitate independent learning preferences.

My discussion with technology teachers disclosed supervising student-centered learning, aligned with curricula activities that motivated them, and enhanced group work. P6 shared that the platforms used in student-centered learning included Nearpod, Pear Deck, and Google Suit. According to P6, "The learning platforms were interactive, allowing students to voice-over complex content, which verbalized the understanding of content for auditory learners." Some technology teachers presented visual elements for students who have preferences for visual learning by graphics and iMovie and kinesthetic activities for motor skill development. Technology teachers indicated that students were participating in student-centered learning and needed to be comfortable using various tools, which was impossible to coach those using different digital tools online. P3 stated that he could not supervise students in student-centered learning as his technology classes were online, and students were using their digital devices. P7 noted that students who selected digital tools based on their comfort level were coached in in-person learning to use digital tools to benefit activity-centered discussions. Those students on online learning were helped by teachers through live chat in virtual breakout classrooms to use digital tools in interactive ways or step-by-step instructions.

**Theme 8: Digital Tools Facilitate Students' Learning Backgrounds**

Technology teachers researched students' environments to plan lessons using digital tools. My discussions with technology teachers revealed that the internet allowed them to learn about students' cultural backgrounds. They said the internet allowed them to download learning material familiar to students' lifestyles to use in instructions in meaningful ways that incorporated their interests and participation. P5 revealed that using the computer and Google browser searches on students' cultural background, community services, and family practices helped in their lesson planning knowing about community affairs. Technology teachers also interacted with students to learn their backgrounds and learning styles and plan lessons to captivate their interests. P8 revealed interacting with students to learn about their environment, culture, and attractions, and discovered more information using the internet to become aware of their community and activities. P8 said, "I try to plan lessons using digital tools to motivate students and hold their interest with content that may reflect their lifestyles." Technology teachers believed that apps and learning platforms were significant for accessing materials that students have shared knowledge about, thus motivating and holding their interest and building their experiences.

Technology teachers noted the relevance of the graphic organizers and mapping diagrams being essential to encourage students' participation in class and build lessons around their backgrounds and experiences. P2 said, "I learn about students' background and about what they know and involve them in lesson planning using graphic organizers. I do not plan complex lessons to confuse students but use digital tools to simplify

learning." The internet was an essential digital tool revealed by technology teachers to learn about students' culture and interests for lesson planning. P7 indicated using the Google search engine to find information about students' cultural background at the beginning of the school year revealed their lifestyles, experiences, and prior knowledge, enabling better lesson planning to facilitate their interest, using the graphic organizer. They assessed students' experiences and learning styles and integrated content relevant to how students learn. Search engines enabled technology teachers to understand the diverse culture of students in their community and have a mental picture of life and learning for digital tools planning.

**Theme 9: Students' Performance Used in Assessing Digital Tools' Quality**

Technology teachers evaluated digital tools' quality based on students' competency in using digital tools, apps, and learning platforms. In discussions with technology teachers, they noted that knowing the quality of digital tools could help them enhance instruction and learning and expand and improve pedagogy and content. P8 indicated using formative assessment of students' performance in research and problem-solving in math to determine the quality of the apps or learning platforms choice. These tools facilitated new and safe learning materials in instruction to check and manage students' performance. Technology teachers indicated that they assessed students' user ability of digital tools to do research, projects, and presentations and understand concepts, formulas, and problem-solving for lessons across the curriculum to determine the quality of digital tools. P7 indicated doing the informal and formal evaluation of students' work using digital tools. P7 said, "I assess students' difficulty level or understanding of the

devices and know if my digital tools selection for the lesson was helpful." P7 noted assessing students' performance with interactive digital tools quality and learning styles. If students showed a low performance, then the suitability of the digital tools is checked regarding students' learning styles, which means revisiting the selection of more suitable digital tools for learning techniques. Technology teachers indicated that they used digital tools to prepare, deliver, and mobilize students to use similar tools to make their learning fun, share with their learning groups, and use learning platforms in simplified ways. P4 remarked that she used learning platforms such as Kahoot or Pear deck for teaching games for students to complete a task. P4 indicated using the GeoGebra software in math to learn how to construct line objects and use students' performance to know the quality of digital tools.

In discussion with technology teachers, they noted digital tools' quality and safe use was optimum to access websites, download content material, and create a presentation using PowerPoint, Publishers Program, and Google Slides or Microsoft Words program. P2 noted that moving to a new topic, she introduced the digital platform to the class systematically to ensure that students understand how to use the tools in a meaningful and progressive way. Technology teachers assisted students in in-person learning by establishing facilitators' roles as technology specialists and subject teachers using digital tools and search engines for content and group learning presentations. P9 noted that she coached students to use apps and learning platforms to understand new concepts and formulas in Math class, such as operations using the PEMDAS rule. Students' performances are checked for steps and procedures to determine instructional

quality in digital tools use. At the same time, some technology teachers do not do formative assessments to test students' user ability of digital tools to facilitate continuous learning for homework assignments. P1 and P3 noted that they only use digital tools in online classes if students can access them and feel comfortable using them.

Grades 3 through 8 technology teachers and coaches commented on their experiences and shared knowledge regarding using digital tools used for instruction. Technology teachers indicated that they relied on the internet to enhance students learning with digital tools using a step-by-step process. They noted the IWBs and the Promethean Boards were the primary digital tools for whole-class instruction in academic subjects in the lab. On the other hand, students having access to using desktop computers, laptops, and iPads were motivated and more focused in class. Technology teachers noted that during the recent COVID-19 pandemic, they assumed new roles in online teaching. In some schools, online teaching mixed with in-person instruction drew on technology teachers' creativity to expand their role as technology-lab teacher-facilitators, online subject teachers, and technical support. The choice of apps and learning platforms was relevant to students' learning styles such as visual, auditory, and kinesthetic and students' learning levels. Technology teachers indicated that they planned pedagogy and content by selecting apps and learning platforms to simplify concepts, complex content, formulas, and problem-solving. Students using different digital tools downloaded suitable apps and learning platforms, which enable them to use laptops, desktops, iPads, and electronic calculators in class.

## Summary

I had discussions with participants, guided by the interview protocol. Participants revealed how they used digital tools in instructions. In lesson planning, technology teachers plan their lessons to use digital tools to involve students and give them better learning opportunities with hands-on use of these devices. Some participants explained how they used digital tools for in-person classes and were teacher-facilitators. Technology teachers used the IWB and Promethean Board to model their lessons and encouraged students to show and tell their learning. Apps and learning platforms were relied upon by technology teachers to enhance their lessons and subsequently used in online learning. Students' learning styles were essential and significant to address by technology teachers for improved teaching and learning.

On the other hand, as the COVID-19 pandemic disrupted in-person classes, technology teachers quickly began using remote instruction for online learning, focusing on facilitating students' learning styles and levels. For enhancing knowledge with shared screen for PowerPoint presentations and Google Slides, technology teachers indicated that they adjusted their teaching styles and methods during COVID-19 to use Zoom and Google Classrooms. Some technology teachers coached students to use digital tools and empowered them to facilitate their learning styles.

During our discussions, participants revealed how they incorporated digital tools into instructions for enhancing pedagogy and content. Technology teachers noted that digital devices, apps, and learning platforms combined pedagogy and content to improve students' learning and hold their interest and class participation. The selection of apps and

learning platforms was critical to technology teachers enabling them to use creative methods with digital tools for pedagogy and content. They indicated that in choosing these tools, first, they had to have a comfort level using the digital tools, and then they introduced them to the students. To be prepared and equipped to enhance students' learning capabilities, teachers revealed that they tried to be knowledgeable about using a broad spectrum of digital devices and practiced using them to facilitate student learning modalities. Some technology teachers indicated that they planned instructional strategies using the available digital tools in the lab for students' differential learning needs. On the other hand, to keep abreast of teaching styles, issues, and trends in educational technology, some technology teachers indicated they consulted with other technology teachers in their school district. They shared current trends in new digital tools applications, instructional methods, and learning platforms for simplifying instructions in pedagogy and content.

RQ themes were derived from deductive analysis of SQ1 and SQ2 themes for how technology teachers used digital tools in instructions. Technology teachers indicated that they incorporated apps, learning platforms and digital hardware, and software in instructional planning for creative strategies in pedagogy and content. They noted that digital tools were both for utility purposes and students' involvement in using these tools for learning. They used digital devices to model lessons and involved students using digital tools to accomplish assignments and become fluent using these tools. Lesson planning to address students' learning styles and levels was essential to technology teachers. They sought to address through their training in technology workshops to use

suitable apps and learning platforms. They selected apps and learning platforms to facilitate students' different learning styles such as visual, auditory, and kinesthetic. They indicated that their training was necessary, which enabled them to coach their students to use these tools in enhancing learning. According to technology teachers, students' competence in using digital tools allowed for remote learning during the COVID-19 pandemic, accomplishing assignments through networking, synchronous and asynchronous learning, and blogs. To keep abreast of educational technology tool trends, technology teachers indicated that they relied on using the internet and browsers to include Google, Teacher Tube, YouTube, Yahoo, Lycos, and Firefox web search engines and web portals.

Chapter 4 leads into Chapter 5, which restates the purpose of this research study, and key findings. There is an interpretation of the findings and the extent of the knowledge revealed. RQ themes are linked with the literature themes in Chapter 5 to interpret findings (See Appendix L for Model-RQ Themes & Literature Themes-Proposed for Discussion). The results are analyzed further in the context of the conceptual framework. The limitations and strengths stated, and recommendations made. I discussed the implications for positive social change. Finally, a strong take-home message culminates this research study.

# Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this basic qualitative research study was to investigate Grades 3 through 8 technology teachers and coaches' methods of selecting and integrating digital tools into instruction to enhance pedagogy and content. The findings of this study could benefit classroom teachers, administrators, and stakeholders in the education system. The key results showed that participants relied on the internet for digital tools to plan instruction using apps, learning platforms, software, and computer hardware.

## Interpretation of Findings

The interpretation of findings revealed how participants used digital tools in instruction to enhance pedagogy and content. Participants felt that information regarding how students learn could enhance student-centered learning and facilitate their learning styles for knowledge building. Participants indicated that they trusted digital tools' quality and used sub-sections of the TPACK model for pedagogy and content.

### Enhancing Pedagogy and Content With Digital Tools

My study findings extended Monem et al.'s (2018) and Flewitt et al.'s (2015) study findings. Participants indicated they showed students to use iPads to enhance learning. Aflalo et al.'s (2018) study revealed that teachers used the IWB for science lessons without students for active participation. On the contrary, my study findings indicated that participants used the IWB to introduce students to active involvement. Participants in my study disclosed using digital tools and the TPACK lens for pedagogy and content (Koehler et al., 2017). Participants used the graphic organizer to model PK that enhanced CK with 3D objects.

**Digital Tools Facilitate Student-Centered Learning**

De Vita and Verschaffel (2018) study revealed that teachers used the IWB in active learning. Similarly, my study findings showed that participants used the IWB to engage students' participation. Palladino and Guardado's (2018) study revealed that teachers used digital devices in creative learning. My study's findings confirmed Palladio's and Guardado's findings as participants indicated using the IWB for student-centered learning. Segal's and Heath's (2020) study revealed that teachers applied the TPACK lens in instruction. Like Segal's and Heath's study findings, participants in my study used PK and TK to enhance learning styles.

**Digital Tools and the Internet Enhance Learning Styles**

Karim et al. (2019) study revealed that some teachers relied on the internet to find programs to improve students' learning styles. My study extended Karim et al.'s (2019) study findings, showing that participants depended on the internet and created lessons for classwork and blog forums that enhanced learning styles. My study findings also extended Kaur et al.'s (2017) study findings, revealing that participants helped students with iPads to use the internet to find learning programs that enable their learning styles for better performance. In my study, participants indicated downloading students learning games such as Kahoot. My study extended Tan et al.'s (2018) study findings revealing that the internet allowed teachers to integrate digital tools to improve instruction and motivate students learning. Similar to Tan et al.'s (2018) study findings, participants in my study used the internet to enhance students' learning styles.

**Digital Tools Facilitate Students' Learning Backgrounds**

Konokman and Yelken's (2016) study revealed that some teachers did not use students' background information for digital tools lesson planning. Dooley et al.'s (2016) study revealed that some teachers were unaware of using students' background experiences in lesson planning. Unlike Konokman and Yelken's (2016) study findings and Dooley et al.'s (2016) study findings, participants in my study indicated using students' background experiences in developing learning plans, which could encourage students to take charge of their learning. Durdu and Dag (2017) suggested that the TPACK subsections allowed teachers a lens to understand using digital tools in participatory learning. In comparison, participants in my study indicated using digital tools to fulfill pedagogy and content strategies.

**Selecting Digital Tools Trusted for Quality in Teaching**

Oman and Hasheim (2015) examined teachers' using laptops to teach film-making and found that teachers focused more on the software and less on the skills to accomplish the learning task. My study findings did not support Oman and Hasheim's findings, as participants indicated that they first coached students to use digital tools, then do learning tasks. Chin et al. (2019) disclosed that the blended curriculum could sustain educational development using social media. My study aligns with Chin et al.'s (2019) study, as most participants indicated using trusted software, apps, and learning platforms.

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participants indicated that they first coached students to use digital tools, then do learning tasks. Chin et al. (2019) disclosed that the blended curriculum could sustain educational development using social media. My study aligns with Chin et al.'s (2019) study, as most participants indicated using trusted software, apps, and learning platforms. Kalonde (2017) noted that teachers could use the TPACK lens to identify pedagogical strategies that enabled students to learn better. Similarly, participants in my study used digital tools to access pedagogical approaches for content and find articles on the internet for assignments.

**Students' Performance Used in Assessing Digital Tools' Quality**

My study could not support the findings of Sousa et al. (2017), which indicated that teachers could not assess the quality of digital devices they used for instruction. Participants in my study stated that they evaluated the quality of digital tools by students' comfort level and performance. My study findings were also contrary to Al-Abdullatif and Alsaeed's (2019) study, which revealed that most teachers could not evaluate digital tools' quality for instruction. Alqurashi et al.'s (2017) examined the relevance of the TPACK lens and found that applying PCK and TCK in instruction enabled teachers to connect pedagogy and content with digital tools. Participants in my study indicated downloading apps and learning platforms to satisfy students' learning styles, similar to Alqurashi et al. (2017).

**Internet Availability for Learning-Platforms and Apps**

Peterson et al. (2020) explored remote instruction during the COVID-19 pandemic and indicated that technology coaches helped classroom teachers to use the

internet for emergency remote teaching (ERT). My study's finding extends the findings of Peterson et al. (2020), as participants indicated using digital tools for remote classes. Aflalo et al.'s (2018) study revealed teachers using different digital devices in remote teaching. My study extended Aflalo et al.'s (2018) findings as participants indicated using apps and learning platforms to simplify complex content in remote classes. Segal and Heath (2020) suggested that the TPACK framework could provide teachers with a lens to resolve complex challenges for pedagogy and content. My study participants indicated using apps and learning platforms to enhance PK and CK skills in remote instructions.

**Enhancing Learning With Learning-Platforms and Apps**

Kaur et al.'s (2017) study revealed that teachers used iPads to help students with learning disabilities. My study's findings aligned with Kaur et al. (2017) since participants indicated using iPads' digital features for improving visual and auditory learning styles. Von-Wangenheim et al. (2017) revealed that teachers taught students hands-on skills with the computer in multidisciplinary classes. My study extended Von-Wangenheim et al.'s (2017) findings as participants indicated that they coached students to use computers. Alqurashi et al. (2017) used the TPACK framework lens to assess how teachers' digital tools use for PK and CK. Similar to Alqurashi et al.'s (2017), participants in my study used various digital tools suited for pedagogical and content.

**Relying on Digital Tools for Problem-Solving**

De Vita et al. (2018) examined teachers using digital tools in instructional planning for the interpretative modes of language learning. De Vita et al.'s (2018) study findings revealed teachers used the IWB for viewing and reading, similar to my study

findings that participants used the IWB to show solving complex problems. Chu et al.'s (2015) study findings revealed that the visual display on the computer desktop showed the processing of ideas in problem-solving. My study findings expanded Chu et al.'s (2015) study findings to show that students learn visually by observing colorful displays on the computer screen. Bingimlas (2018) indicated that TK, CK, and PK could enable teachers to understand better how to use digital tools to simplify complex learning materials. Similarly, participants used TK, CK, and PK in step-by-step animated learning procedures.

## Limitations of the Study

I identified limitations that could cause concerns about the trustworthiness of the findings. These included a change in the study methodology, participants and researcher availability, and participants' experience using digital tools in schools at different levels. Due to the COVID-19 pandemic, I changed the planned methods for data collection. The data collection method changed from in-person interviews to telephone interviews. Not having the in-person one-on-one interview may have compromised the trustworthiness of participants' answers. Data collection may be more than spoken words and includes careful observation of participants' gestures and facial expressions (Janesick, 2014). Another data collection method proposed was field observation that was not possible. Therefore, I did not have a second data source to cross-check or triangulate data to check the answers' validity.

The second limitation relates to the recruitment of volunteers, which could affect transferability due to the number of participants in the study. I used the social-media

forum for recruiting volunteers. Some volunteers who indicated their willingness to participate were unable to be reached due to their job responsibilities and time zone differences. Other volunteers could not dedicate themselves to a 45 minutes interview due to their overwhelming job workload nearing the end of a school year in May. After posting my recruitment invitation one month, I reached the proposed number of participants (nine) who were found suitable (see Appendix A for Detached Inclusion Criteria). I withdrew my invitation flyer from social media, did not exceed my data collection time plan, and focused on compiling my data.

The third limitation also relates to transferability. There may not be many technology teachers. Therefore, I recruited volunteers from a broad cross-section of Grades 3 through 8 technology teachers and coaches. The disadvantage is that I had participants who may not share a common experience using digital tools. I experienced a challenge in identifying data patterns to find similar activities. However, I made sense of the data (Miles et al., 2014) for practice and did an intense look into deductive data analysis.

## Recommendations

My study could be used as a platform to conduct similar studies and use alternate data collection methods. Multiple data sources may enable data collection, analysis, and cross-checking using triangulation for improving data reliability. Janesick (2015) noted that data collection by observation allows the researcher to see critical details that could compare and clarify data from other sources.

Collecting data is time-consuming and requires the researcher and the participant to come together at the best time. Most technology teacher-participants experienced additional workload stress at the start of the school year, the testing period, and the end of the school year, which may not be suitable for collecting data. A reasonable time takes into account the time of the school year and the interviewer facilitating that time. Recruiting more than the minimum number of participants could contribute to getting more data for identifying patterns. Miles et al. (2014) indicated that data quality could improve when there are more participants.

Findings for this study revealed meaningful use of digital tools. Several factors identified could be explored further to contribute more to digital tools integration. Further research could contribute to understanding using digital tools for pedagogy and content improvement, empowering students learning through student-centered instruction, blended learning through synchronous and asynchronous methods, and learning networks for student and teachers' collaboration. Therefore, I recommend further research with a broader population to expand knowledge on digital tools for academic and social learning.

## Implications

The positive social change from the results of this study may contribute to the educational field for social and academic development (Office of Educational Technology, 2017). For educational benefits to be derived, the understanding of digital tools remains a priority for all who must learn to integrate digital tools into instruction (Kurt et al., 2019). The TPACK learning model of pedagogy, content, and technology

noted as meaningful practice in teaching needs to be explored more for 21st-century education (Koehler et al., 2017). Educators should expand their understanding of integrating digital tools (Segal and Heath, 2020).

The results of this research study could benefit the field of education technology for positive social change. The beneficiaries could be participants who first shared their knowledge to propose a breakthrough in using digital tools for instruction and how these tools apply to enhancing pedagogy and content. Administrators may benefit from knowing the significant impact of digital tools across the curriculum, providing technology infrastructure at their schools, and the availability of digital tools and training for staff. Classroom teachers may benefit immensely, knowing best practices in using digital tools and how these tools apply in learning models, students learning backgrounds, students learning styles, and the fun that learners can have while promoting learning. Learners could benefit from the choice of digital tools that can empower educational practices (Office of Educational Technology, 2017).

Universities may integrate digital tools training for all teachers and coaches using the TPACK model. Digital tools integration into the curriculum might enable all teachers to understand the TPACK model and the lens better. The TPACK lens may allow using digital tools practically for TK to enhance PK and CK for enhancing instruction. Technology teachers could become more involved mentors for classroom teachers, showing them how to integrate digital tools for TCK and TPK in simplified ways for improving the learning of complex materials. Technology teachers' sharing their knowledge regarding digital tools uses may open a path for all educators to use digital

tools in meaningful ways to address technology skills and academic improvement to benefit learners and add to positive social development.

Technology teachers could take proactive action to share their digital tools experience and knowledge. School workshops are valuable meeting times that technology teachers could contribute to interactive sessions on essential digital tools practices that address learning styles and challenges. Technology teachers may help train classroom teachers on selecting digital tools to suit students' learning styles and include students' background information for more effective learning experiences in lesson planning. A better understanding of digital tools shared by technology teachers with classroom teachers might enhance instruction and active learning in class.

## Conclusion

Technology teachers' use of digital tools in instruction revealed knowledge that could help all educators enhance pedagogy and content. Technology teachers in Grades 3 through 8 indicated that digital tools were meaningful choices for improving learning in practical ways. Digital tools such as apps, learning platforms, online programs, and software could enhance pedagogy and content. Technology teachers indicated that creative use of digital hardware in the technology lab and blended learning could support worthwhile learning models such as problem-based learning, inquiry-based learning, and cooperative learning.

Technology teachers have valuable knowledge that they can share with classroom teachers to assist them in designing and implementing quality instruction. Technology teachers used the TPACK lens to design and implement quality instruction using digital

tools. Technology teachers used the TPACK subsections for PK and CK in digital tools choice to combine TPK and TCK to simplify complex learning materials that benefitted students learning styles and levels. The significant areas in instructional planning identified by technology teachers could impact positive learning and social change for classroom teachers and students. The favorable impact of digital tools is that principals, school leaders, and stakeholders can invest in digital technology policies, infrastructure, curriculum, and professional development training for educators, improving 21st-century education.

## References

Aflalo, E., Zana, L., & Huri, T. (2018). The interactive whiteboard in primary school science and interaction. *Interactive Learning Environments, 26*(4), 525-538. https://doi.org/10.1080/10494820.2017.1367695

Al-Abdullatif, A. M., Alsaeed, M. S., & Wang, S. (2019). Evaluating visible learning: Mathematics teachers' practices in technology-enhanced classrooms. Cogent Education, *6*(1), 1-12. https://doi.org/10.1080/2331186X.2019.1686798

Alavi, S. M., Borzabadi, D., & Dashtestani, R. (2016). Computer literacy in learning academic English. Iranian EAP students' and instructors' attitudes and perspectives. *Teaching English with Technology, 16*(4), 56-77.

Albion, P. R., Tondeur, J., Forkosh-Baruch, A., & Peeraer, J. (2015). Teachers' professional development for ICT integration. Towards a reciprocal relationship between research and practice, *20*(4), 655-673. https://doi.org/10.1007/s10639-015-9401-9

Alhassan, R. (2017). Exploring the relationship between Web 2.0 tools self-efficacy and teachers' use of these tools in their teaching. *Journal of Education and Learning, 6*(4), 217-228. http://doi.org/10.5539/jel.v6n4p217

Allen, L. (2018). Computer science education: Online content modules and professional development for secondary teachers in west Tennessee-a case study. *Journal of Educational Technology, 15*(2), 8-15.

Alqurashi, E., Gokbel, E. N., & Carbonara, D. (2017). Teachers' knowledge in content, pedagogy and technology integration. A comparative analysis between teachers in

Saudi Arabia and United States. *British Journal of Educational Technology, 48*(6), 1414-1426. https://doi.org/10.1111/bjet.12514

Altawil, A. (2016). Exploring how digital media technology can foster Saudi EFL students' English language learning (Paper presentation, Dec. 2016). *In the proceedings of the International Conferences on Internet Technologies & Society (ITS)* (pp. 329-332). Education Technologies (ICEduTECH), and Sustainability, Technology and Education (STE).

Anney, V. (2015). Ensuring the quality of the findings of qualitative research. Looking at trustworthiness criteria. *Journal of Emerging Trends in Educational Research and Policy Studies*, *5*(2), 227-281.

Ardıç, M. A., & İşleyen, T. (2018). The Effect of mathematics instruction through computer algebra systems on the academic achievements of secondary education students-Turkey Example. *Journal of Education and e*-learning, *5*(3), 165-173. https://doi.org/10.20448/journal.509.2018.53.165.173

Bakhshaei, M., Hardy, A., Ravitz, J., & Seylar, J. (2020). Instructional coaching holds promise as a method to improve instruction with technology (Paper presentation, April 2020). *In the proceedings of the Society for Information Technology & Teacher Education International Conference* (pp.1600-1609). Association for the Advancement of Computing in Education (AACE).

Bingimlas, K. (2018). Investigating the level of teachers' knowledge in technology, pedagogy, and content (TPACK) in Saudi Arabia. *South African Journal of Education*, *38*(3), 1-12. https://doi.org/10.15700/saje.v38n3a1496

Bodsworth, H., & Goodyear, V. A. (2017). Barriers and facilitators to using digital technologies in the cooperative learning model in physical education. Physical education and sport pedagogy, *22*(6), 563-579. https://doi.org/10.1080/17408989.2017.1294672

Bolstad, R. (2017). *Lecture notes in digital technologies for learning: (pp. 1-63). Findings from the NZCER national survey of primary and intermediate schools.* New Zealand Council for Educational Research.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27-40. https://doi.org/10.3316/QRJ0902027

Cabus, S. J., Haelermans, C., & Franken, S. (2017). SMART in Mathematics? Exploring the effects of in-class-level differentiation using SMARTboard on math proficiency. *British Journal of Educational Technology (BJET), 48*(1), 145-161. https://doi.org/10.1111/bjet.12350

Chigona, A. (2017). Western Cape subject advisors' perception of their preparedness for connected classrooms. *Electronic Journal of E-Learning, 15*(5), 444-454.

Chin, C. K., Munip, H., Miyandera, R., Thoe, N. K., Ching, Y. S., & Promising, N. (2019). Promoting education for sustainable development in teacher education integrating blended learning and digital tools. An evaluation with exemplary cases. *Eurasia Journal of Mathematics, Science & Technology Education, 15*(1), 1-17. https://doi.org/10.29333/ejmste/99513

Chu, P. Y., Hung, H. Y., Wu, C. F., & Liu, Y. T. (2015). Effects of various sketching tools on visual thinking in idea development. *International Journal of Technology*

*and Design Education, 27*(2), 291-306. https://doi.org/10.1007/s10798-015-9349-5

Correia, A. P. (2020). Healing the digital divide during the COVID-19 pandemic. *Quarterly Review of Distance Education, 21*(1), 13-21.

Craciun, D. (2019). Training future language teachers to educate the digital generation. *Journal of Educational Sciences, 20*(39), 90-107.

Cuhadar, C. (2014). Information technologies preservice teachers' acceptance of tablet PCs as an innovative learning tool. *Educational Sciences Theory and Practice, 14*(2), 741-753.

Curry, L. A., Nembhard, I. M., & Bradley, E. H. (2009). Key issues in outcome research. Qualitative and mixed methods provide unique contributions to outcomes. *Resources and Education, 119*(10), 1442-1452. https://doi.org/10.1161/circulationaha.107.742775

Dalal, M., Archambault, L., & Shelton, C. (2017). Professional development for international teachers. Examining TPACK and technology integration decision making. *Journal of Research on Technology in Education, 49*(3-4), 117-133. https://doi.org/10.1080/15391523.2017.1314780

Davies R.S., West R.E. (2014). Technology Integration in Schools. In Spector J., Merrill M., Elen J., Bishop M. (Eds.), *Handbook of Research on Educational Communications and Technology*. Springer, New York, NY. https://doi.org/10.1007/978-1-4614-3185-5_68

Demirbas, D., & Timur-Ogut, S. (2020). Re-designing the design brief as a digital

learning tool with participatory design approach. *Turkish Online Journal of Distance Education, 21*(7), 83-100. https://.doi.org/10.17718/tojde.690356

de Silva, C. R., Chigona, A., & Adendorff, S. A. (2016). Technology integration exploring interactive whiteboards as dialogic spaces in the foundation phase classroom. *The Turkish Online Journal of Educational Technology, 5*(3), 141-150.

De Vita, M., Verschaffel, L., & Elen, J. (2018). The power of interactive whiteboards for secondary mathematics teaching. *Two case studies-SAGE journal. 47*(1), 50-78. https://doi.org/10.1177/0047239518767112

Di Bella, K. S., & Williams, K. G. (2015). Beneficial Web 2.0 tools to engage learners and maximize learning. *Journal of Learning in Higher Education. 11*(2), 75-81.

Dong, Y., Chai, C. S., Guo-Yuan, S., Joyce-Hwee, L. K., & Chin-Chung, T. (2015). Exploring the profiles and interplays of preservice and inservice teachers' technological pedagogical content knowledge (TPACK) in china. *Journal of Educational Technology & Society, 18*(1), 158-169.

Dooley, C. M., Ellison, T. L., Welch, M. M., Allen, M., & Bauer, D. (2016). Digital participatory pedagogy. Digital participation as a method for technology integration in curriculum. *Journal of Digital Learning in Teacher Education, 32*(2), 52-62. https://doi.org/10.1080/21532974.2016.1138912

Doukakis, S., & Papalaskari, M. (2019). Scaffolding technological pedagogical content knowledge (TPACK) in computer science education through learning activity creation (Paper presentation, Sept. 2019). *In the proceedings of Computer*

*engineering-Computer Networks and Social Media Conference-SEEDA-CECNSM* (pp. 1-5). https://doi.org/10.1109/SEEDA-CECNSM.2019.8908467

Durdu, L., & Dag, F. (2017). Preservice teachers' TPACK development and conceptions through a TPACK-based course. *Australian Journal of Teacher Education, 42*(11), 150–171. https://doi.org/10.14221/ajte.2017v42n11.10

EL-Daou, B. M. N. (2016). The effect of using in computer skills on teachers' perceived self-efficacy beliefs towards technology integration, attitudes and performance. *World Journal on Educational Technology, 8*(3), 294-306.

Engeness, I., & Edwards, A. (2016). The complexity of learning. Exploring the interplay of different mediational means in group learning with digital tools. *Scandinavian Journal of Educational Research, 61*(6), 650–667. https://doi.org/10.1080/00313831.2016.1173093

Felder, R. M., & Solomon, B. A. (1997). Index of learning styles-felder-soloman model questionnaire. *The peak performance center.* Research Gate (pp. 1-4).

Feride, K. R. C. (2015). An investigation of preservice teachers' technological pedagogical content knowledge based on a variety of characteristics. *International Journal of Higher Education, 4*(4), 128–136. https://doi.org/10.5430/ijhe.v4n4p128

Flewitt, R., Messer, D., & Kucirkova, N. (2015). New directions for early literacy in a digital age. *Journal of Early Childhood Literacy, 15*(3), 289–310. https://doi.org/10.1177/1468798414533560

Gates, B., & Gates, M. (2015). Teachers know best: *What educators want from digital instructional tools 2.0.* Bill and Melinda Gates Foundations (pp. 1-32).

Geiger, V., Goos, M., & Dole, S. (2015). The role of digital technologies in numeracy teaching and learning. *International Journal of Science and Mathematics Education, 13*(5), 1115-1137 https://doi.org/10.1007/s10763-014-9530-4

Ghavifekr, S., Kunjappan, T., Ramasamy, L., & Annreetha, A. (2016).Teaching and learning with ICT tools. Issues and challenges from teachers' perceptions. *Malaysian Online Journal of Educational Technology, 4*(2), 38-57.

Ghavifekr, S., & Rosdy, W. A. (2015). Teaching and learning with technology-effectiveness of ICT integration in schools. *International Journal of Research in Education and Science, 1*(2), 175-191.

Giannikas, C. N. (2016). The use of interactive whiteboards: enhancing the nature of teaching young language learners. In S. Papadima-Sophocleous, L. Bradley & S. Thouësny (Eds.), *CALL communities and culture-short papers from EUROCALL 2016.* Research-publishing.net (pp.160-166). https://doi.org/10.14705/rpnet.2016.eurocall2016.555

Goodwin, A. L., Ling, L. E., Tee, N. P., Yeung, A. S., & Li, C. (2015). Enhancing playful teachers' perception of the importance of ICT use in the classroom. The role of risk taking as a mediator. *Australian Journal of Teacher Education, 40*(4), 132-150. https://doi.org/10.14221/ajte.2015v40n4.8

Güneş, E., & Bahçivan, E. (2016). A multiple case study of preservice science teachers'

TPACK. Embedded in a comprehensive belief system. *International Journal of Environmental & Science Education, 11*(15), 8040-8054.

Harris, J. (2016). Planning for deep learning using TPACK-based learning activity types. In M. Searson & M. Ochoa (Eds.), (Paper presentation, March 2016). *In the proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 2864-2871). Association of Advancement in Computing Education (AACE).

Hillmayr, D., Ziernwald, L., Reinhold, F., Hofer, S. I., & Reiss, K. M. (2020). The potential of digital tools to enhance mathematics and science learning in secondary schools. A context-specific meta-analysis. *Computers & Education*, *153*, 1-25. https://doi.org/10.1016/j.compedu.2020.103897

Hoffmann, M. M., & Ramirez, A. Y. (2018). Students' attitudes toward teacher use of technology in classrooms. *21st Century Learning & Multicultural Education, 25*(2), 51-56.

Holtz, S. (2018). 12 rules of effective instructional technology coaching: Instructional Technology Coaching (ITC) (Blog). *Education and e-learning.* BLOG from NEO LMS.

Hsu, P. (2016). Examining current beliefs, practices and barriers about technology integration: A case study. *Tech-trends-Linking Research and Practice to Improve Learning*, *60*(1), 30-40. https://doi.org/10.1007/s11528-015-0014-3

Hutchison, A., & Colwell, J. (2015). Developing digital reading and writing practices in grades K-6. *Bridging technology and literacy*. Rowman & Littlefield Publishers,

Inc.

Janesick, V. J. (2015). *Stretching exercises for qualitative researchers* (4th ed.). SAGE Publication Inc.

Jiang, Y., Nilsen, K., & Whitaker, W. (2017). The impact of contextual factors on technology integration in STEM (Paper presentation, June 2017). *In the proceedings of the International Society for Technology in Education-ISTE Conference* (pp. 1-15). University of San Diego.

Jimenez, J. D., & Moorhead, L. (2017). Recasting the history textbook as an e-book. The collaborative creation of student-authored interactive texts. *Journal of History Teacher, 50*(4), 565-595.

Johnson, S., & Rasulova, S. (2017). Qualitative research and the evaluation of development impact-incorporating authenticity into the assessment of rigour. *Journal of Development Effectiveness*, *9*(2), 263-276. https://doi.org/10.1080/19439342.2017.1306577

Jones, S. J. (2017). Technology in the Montessori classroom: Teachers' beliefs and technology use. *Journal of Montessori Research*, *3*(1), 16-29. https://doi.org/10.17161/jomr.v3i1.6458

Joo, Y. J., Park, S., & Lim, E. (2018). Factors influencing preservice teachers' intention to use technology: TPACK, Teacher self-efficacy, and technology acceptance model. *Journal of Educational Technology & Society, 21*(3), 48-59.

Kahlke, R. M. (2014). Generic qualitative approaches: Pitfalls and benefit of methodological mixology. *International Journal of Qualitative Methods, 13*(51),

37-52. https://doi.org/10.1177/160940691401300119

Kale, U. (2018). Technology valued? Observation and review activities to enhance future teachers' utility value toward technology integration. *Computers & Education, 117*, 160-174. https://doi.org/10.1016/j.compedu.2017.10.007

Kalonde, G. (2017). Technology use in rural schools. A study of a rural high school trying to use iPads in the Classroom. *Rural Educator*, *38*(3), 27-38.

Karim, A., Shahed, F. H., Rahman, M. M., & Mohamed, A. R. (2019). Revisiting innovations in ELT through online classes. An evaluation of the approaches of 10 minute school. *Turkish Online Journal of Distance Education, 20*(1), 248-266. https://doi.org/10.17718/tojde.522729

Karlsudd, P. (2018). Cheating or legitimate support? Student-teachers' attitudes toward digital tools in school. *Journal for Support for Learning, 33*(4), 338-359. https://doi.org/10.1111/1467-9604.12224

Kaur, D., Koval, A., & Chaney, H. (2017). Potential of using IPads as a supplement to teach math to students with learning disabilities. *International Journal of Research in Education and Science*, *3*(1), 114-121.

Khan, S. N. (2014). Qualitative research method-phenomenology. *Asian Social Science Canadian Center of Science and Education, 10*(21), 1911-2025. https://doi.org/10.5539/ass.v10n21p298

Kılıçkaya, Ferit. (2019). Materials design in CALL: a case study of two teachers of English as creators of digital materials. In Giannikas, Christina Nicole; Kakoulli Constantinou, Elis; Papadima-Sophocleous, Salomi (Eds.), *Lecture notes in*

*professional development in CALL: Chapter 9. A selection of papers* (pp. 131-144). Research-publishing.net. https://doi.org/10.14705/rpnet.2019.28.875

Kirikcilar, R. G., & Yildiz, A. (2018). Technological content knowledge (TPACK) craft: Utilization of the TPACK when designing the GeoGebra activities. *Acta Didactica Napocensia, 11*(1), 101-116. https://doi.org/10.24193/adn.11.1.8.

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60-70.

Koehler, M. J., Mishra, P., & Cain, W. (2017). What is technological pedagogical content Knowledge (TPACK)? *Educational Psychology and Educational Technology, 193*(3), 13-19. https://doi.org/10.1177/002205741319300303

Koh, J. H. L., Chai, C. S., Benjamin, W., & Hong, H. Y. (2015). Technological Pedagogical Content Knowledge (TPACK) and design thinking-a framework to support ICT lesson design for 21st century learning. *The Asia-Pacific Education Researcher, 24*(3), 535-543. https://doi.org/10.1007/s40299-015-0237-2

Konokman, G. Y., & Yelken, T. Y. (2016). Preparing digital stories through the inquiry-based learning approach: Its effect on prospective teachers' resistive behaviors toward research and technology-based instruction. *Educational Sciences-Theory & Practice, 16*(6), 2141-2165. https://doi.org/10.12738/estp.2016.6.0410

Kurt, A. A., Sarsar, F., Filiz, O., Telli, E., Orhan-Göksün, D., & Bardakci, S. (2019). Teachers' Use of Web 2.0: Education Bag Project Experiences. *Malaysian Online Journal of Educational Technology, 7*(4), 110-125.

http://doi.org/10.17220/mojet.2019.04.008

Lee, C., & Kim, C. (2014). An implementation study of a TPACK-based instructional design model in a technology integration course. *Education Tech Research Development, 62*(4), 437-460. https://doi.org/10.1007/s11423-014-9335-8

Lehiste, P. (2015). The impact of a professional development program on inservice teachers' TPACK -study from Estonia. *Journsl of Problems of Education in the 21st Century, 66*(1), 18-28. http://doi.org/10.33225/pec/15.66.18

Lembke, E. S., Allen, A., Cohen, D., Hubbuch, C., Landon, D., Bess, J., & Bruns, H. (2017). Progress monitoring in social studies using vocabulary matching curriculum-based measurement. *Learning Disabilities Research & Practice, 32*(2), 112-120. https://doi.org/10.1111/ldrp.12130

Lin, C. Y., Kuo, Y. C., & Ko, Y. Y. (2015). A study of preservice teachers' perception of technological pedagogical content knowledge on algebra. *Journal of Computers in Mathematics and Science Teaching*, *34*(3), 327-344.

Livingstone, K. (2015). The impact of Web 2.0 in education and its potential for language learning and teaching. *International Journal of Instructional Technology and Distance Learning, 12*(4), 1-18.

Lu, Y. H., Ottenbreit-Leftwich, A. T., Ding, A. C., & Glazewski, K. (2017). Experienced iPad-using early childhood teachers-practices in the one-to-one iPad classroom, computers in the schools, *34*(1-2), 9-23. https://doi.org/10.1080/07380569.2017.1287543

Maddamsetti, J. (2018). Perceptions of preservice teachers on mentor teachers' roles in promoting inclusive practicum: case studies in U.S. elementary school contexts. *Journal of Education for Teaching: International Research and Pedagogy, 44*(2), 232-236. https://doi.org/10.1080/02607476.2017.1422608

Marsh, H. W. (1992). The self-description questionnaire (SDQ) I. A theoretical and empirical basis for the measurement of multiple dimensions of preadolescent self-concept. *A test manual and research monograph. Macarthur*: University of Western Sydney-Scientific Research Academic Publisher.

Maxwell, J. A. (2013). *Qualitative research design: An interactive approach*, (Vol. 41. 2nd ed.). Thousand Oaks: SAGE Publication Inc.

Mayes, C. R., Natividad, G., & Spector, J. M. (2015). Challenges for educational technologists in the 21st century. *Journal of Education Science, 5*(3), 221–237. https://doi.org/10.3390/educsci5030221

McCrory, R. (2006). Technology and teaching-a new kind of knowledge. In E. A. Ashburn & R. E. Floden. *Meaningful learning using technology-what educators need to know and do* (pp. 141–160). Teachers College Press.

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative data analysis-a methods sourcebook* (3rd ed.). SAGE Publication Inc.

Millen, R. A., & Gable, R. (2016). Closing the gap between technological and best practice innovations. TPACK and DI. K-12 education. *Center for Research and Education, 33*, 1-39.

Mishra, P. (2014). Punya Mishra's Web-TPACK Newsletter #21. *Living at the junction of*

*education, creativity, design & technology*.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge. A framework for teacher knowledge-cognition and instruction. *Journal of Computing in Teacher Education and the Journal of Educational Computing Research 108*(6), 1017-1054.

Monem, R., Bennett, K. D., & Barbetta, P. M. (2018). The effects of low-tech and high-tech active student responding strategies during history instruction for students with SLD-learning disabilities. *A Contemporary Journal, 16*(1), 87-106.

Montebello, M. (2017). Digital pedagogies for teachers' CPD. International association for development of the information society (Paper presentation, Dec. 2017). *In the proceedings of the International Association for Development of the Information Society (IADIS)* (pp. 161-1657). International Conference on Educational Technologies.

Motshegwe, M. M., & Batane, T. (2015). Factors influencing instructors' attitudes toward technology integration. *Journal of Educational Technology Development and Exchange*, *8*(1), 1-15. https://doi.org/10.18785/jetde.0801.01

Munguia, C. (2017). Principals supporting teachers in providing language instruction to English learners in elementary school. *International Journal of Teacher Leadership, 8*(1), 92-108.

Mustafina, A. (2016). Teachers attitudes towards technology integration in a Kazakhstani secondary school. *International Journal of Research and Education and Science. 2*(2), 322-332.

O'Connor, A., Seery, N., & Canty, D. (2018). The experiential domain: Developing a model for enhancing practice in D&T education. *International Journal of Technology and Design Education, 28*(1), 85-99. https://doi.org/10.1007/s10798-016-9378-8

Office of Educational Technology. (2017). Learning-engaging and empowering learning through technology. *Reimagining the role of technology in education, 2017. National Education Technology Plan Update*. January 2017, US Department of Education (pp. 9-25).

Öman, A., & Hashemi, S. (2015). Design and redesign of a multimodal classroom task – Implications for teaching and learning. *Journal of Information Technology Education: Research, 14*, 139-159.

Palladino, V., & Guardado, M. (2018). Extending the heritage language classroom: experiences of digital technology use in two community schools in Alberta, Canada. *Language, Culture and Curriculum*, *31*(2), 150-167. https://doi.org/10.1080/07908318.2017.1415923

Pamuk, S., Mustafa, E., Cakir, R., Yilmaz, H. B., & Ayas, C. (2015). Exploring relationships among TPACK components and development of the TPACK instrument. *Education and Information Technologies, 20*(2), 241-263. https://doi.org/10.1007/s10639-013-9278-4

Pattillath, H. P., Velagapudi, V., & Menon, S. (2018). Teachers' practices in technology integrated classrooms in the Indian context (Paper presentation, Dec. 2018). *In the proceedings for the 2018 IEEE Tenth International Conferences on Technology*

*for Education (T4E), 1*(162-165). https//doi.org/10.1109/T4E.2018.00043

Patton, M. Q. (2015). *Qualitative research & evaluation methods integrating theory and practice* (4th ed.). Thousand Oaks: SAGE Publication Inc.

Percy, W. H., Kostere, K., & Kostere, S. (2015). Generic qualitative research in psychology. *The qualitative report*, *20*(2), 76-85. https://doi.org/10.46743/2160-3715/2015.2097

Peterson, L., Scharber, C., Thuesen, A., & Baskin, K. (2020). A rapid response to COVID-19. One district's pivot from technology integration to distance learning. *Information and Learning Science, 121*(5/6), 461-469. https://doi.org/10.1108/ILS-04-2020-0131

Pombo, L., Carlos, V., & Loureiro, M. J. (2017). Edulabs AGIRE project-evaluation of ICT integration in teaching strategies. *Educational Media International, 54*(3), 215-230. http://doi.org/10.1080/09523987.2017.1384158

Rabah, J. (2015). Benefits and challenges of information and communication technology (ICT) integration in Quebec English schools. *The Turkish Online Journal of Educational Technology-TOJET, 14*(2), 24-31.

Raji, M., & Zualkernan, I. (2016). A decision tool for selecting a sustainable learning technology intervention. *Educational Technology & Society, 19* (3), 306-320.

Roland, J. (October 7, 2015). Empowering teachers to implement technology-driven educational programs (ISTE blog). *International Society of Technology in Education.*

Sadaf, A., Newby, T. J., & Ertmer, P. A. (2015). An investigation of the factors that

influence pre-service teachers' intentions and integration of Web 2.0 tools. *Educational Technology Research and Development, 64*(1), 37-64. https://doi.org/10.1007/s11423-015-9410-9

Sailin, S. N., & Mahmor, N. A. (2018). Improving student teachers' digital pedagogy through meaningful learning activities. *Malaysian Journal of Learning and Instruction, 15*(2), 143-173.

Saldana, J. (2016). *The coding manual for qualitative researchers* (3rd ed.). Thousand Oaks: SAGE Publication Inc.

Scherer, R., Tondeur, J., & Siddiq, F. (2017). On the quest for validity. Testing the factor structure and measurement invariance of the technology-dimensions in the technological, pedagogical, and content knowledge (TPACK) model. *Computers & Education, 112,* 1-17.

Segal, P., & Heath, M. (2020). The "wicked problem" of technology and teacher education: Examining teacher educator technology competencies in a field-based literacy methods course. *Journal of Digital Learning in Teacher Education*, *36*(3), 185-200. https://doi.org/10.1080/21532974.2020.1753600

Sensoy, O., & Yildirim, H. I. (2018). Impact of technological pedagogical content knowledge based education applications on prospective teachers' self-efficacy belief levels toward science education. *Journal of Education and Training Studies, 6*(10), 29-38. https://doi.org/10.11114/jets.v6i10.3433

Sheffield, R., Dobozy, E., Gibson, D., Mullaney, J., & Campbell, C. (2015). Teacher education students using TPACK in science-a case study. *Educational Media*

*International, Advance online publication, 53*(3), 227-238. https://doi.org/10.1080/09523987.2015.1075104.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information, 22*(2), 63-75. https://doi.org/10.3233/EFI-2004-22201

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching: Educational researcher. *American Educational Research Association, 15*(2), 4-14 https://doi.org/10.2307/1175860

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, *57(*1), 1-21.

Sousa, M. J., Cruz, R., & Martins, J. M. (2017). Digital learning methodologies and tools-a literature review (Paper presentation, July 2017). *In the proceedings of the Annual International Conference on Education and New Learning Technologies* (pp. 5185-5192). Journal of Education and Learning (EDULEARN 2017).

Spooner, F., Kemp-Inman, A., Ahlgrim-Delzell, L., Wood, L., & Ley-Davis, L. (2015). Generalization of literacy skills through portable technology for students with severe disabilities. *Research and practice for persons with severe disabilities.* SAGE Publication Inc., *40*(1), 52-70. https://doi.org/10.1177/1540796915586190

Starkey, L. (2020). A review of research exploring teacher preparation for the digital age. *Cambridge Journal of Education, 50*(1), 37-56. https://doi.org/10.1080/0305764X.2019.1625867

Tachie, S. A. (2019). Challenges and opportunities regarding usage of computers in the

teaching and earning of mathematics. *South African Journal of Education, 39*(2), 1-10. https://doi.org/10.15700/saje.v39ns2a1690

Tan, J. P. L. (2009). *Digital kids, analogue students: a mixed methods study of students' engagement with a school-based Web 2.0 learning innovation* (Thesis Ph.D. 2009-ID Code 30396). Doctoral dissertation, Queensland University of Technology, Australia. QUT Thesis ePrints (pp. 165-191).

Tan, P., Wu, H., Li, P., & Xu, H. (2018). Teaching management system with applications of RFID and IoT technology. *Journal of Education Science, 8*(1), 1-13. https://doi.org/10.3390/educsci8010026

Thomas, E., & Magilvy, J. K. (2011). Qualitative rigor or research validity in qualitative research. *Journal for Specialists in Pediatric Nursing*, *16*(2), 151-155. https://doi.org/10.1111/j.1744-6155.2011.00283.x

Tseng, J. J. (2018). Exploring TPACK-SLA Interface: Insights from the Computer-Enhanced Classroom. *Computer Assisted Language Learning, 31*(4), 390-412. http://doi.org/10.1080/09588221.2017.1412324

Tunaboylu, C., & Demir, E. (2017). The effect of teaching supported by interactive whiteboard on students' mathematical achievements in lower secondary education. *Journal of Education and Learning, 6*(1), 5250-5269. https://doi.org/10.5539/jel.v6n1p81

Vatanartiran, S., & Karadeniz, S. (2015). A needs analysis for technology integration plan: Challenges and needs of teachers. *Contemporary Educational Technology, 6*(3), 206-220.

Von-Wangenheim, A., Von-Wangenheim, C. G., Pacheco, F. S., Hauck, J. C. R., & Ferreira, M. N. F. (2017). Motivating teachers to teach computing in middle school: A case study of a physical computing taster workshop for teachers. *International Journal of Computer Science Education in Schools, 1*(4), 1-15. https://doi.org/10.21585/ijcses.v1i4.17

Voogt, J., & McKenny, S. (2017). TPACK in teacher education: are we preparing teachers to use technology for early literacy. *Journal of Technology, Pedagogy and Education Association (TPEA), 26*(1), 69-83. https://doi.org/10.1080/1475939X.2016.1174730

Wall, J. A., & Dunne, T. C. (2012). Mediation research: A current review. *Negotiation Journal, 28*(2), 217-244. http://doi.org/10.1111/j.1571-9979.2012.00336.x

Wijaya, D., & Djasmeini, C. (2017). Input-based processing instruction vs. Output-based traditional instruction in learning plural-s. *Electronic Journal of Foreign Language Teaching, 14*(1), 70-83.

Xiong, X. B., & Lim, C. P. (2015). Curriculum leadership and the development of ICT in education competencies of preservice teachers in South China. *The Asia-Pacific Education Researcher*, *24,* 515-524. https://doi.org/10.1007/s40299-015-0238-1

Xu, A., & Chen, G. (2016). A study on the effects of teachers' information literacy on technology integrated instruction and teaching effectiveness. *Eurasia Journal of Mathematics, Science and Technology Education*, *12*(2), 335-346.

https://doi.org/10.12973/eurasia.2016.1222a

Yagci, T. (2015). Blended learning via mobile social media and implementation of "Edmodo" in reading classes. *Advances in Language and Literary, 6*(4), 41-47. http://doi.org/10.7575/aiac.alls.v.6n.4p.41

Ya-Huei-Lu, A. T., Ottenbreit-Leftwich, A. C. D., & Glazewski, K. (2017). Experienced iPad-using early childhood teachers; Practices in the one-to one iPad classroom. *Computers in the Classroom, 34*(1-2), 9-23. https://doi.org/10.1080/07380569.2017.1287543

Yaki, A. A., & Babagana, M. (2016). Technology instructional package mediated instruction and senior secondary school students' academic performance in biology concepts. *Malaysian Online Journal of Educational Sciences, 4*(2), 42-48.

Yang, H. Y. (2016). The efects of attention cueing on visualizers' multimedia learning. *Journal of Educational Technology & Society,19*(1), 249-262.

Young, J., Hamilton, C., & Cason, M. (2017). Interactive whiteboards in mathematics spaces: An examination of technology integration in an urban middle school. *Contemporary Educational Technology, 8*(4), 303-318.

Zyad, H. (2016). Integrating computers in the classroom: Barriers and teachers' attitudes. *International Journal of Instructions, 9*(1), 65-78.

## Appendix A: Detached Inclusion Criteria

Candidate #: _____
Each candidate asked to answer the questions.

| Evaluating Questions | Responses | |
|---|---|---|
| 1. What teaching title best describes you for using digital tools in instruction? Circle your response. | a. technology teacher<br>b. technology coach<br>c. both technology teacher and coach | |
| 2. Indicate your grade level/s for using digital tools in instruction. Circle the grade level/s. | 1 2 3 4 5 6 7 8 | |
| 3. How many years' experience do you have using digital tools in instruction? | Indicate Number of years | |
| 4. Do you practice student-centered instruction including the use of digital tools? If yes, how many years? | Yes<br>No | Number of years? |
| 5. Do you develop your lesson plans, including the use of digital tools in instruction? If yes, how many years? | Yes<br>No | Number of years? |
| 6. Do you use formative assessment for the quality of use of digital tools? If yes, how many years? | Yes<br>No | Number of years? |
| 7. Do you use of digital tools in the lesson guided by a curriculum? If yes, how many years? | Yes<br>No | Number of years? |

Total of years: _____

Note: Criteria evaluation for selecting candidate

1. Stated number of years for question # 3-7:_____
2. Answered YES for questions # 4-7: _____

Comments:_____
_____

## Appendix B: Research Subquestions Development Table

| **SQ1**<br><br>What instructional needs do Grades 3 through 8 technology teachers and coaches fulfill by integrating digital tools use into instruction? | **Research from the literature review that informed the research sub-questions** | **Keywords, phrase or concepts from research content** |
|---|---|---|
| | Isiksal-Bostan, Sahin, & Ertepinar (2015) – beliefs regarding teaching experience related to attitude for traditional approach and understanding regarding knowledge and relationship to technology-enhanced teaching approach | experience, technology, instruction |
| | Motshegwe (2015) –attitude and belief versus technology usefulness and application impact on attitudes towards the integration of technology | tools usefulness, attitude, |
| | Alhassan (2017) - the impact of training, on attitude and beliefs towards the integration of digital tools | training experience |
| | El-Daou (2016) – the effectiveness of computer technology training impacting s teachers' attitude for the integration of technology | effective training, technology integration, and attitude |
| | Downey & Kher (2015) – the reduction in teachers' anxiety due to training and competence for technology tools affecting teacher's attitude | technology teachers and coaches competency |
| | Monem, Bennett,& Barbetta (2018) – active student response in using digital tools contribute to an effective instructional strategy for challenged learners | students active response, effective instructional strategy |
| | De Sila, Chigona, & Adendroff (2016) – instruction including dialogic engagement of students expanding critical thinking and participation | dialogic inclusion, expanding students involvement |
| | Kale (2018) – the teachers who lacked knowledge of the utility value of digital tools were not able | utility value, digital tools, describe strategies |

| **SQ1** | **Research from the literature review that informed the research sub-questions** | **Keywords, phrase or concepts from research content** |
|---|---|---|
| | to describe integration strategies | |
| | Yang (2016) – content presentation using multimedia for cueing information to reduce mental loading and improve cognitive development | content presentation multimedia use, mental loading and cognitive process |
| | Owens-Hartman (2015) – teachers facilitating students need to use technology that could adapt to students' learning style | technology for facilitating and adapted students learning styles |

| SQ2<br><br>How do Grades 3 through 8 technology teachers and coaches plan their lessons to select and integrate the use of digital tools for pedagogy and content in the subject area? | Research from the literature review with issues of concern that may be relative to my prospective study | Keywords, phrase or concept from research content |
|---|---|---|
| | DiBella & Williams (2015) – collaboration in the use of selected digital tools that encouraged learners to share their learning experiences Collaborative learning, Purposeful selection of digital tools | collaborative learning, purposeful selection of digital tools |
| | Günes & Bahçivan (2017) – teachers' positive perceptions regarding constructivist teaching method and learning contributed to digital tools application | constructivist teaching and learning methods, contributing to digital tools use |
| | Sensory & Yildirim (2018) –attitude and belief in technology, pedagogy and content knowledge for instructional material design | instructional technology for pedagogy, content |
| | Vatanartiran & Karadeniz (2015) – barriers and infrastructural issues, technological and physical challenges inclusive of materials, students readiness and teacher's incompetence | barriers, technology challenges, readiness, teacher's Incompetence |
| | Yagci (2015) - using apps to include Edmodo to promote strategies that improve students reading and comprehension skills | Apps to promote learning strategies, improve reading |

| | | |
|---|---|---|
| SQ2 | Research from the literature review with issues of concern that may be relative to my prospective study | Keywords, phrase or concept from research content |
| | Lu, Ottenbreit-Leftwich, Ding, & Glazewski (2017) – literacy instruction and teachers becoming director of approaches for child-centered digital learning | literacy instruction, director of approaches, child centered learning |
| | Hsu, Tsai, Chang, & Liang, (2017) – teacher's use of game-based technology teaching approach that enabled improved pedagogy and content learning | Technology, improved pedagogy, content |
| | Tunaboylu & Demir (2017) – improved instructional technology using interactive digital tools show a positive impact on students understanding of difficult content | interactive digital tool, improved understanding of difficult content |

## Appendix C: Interview Protocol

Participant # _____

| Column 1 | Column 2 | Column 3 | Column 4 |
|---|---|---|---|
| **Research Subquestion 1** | **Nine Interview questions** | **Interviewees' responses and reflections** | **Identifying patterns in data** |
| **SQ1**<br><br>What instructional needs do Grades 3 through 8 technology teachers and coaches fulfill by integrating digital tools use into instruction? | 1. How do you use digital tools to enhance instruction compared to instruction without using digital tools? | | |
| | Clarification: Can you give an example? | | |
| | 2. How do you use digital tools beyond utility value (typing lessons) to accomplish learning objectives? | | |
| | Clarification: Can you give an example? | | |
| | 3. How do you apply digital tools for teaching concepts, formulas, and problem solving? | | |
| | Clarification: Can you give an example? | | |
| | 4. How do you use digital tools to simplify complex materials for a | | |

| Column 1 | Column 2 | Column 3 | Column 4 |
|---|---|---|---|
| **Research Subquestion 1** | **Nine Interview questions** | **Interviewees' responses and reflections** | **Identifying patterns in data** |
| | deeper understanding? | | |
| | Clarification: Can you give an example? | | |
| | 5. How do you use digital tools to facilitate for differentiated learning to cope with students' learning levels? | | |
| | Clarification: Can you give an example? | | |
| | 6. How do your choices of digital tools (apps/online program) engage student in the lesson? | | |
| | Clarification: Can you give an example? | | |
| | 7. How do you use digital tools to facilitate students' for student-centered learning activities? | | |
| | Clarification: Can you give an example? | | |
| | 8. How do you use digital tools to | | |

| Column 1 | Column 2 | Column 3 | Column 4 |
|---|---|---|---|
| **Research Subquestion 1** | **Nine Interview questions** | **Interviewees' responses and reflections** | **Identifying patterns in data** |
| | include students' background knowledge (metacognition) in lessons? | | |
| | Clarification: Can you give an example? | | |
| | 9. How do you evaluate digital tools use to ensure adequate quality in instruction and learning? | | |
| | Clarification: Can you give an example? | | |

**Research Subquestion 2 and Interview Questions**

| Column 1 | Column 2 | Column 3 | Column 4 |
|---|---|---|---|
| **Research Subquestion 2** | **Six Interview questions** | **Interviewees' responses and reflections** | **Identifying patterns in data** |
| **SQ2**<br><br>How do Grades 3 through 8 technology teachers and coaches plan their lessons to select and integrate the use of digital tools for pedagogy and content in the subject area? | 1. How do you incorporate digital tools in teaching models/styles/strategies to facilitate pedagogy and content? | | |
| | Clarification: Can you give an example? | | |
| | 2. How do you use digital tools to ensure that pedagogy is facilitating for students | | |

| Column 1 | Column 2 | Column 3 | Column 4 |
|---|---|---|---|
| **Research Subquestion 2** | **Six Interview questions** | **Interviewees' responses and reflections** | **Identifying patterns in data** |
| | with different learning styles? | | |
| | Clarification: Can you give an example? | | |
| | 3. How do you use digital tools for pedagogy and content to search or discover, facilitating new learning experiences? | | |
| | Clarification: Can you give an example? | | |
| | 4. How do you use digital tools for pedagogy and content and enable learning modalities (seeing, doing, auditory)? | | |
| | Clarification: Can you give an example? | | |
| | 5. How do you use digital tools to combine pedagogy and content for concepts, skills, and problem-solving learning? | | |
| | Clarification: Can you give an example? | | |
| | 6. How do you use digital tools for pedagogy and content to empower students for extended learning (homework or assignment)? | | |
| | Clarification: Can you give an example? | | |

**Appendix D: SQ1 Interview Questions-Coding Data Patterns/Categories for Themes**

| SQ1: What instructional needs do grades 3 through 8 technology teachers and coaches fulfill by integrating digital tools into instruction? | | | |
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| **Interview Questions for SQ1** | **Coding for Data Patterns** | **Data Patterns/Categories** | **Derived Themes** |
| 1. How do you use digital tools to enhance instruction compared to instruction without using digital tools? | Values placed on digital tools use | Due to COVID-19 pandemic digital tools now make remote teaching possible-training enabled using digital devices in a technology lab-use learning platforms and apps, Promethean Board and PowerPoint lessons-facilitate students using iPads make learning interesting-teacher-centered instruction was before digital tools-the IWB, Desktop computers, and iPad, including learning platforms, and apps-now benefits to learners and myself-the Smartboard has built in design features-use GeoGebra software for math-Near-pod capture students' attention to maintain focus throughout the lesson-SIM substitute for hands on learning | Digital tools variety enhances student-centered learning across different subject areas. . |
| | Descriptive use of digital tools | Students use Google Classroom-digital tools used in simplified ways- make lesson easy to learn-more fun to learn-lessons unlimited-different models or tasks-enhanced instruction-by exposure to learning material- lesson modified to suit my class-brings life to Geometry-colorful picture- use learning models that show real world immersive experiences- engage the students' attention-use the Read 180 program, myOn, and I-Ready reading program-for reading and writing, Math, and Science benefits- students become focused and motivated reading material that suits Lexile levels | Digital tools enhance instruction and motivate students for learning |
| | Process of using digital tools | Give instruction in simplified ways-fulfil learning expectations-download apps and learning platforms- use for interactive teaching and learning to | Digital tools are used to enhance learning and |

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| | | stimulate learner-use Read 180 app and achieve 3000 for academic intervention and levelled differentiation-use IWB in remote learning to engage students in audio-visual instruction-Use PowerPoint, selecting slides, creating Texts, and downloading graphics. For ELA-Students use iPads to work cooperatively in a student-centered way at their own pace and with interactive learning platforms | facilitate remote classes |
| 2. How do you use digital tools beyond utility value (typing lessons) to accomplish learning objectives? | Values placed on digital tools use | Microsoft PowerPoint-teach ELA using interactive programs-learning platforms and websites-and resource-IWB or promethean board to model lessons-students use the IWB to show and tell their knowledge,-students use iPads-digital platforms for doing investigations-students coached using the Jamboard, Pear Deck Nearpod, PopArt, Flipgrid, and Kahoot-desktop computers enable students to use apps that are user friendly and interactive | Digital tools trusted to enhance instruction and learning |
| | Descriptive use of digital tools | Screen sharing-students view lesson-improve their learning-enable remote learning-observation by Zoom-interact with peers to show and tell their work-students with disability in reading use assistive technology to incorporate content and to explore class projects-translate ESL into audio for low Lexile readers, to develop vocabulary learning-learning platforms and apps for project-based learning-showing work in step-by-step procedures-students use the touch screen technology to answer questions and do annotations | digital tools used in a variety of ways enhance instruction and learning |
| | Process of using digital tools | Use the keyboard in creative ways-model learning tasks and assignments-use reading apps A-Z that allows self-paced learning-for academic and vocabulary expansion in classwork, enrichment activities-use learning platforms download apps that enable | Digital tools learning apps and platforms facilitate students' learning modalities |

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| | | different learning levels for differentiated learning, for students' modalities such as auditory, reading, writing, and kinesthetic-research new information for my lesson content using the internet and the Yahoo and Google search engines-coach students to use the Storyboard learning platform | |
| 3. How do you apply digital tools for teaching concepts, formulas, and problem solving? | Values placed on digital tools use | PowerPoint software-use digital tools/apps-internet to download multiple learning platforms- Google, Jamboard and SIM-use IWB, Promethean Board is designed with digital aids to do vocabulary searches using the online dictionary-used for Mathematics-learning platform Generation Genius for online Science videos and lessons-Promethean Board enables the GeoGebra software for illustrating solutions to math problem using 3D objects | Digital tools are relied on for enabling understanding of complex learning materials |
| | Descriptive use of digital tools | Used to motivate students and hold their interest-apps helps to simplify problems in lesson-develop students' memorization- shared screen- engaging in lessons-vocabulary games with approval sounds-extend learning with pivotal questions-concepts and formulas in applications-problem solving using real world scenario-use the Graphic organizer on the IWB with fillable KWL Venn diagram-bringing abstract ideas in a structured form for understanding; formulas that show mathematical relationship; and problem-solving complex issues on voice-over videos, colorful pictures, and text | Digital tools help to define concepts, formulas, and problem-solving |
| | Process of using digital tools | use draw feature-write on slide-learning tasks by seeing, doing and observing-show step-by-step procedures solving complex math problem-mirroring the use of formulas, matching Geometric shapes-use IWB for visual and concrete problem solving- formative assessment | Digital tools enable teaching and learning across subject areas |

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| | | using the Kahoot with quizzes-Nearpod provide the means to synthesize learning models- enable students to understand science and the nature of things- Students use personal computers for interactive and kinesthetic motor skills development using the desktop and keyboard-class simplify concept in understandable, practical, and testable ways | |
| 4. How do you use digital tools to simplify complex materials for a deeper under-standing? | Values placed on digital tools use | use visual/clipart-web-links-PowerPoint slides-and shared screen-working groups-using iPads- use IWB to demonstrate the annotation of texts text-White Board and Promethean Screen to illustrate concepts-use learning platforms, apps Nearpod, Flipgrid, and Padlet- use IWB internet learning platforms, google docs connect for Newsela Online Educational Platform for content simplification and presentation-the Flipgrid and Pear Deck platforms used to simplify lesson-use Promethean Board, with the internet to download the Educational Infographics | Digital tools apps and learning platforms to enhance learning methods. |
| | Descriptive use of digital tools | motivate students and holds their attention-make lesson interesting- online student friendly learning resources-engage students in learning tasks, discussions and expectations-expand information-computer for color coding label images, underline correct answers, do bold and italic font words to show connection of phrases- the online dictionary and templates used for texts, chunking of content-voice-over facilitates and simplifies learning materials-the digital visual aids work as teaching aids with graphic posters clip-art feature, learning templates and short inset videos | Digital tools varieties enabled different choices for teaching strategies |
| | Process of using digital | simplify complex learning materials-access learning platforms and websites-use web diagram-students finding | Digital tools are designed for interactive |

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| | tools | synonyms for similar words meaning-develop PowerPoint presentations-voice-over on modeling or reading difficult text- annotate texts-word games, online dictionaries-students using their desktop computers log into learning platforms and do interactive lessons for vocabulary and complex content-students use iPads for vocabulary searches given cues that show synonyms and then write texts showing understanding of complex material | learning to simplify complex material |
| 5. How do you use digital tools to facilitate for differentiated learning to cope with students' learning levels? | Values placed on digital tools use | use Google Classroom-PowerPoint shared screen-laptops, desktops and iPads-use apps such as Inspire Science on their iPads-use IWB for online curricula with content and activities-iMovie, posters and topics for essay writing- multiple learning platforms and apps to facilitate learners' modality-Google Docs, Promethean Board in project-based learning (PBL) for student-centered learning with interactive learning apps, and real-life examples of problem-solving material in a step-by-step process | Digital tools learning apps and platforms facilitate student-centered learning |
| | Descriptive use of digital tools | break out rooms-move fast learners to next topic-slower learners work at grade level-set classwork and assignments-differentiated learning-suitability and use for students learning-Students use their iPads for differentiated learning-Google translate for multiple languages-developed for high achievers to incorporate Flexton apps for learning games-research cultural background and different learning levels and styles-Online learning program Reading Rockets based for Lexile levels vocabulary readiness both for auditory and visual means by texts-Students work in interactive settings overlap their learning styles | Digital tools enable using apps to cope with students learning needs |

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| | Process of using digital tools | differentiated learning- increase involvement doing special learning tasks-research facts and important information- identify phrases and clauses for determining how a plant grows- Students use computers for Break-out Rooms- use voice-over, texting, or even Flipgrid to complete work-illustrate step-by-step process for differentiated learning-coach students at workstations with desktop computers, selecting user-friendly interactive digital tools for differentiated learning-use Promethean Board for different techniques for my lessons as for diverse-learners determining their learning styles | Digital tools interactive use promotes learning and understanding |
| 6. How do your choices of digital tools (apps/online program) engage student in the lesson? | Values placed on digital tools use | internet relied on for searches for apps and learning platforms-Apps recommended by school- Google Suite, Nearpod, Pear Deck, and Flipgrid for different learning styles-use Kahoot apps for learning games-include step-by-step challenges-use the Promethean Board with Web pages, and that carry cues, and are designed with chiming sounds to detect students' correct answers-students use iPads, learning platforms for online programs and do quizzes-Jeopardy, the Jamboard, and slides that are audio-visual designed | Digital tools designs are trusted choices for apps and learning platforms |
| | Descriptive use of digital tools | students engaged on digital device for online learning-choices to select tools for engaging – apps for word finds with games such as word puzzles-quiz based games for reading and comprehension levels-iPad and laptops, used for students to be more engaged in learning-plethora of activities that caters for students' preferred way of learning-interactive activities are fun in helping students learning Math, Science, ELA for reading and comprehension with vocabulary building and concepts-the | Digital tools apps and learning platforms rely on the internet for usefulness |

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| | | Promethean Board for interactive and cooperative learning-sometimes experience apps interruption with students learning | |
| | Process of using digital tools | select comfort level-online program-tools choice compatible with students-Google search for learning apps and websites-explore learning materials, learning levels-enable formative and summative reports-find similar words meaning-coach students to use apps such as Adventure Academy and ABC Mouse-excel in using immersive digital games-coached students to use their iPads to learn at their own pace and share with others in their groups | Technology teachers explore the usability of digital tools for the class |
| 7. How do you use digital tools to facilitate students' for student-centered learning activities? | Values placed on digital tools use | Google Classroom Notebook-use digital platforms to access learning content and apps-Google Slides and videos-enhance presentation- use the computer for ESL learning Google translates, and their digital folders- search engines, SIM, and communication devices allow students to take control of their learning- Padlet apps or Kahoot for digital program on the desktop computer, Microsoft Programs , PowerPoint and Publishers-Promethean Board is the primary digital tool in the technology lab-the Jamboard learning platform enable showing 3D objects that are colorful to attract attention | Digital tool are primary for student-centered learning |
| | Descriptive use of digital tools | used at early stage-students work in learning zones-students use iPhone for ELA-students select digital tools based on their comfort level- activity on a slides for exploring learning situations that would otherwise be impossible due to geographical location, nature of the subject-in Math, the 3D objects allow students to understand things better and show how to use formulas for finding size-animated text is used with voice-over for ELA, templates and annotate | Digital tools facilitate for students learning styles |

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| | | complex content | |
| | Process of using digital tools | students locate assignment in Google Classroom to facilitate and engage students learning-Technology teachers select digital platforms and teach how to incorporate in classwork-coach students to use their computers in doing group work-learning-centers with computers-the Padlet apps to create digital products for content-supervise students' technical skills using the desktop, technology, and for academic learning- students use iPads for assignments and network on social media blogs to share their knowledge-Students takes responsibility for their learning using their digital tool with the internet to collaborate and share their knowledge in doing assignments | Students are coached to use digital tools in student-centered learning |
| 8. How do you use digital tools to include students' background knowledge (metacogniti on) in lessons? | Values placed on digital tools use | Technology teachers use computer to do Google search regarding the students' cultural background and plan lessons to include student background knowledge and cultures use IWB Graphic Organizer–for what I know, what I want to know , and what I learned (KWL)-Google search for introducing learning materials-use the IWB for digital lessons to involve students' interests, backgrounds, and interest for motivation to interact and participate- | The internet facilitates searches for students' backgrounds and learning styles |
| | Descriptive use of digital tools | include students' experiences-include students' background or environmental settings in the lesson planning-use computer for environmental awareness-apply unit with digital assessments: Pre, Mid, and End sort the students to check their background knowledge-plan lessons using graphic organizers, audiovisuals to enable students interest-interest in Hip-Hop music and the latest fashion in clothing-use Mapping Diagram-interact with students to hear their ideas on subjects or topics and | Digital tools facilitate for students' background in learning |

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| | | their academic skills and use digital tools-PowerPoint presentations enlighten the Cinco de Mayo's meaning | |
| | Process of using digital tools | Technology teachers conduct assessment- student read and do activity-learn about students' environment and background-simplify ways to enable learning-uses the Padlet on their computers to create audio visual music images and scenarios-students complete Google Forms where they evaluate lessons activities-do interviews to learn about students lifestyles, experiences, and prior knowledge-download pictures, writing assignments on iPads-use search engines to understand the diverse culture of students- search school's community to have a mental picture of life-integrate students' ideas and community life in digital lessons to involve students in learning | Digital tools for keeping abreast of students' practices for lesson planning |
| 9. How do you evaluate digital tools use to ensure adequate quality in instruction and learning? | Values placed on digital tools use | digital tools designed with educational qualities-digital tools designed useful for educational programs-tool choices are the Nearpod, and the Jamboard-The computer programs of PowerPoint, Publishers, and Microsoft Word | Digital tools quality evaluated for reliability to facilitate instruction and learning |
| | Descriptive use of digital tools | Digital tools assignments helps improve lesson quality and learning-use grading criteria-digital platforms incorporated in learnings-selection and use of suitable instrument for assignments enable academic needs through formative assessment-students use desktop or iPads to do research, learn interactively and do problem-solving in math-students are exposed to using digital tools that are user-friendly and interactive to build experiences-on the other hand, the quality of digital tools not checked-concern is having internet and Wi-Fi | Digital tools used in students' academic studies and assignments |

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| | Process of using digital tools | use students' achievement level to determine tools to select and use- learning assessment compare with students' use of digital tools for classwork and assignments-on the computer- digital tools are explored to ensure their usability-assessment is both informal and formal evaluation of my students' background and difficulty level of understanding-digital learning platforms facilitate students' learning styles and learning levels- students are coached to ensure digital tools knowledge application-The learning platforms include myOn in reading and comprehension, My Math's Academy for evaluating digital tools use | Students' performance measure the quality of digital tools |

## Appendix E: Derived Themes From SQ1 Interview Questions (IvQ) Data

| **SQ1-IvQ1 Themes** |
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| **Digital tools variety enhance student-centered learning across different subject areas** |
| The value theme for SQ1 interview question 1 showed that technology teachers enabled student-centered learning using different digital tools. P1 noted using Google Classroom for instruction, and students used iPads and Tablets to participate in class. P4 indicated using GeoGebra software to bring math to life. P5, P7, and P8 used the read 180 apps and 3000 to include desktop computers and iPads for academic intervention. P6 indicated using SIM as an excellent substitution for hands-on learning. P9 noted using PowerPoint with the Promethean Board to present lessons and engage students using iPads. |
| **Digital tools enhance instruction and motivate students for learning** |
| The descriptive theme for SQ1 interview question 1 showed that digital tools enhanced instruction and motivated students for learning. Technology teachers said that they used digital tools to make learning fun using manipulatives to engage students. P2 and P7 noted that instructions were given in simplified ways using different models and tasks. P4 reported using colorful pictures in class with digital tools manipulatives. P6 specified using digital tools with students to direct new pathways in learning and discover new content. P6 indicated using digital tools that captured students' attention, supplement virtual hands-on learning, and kept students focused throughout the lesson. P8 noted that students experienced different learning benefits using digital tools and were motivated to do their work. P9 indicated that digital tools made lessons more creative for students to participate. |
| **Digital tools are used to enhance learning and facilitate remote classes** |
| The process theme for SQ1 interview question 1 revealed that technology teachers used digital tools for interactive learning and facilitated remote classes. P3 indicated that lessons were not teacher-centered due to the COVID-19 pandemic and doing online classes. P7, P8, and P9 stated that they shared teaching with students using the IWB and Promethean Board in doing PowerPoint projects. P4 used the IWB to show colorful manipulatives for problem-solving in math. P5 noted that she used interactive learning models for students to immerse themselves in learning games. P1 reported teaching remote classes using Google Classroom, assisted students in downloading apps and websites to participate in class, and enhanced their lessons. |
| **SQ1-IvQ2 Themes** |
| **Digital tools are trusted learning tools to enhance instruction and learning** |
| The value theme for SQ1 interview question 2 showed that technology teachers trusted digital tools for enhancing instruction and learning. P4 and P8 used the IWB for teaching to present complex content. P4 indicated, "I model my lessons |

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| using the IWB, and students can understand complex lessons." P1 noted using Microsoft PowerPoint presentation and shared Google Classroom for students' interactive learning. P5, P7, and P9 used apps and learning platforms for creating lessons. P5 indicated using the A-Z apps, which enabled students to learn to read at their levels. P6 noted applying several apps and learning platforms to include Jamboard, PoPArt, Flipgrid, and Kahoot, to help students develop their academics and vocabulary skills. |
| **The use of digital tools in a variety of ways enhances instruction and learning** |
| The descriptive theme for SQ1 interview question 2 revealed that using digital tools enhanced instruction and learning in various ways. Technology teachers indicated that they improved students learning for ESL, integrating audio for listening, helping low Lexile readers to develop their vocabulary. P3 believed that students could become knowledgeable of the digital tool using them daily in class and digital tools for students' learning styles with various learning platforms and websites. In bringing Geometry to life, technology teachers reported using colorful pictures and learning models. P7, P8, and P9 noted that they depended on the internet and search engines for lesson plans that showed different instructional methods. |
| **Digital tools learning apps and platforms facilitated students learning modalities** |
| The process theme for SQ1 interview question 2 revealed that digital tools, apps, and learning platforms facilitated students' learning modalities. P8 indicated using apps and learning platforms for differentiated learning, enabling students' learning modalities. Technology teachers used digital tools to include assistive technology for students with disabilities in reading and used learning platforms and apps in project-based learning. P2 noted using the computer keyboard to help students develop their typing skills. P4 reported using mini researches with students showing how to use search engines. P5 indicated that students participated using the IWB to show and tell their work. P5 used YouTube and Teacher Tube for exploring differentiated learning material in class. |
| **SQ1-IvQ3 Themes** |
| **Digital tools are relied on for enabling understanding of complex learning materials.** |
| The value theme for SQ1 interview question 3 showed that technology teachers relied on digital tools to understand concepts, formulas, and problem-solving methods. Technology teachers indicated using multiple learning platforms that included the IWB, Promethean Board, Sims, and Google for delivering lessons on complex learning materials. P5 and P8 revealed using the IWB for simplifying complex concepts and solving math problems. P9 noted, "My Promethean Board is designed with aids to simplify concepts in a more understandable form." P6 indicated using multiple learning platforms as means for synthesizing complex learning materials. P4 suggested using learning platforms helped to mirror concepts in lesson presentation. |

| **Digital tools help to define concepts, formulas, and problem-solving** |
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| The descriptive theme for SQ1 interview question 3 indicated that digital tools enabled defining concepts, formulas, and problem-solving. Technology teachers pointed out that they used digital tools with vocabulary games that sounded approval chimes for correct answers and noted pivotal questions to understand procedures and concepts better. Digital tools enabled the use of graphic organizers and fillable KWL (A research strategy for "What I know, what I want to know and, what I learned.") Venn diagrams. P1 said, "I used the Microsoft PowerPoint software to write on slides to teach my class." P4, P5, and P8 indicated using the IWB for in-depth instruction on formula uses and processing of problem-solving methods. P7 noted that students increased understanding when they immersed themselves in games for a better experience of problem-solving. |
| **Digital tools enable teaching and learning across subject areas** |
| The process theme for SQ1 interview question 3 revealed that digital tools enabled teaching and learning across subject areas in understandable ways. Technology teachers indicated using the digital tools draw feature to write on slides and improve students learning by seeing, doing, applying manipulatives, and used step-by-step procedures to solve complex math problems. Technology teachers noted applying digital tools for formative assessment to check students' understanding and use of formulas. P5 and P7 indicated using learning games with students that promoted formula and concept use. P9 noted, "I download the GeoGebra software using the internet-connected to my Promethean Board to illustrate solving math problems and used animated learning texts." P1 reported using digital tools to include apps for students to practice learning games and develop their memory. |
| **SQ1-IvQ4 Themes** |
| **Digital tools apps and learning platforms to compare learning methods** |
| The value theme for SQ1 interview question 4 showed that technology teachers relied on digital apps and learning platforms to compare learning methods. Technology teachers indicated using apps and online learning platforms such as Flipgrid, Nearpod, and Pear Deck to compare different strategies for a deeper understanding of complex material. P1 noted the use of visual aids and website links to enhance knowledge with a PowerPoint presentation. P4, P5, and P8 all used the IWB and built-in feature to download apps for showing different and in-depth understanding of complex material. P4 noted, "I use my IWB to model my lesson illustrating with web diagrams use of formulas." P2 said, "I use digital tools to simplify procedures and complex materials." |
| **Digital tools varieties enabled different choices for teaching strategies** |
| The descriptive theme for SQ1 interview question 4 showed that using digital tools varieties enabled different teaching strategies. Digital tools such as the IWB and Promethean Board were noted by technology teachers for defining complex learning materials in more accessible ways. According to technology teachers, |

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| digital tools allowed for color codes, labeling images, and bold or italic font words showing the connection of contents that students could observe and learn. P3 noted that digital tools with attractive learning features gave an advantage for discussion in learning with students. P8 pointed out that the desktop allowed students to download interactive learning platforms and helped to make complex material learnable using graphic organizers. P9 noted that the Promethean Board promoted inquiry-based learning for students to reveal new knowledge. |
| **Digital tools are designed for interactive learning to simplify complex material** |
| The process theme for SQ1 interview question 4 revealed that digital tools carried designs for interactive learning to simplify complex material. Technology teachers noted using voice-over apps, reading, and modeling lessons to help students develop vocabulary and encourage group learning. According to technology teachers, students used digital devices to log in to learning platforms to do interactive learning for vocabulary development and learn complex content. P6 and P9 noted that the Promethean Board widescreen enabled teaching concepts and materials that encourage full class participation for corporative learning and knowledge sharing in a show and tell presentation. P9 stated, "Some students preferred using color objects to participate in class, giving an illustration of their work and using the hands-on feature of the Promethean Board." P5 indicated, "My students used the color code feature of the IWB to show and tell their work to the class." |
| **SQ1-IvQ5 Themes** |
| **Digital tools learning apps and platforms facilitate student-centered learning** |
| The value theme for SQ1 interview question 5 showed that technology teachers relied on digital apps and learning platforms to facilitate student-centered learning for students using digital tools. Technology teachers revealed that they used Inspire Science, a science curriculum for grades 6 -12 that allowed for hands-on learning interactions, which would otherwise be difficult to implement inside the classroom demonstrated on the IWB and iPads to facilitate differentiated learning styles. According to technology teachers, the apps and learning platforms helped simplify complex learning materials and facilitated students' learning techniques. P1 and P6 indicated using Google Classroom and Docs to promote students' differentiated learning styles. P1, P4, and P5 noted the use of breakout rooms. P9 stated that diverse learners used digital tools for Project-Based-Learning in class. P9 said, "I allowed my students to download user-friendly and interactive learning apps for problem-solving." |
| **Digital tools enable using apps to cope with students learning needs** |
| The descriptive theme for the SQ1 interview question 5 showed that digital tools apps enabled coping with students learning needs. Technology teachers indicated that they used apps to download online reading programs to guide students in reading development. The reading programs included the online Reading Rockets |

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| to assist students' Lexile levels for auditory and visual learning. P1 and P4 revealed that students at higher reading levels were doing challenging research topics using iPads. P3 and P7 indicated that students used their iPads, laptops, or desktop to download apps to help them cope with their assignments. P9 noted, "I determine my students learning styles, and with their digital tools, I encourage them to work cooperatively in groups in interactive settings." |
| **Digital tools interactive use promotes learning and understanding** |
| The process theme for SQ1 interview question 5 revealed that digital tools' interactive use promoted a better understanding of lessons. Technology teachers noted assisting students in selecting user-friendly interactive digital tools for differentiated learning. They said that interactive digital devices such as Flipgrid could enable voice-over, texting, and learning in a step-by-step sequence. P5 indicated assessing students' performance using digital tools. According to P5, "Students showing low performance due to difficulty using digital tools were assigned digital tools that were easier to use." P7 and P8 indicated that apps and learning platforms enabled user-friendly digital tools to facilitate students learning styles. P3 noted assigning digital tools to satisfy students' learning levels and improve students' ability to use digital tools. P2 and P5 indicated that digital tools enhanced differentiated learning when used for targeted discussions. |
| **SQ1-IvQ6 Themes** |
| **Digital tools designs are trusted choices for apps and learning platforms** |
| The value theme for SQ1 interview question 6 showed that technology teachers relied on digital tools designs and trusted using apps and learning platforms for quality lesson delivery. Technology teachers indicated that they used apps and learning platforms recommended by their schools. They believed that the designs of digital tools carried the necessary step-by-step instructional strategy for enhancing learning. P3 noted that downloading online learning programs allowed students to engage in classwork. On the other hand, P1 indicated that some online learning programs did not easily download on some digital hardware. P5 and P8 noted that they selected apps and learning platforms based on students' interests and ability to use them. The topic of the lesson takes importance to the chosen apps and learning platforms. P9 said, "Depending on the subject of my lesson, I download apps for my lesson on my Promethean Board." |
| **Digital tools apps and learning platforms rely on the internet for usefulness** |
| The descriptive theme for the SQ1 interview question 6 indicated that digital tools, apps, and learning platforms needed the internet for usefulness. Technology teachers noted using the internet for remote learning with apps and learning platforms for engaging students in games to find word puzzles for reading and comprehension skills. P6 pointed out that a plethora of online activities catered to students' preferred styles of learning. P4 and P8 indicated that they used the internet to engage students using the ABC mouse learning apps. P8 said, "I sometimes experienced internet interruption while my class is using the |

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| Adventure academy and ABC Mouse apps, which allowed them to immerse in reading games and excel in their reading having fun after interruptions." |
| **Technology teachers explore the usability of digital tools for their class** |
| The process theme analysis for SQ1 interview question 6 revealed that technology teachers explored the usability of digital tools for their classes. Technology teachers said that they made digital tools choices that were compatible with students learning. They indicated using Google search engines to locate apps and websites for meaningful learning material and suitability for students' learning levels. P4 said, "I showed students how to use their iPads to find reading materials that challenge them for matching phrases and completing sentences." P2 noted, "I do an internet search to become familiar with digital tools such as apps that students can use in their lessons for online programs." P7 indicated encouraging students to use apps and interactive student-friendly platforms for learning games that simplify content. |
| **SQ1-IvQ7 Themes** |
| **Digital tool are primary for student-centered learning** |
| The value theme for SQ1 interview question 7 showed that digital tool use was primary for student-centered learning. Technology teachers noted coaching students to use various digital tools to expand their understanding. These tools were hardware and software, consisting of desktop computers, iPads and laptops, and Microsoft Programs to include PowerPoint and Publishers programs. According to technology teachers, these software programs helped students simulate teaching with colorful 3D objects. P1 noted introducing students to use digital tools early in the school year. P3 stated that students' comfort using digital tools was essential to the choice of tools. On the other hand, P4 used the IWB in cooperative group learning, and students shared their knowledge, asking questions and enhancing the use of the IWB by its built-in digital features. P5 noted coaching students to use computers to share in group work. |
| **Digital tools facilitate for students learning styles** |
| The descriptive theme for the SQ1 interview question 7 indicated that digital tools facilitated students' learning styles. Technology teachers suggested using slides in presentations that suited students' comfort to cope with their learning levels. Technology teachers said they used 3D objects to help students understand better and annotated texts with voice-over apps and templates for presenting complex content. P5 noted that students chose to use digital learning centers on iPads and redo content in the way they understood. P4 indicated that students used their iPads to download graphic organizers and select pictures to help them do picture reading as their preferred way of learning. |
| **Students are coached to use digital tools in student-centered learning** |
| The process theme for SQ1 interview question 7 revealed that technology teachers coached students to use digital tools in student-centered learning. Technology teachers indicated they show students how to locate their assignments in Google |

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| Classrooms to include apps and digital learning platforms. They noted coaching students to do group work using digital tools in learning centers and believed that students should take responsibility for their learning and collaborate and share their knowledge. P5 said that some students used their iPhones in ELA class. P3 pointed out that students using their iPhones showed that the school could not provide digital tools to expand digital tools for online learning during the COVID-19 pandemic. P7 said, "I coach my students to get the most in learning using digital devices in activity centers using the Padlet apps." |
| **SQ1-IvQ8 Themes** |
| **The internet facilitated searches for students' backgrounds and learning styles** |
| The value theme for SQ1 interview question 8 showed that the internet facilitated searches for students' backgrounds and learning styles. Technology teachers indicated that they used their computers to do Google searches regarding students' cultural experiences to create lesson plans that held students' interest. They used the IWB for information on students' backgrounds and interests using the graphic organizer for "what I want to know" (KWL), allowing students to share their knowledge on what they like to do and helped to enhance lesson planning. P1 noted, "I learned about students' background in their environment doing Google search so I can plan my lessons to include their experiences." P4 said, "I used the Google search engine at my school community and locations that my students are from to learn about their community." On the other hand, P3 noted that including students' background information for lesson planning was his weakness, as he relied on digital tools design to facilitate students' learning needs. |
| **Digital tools facilitated for students' background in learning** |
| The descriptive theme for the SQ1 interview question 8 indicated that digital tools facilitated students' learning backgrounds. Technology teachers said they conduct Google searches to find information on the subject taught, including learning experiences encouraging students to participate. Technology teachers said they identified apps and learning platforms that may consist of students' cultural backgrounds in learning. P4 noted that for lesson planning, "My students who have an interest playing with dolls use the Storyboard apps for creating pictures of a home design moving around objects and learning about organizing with model rooms." P5 indicated that students' environment information helped in planning lessons to integrate community activities related to students. P8 noted that students from the inner city showed interest in Hip-Hop music and the latest fashion in clothing, which helped in lesson planning. |
| **Digital tools used to keep abreast of students' practices for lesson planning** |
| The process theme for SQ1 interview question 8 revealed that technology teachers used digital tools to keep abreast of lesson planning practices. Technology teachers noted assessing students' work for indicators to select digital tools of their interests. They indicated planning simplified ways to enable students learning by engaging students in using digital tools to explore scenarios of music |

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| and images on the computer search bar. P6 and P8 used Google forms that students fill out for assessment for lesson planning. P6 said, "Students are encouraged to complete Google forms, which I used to evaluate and plan lesson activities." P9 noted that some students expressed an interest in "Cinco de Mayo." Therefore, around May, lesson plans focused on the Cinco de Mayo activities during the school year. P7 said, "I used digital tools to research my students' interest and prior knowledge so that I can better plan my lessons to facilitate for their interests." |
| **SQ1-IvQ9 Themes** |
| **Digital tools qualities are evaluated for reliability to facilitate instruction and learning** |
| The value theme for SQ1 interview question 9 showed that technology teachers evaluated digital tools' reliability to facilitate instruction and learning. Technology teachers said they believed that digital tools design should enhance educational qualities. They used online tools, including Pear Deck and Jamboard, with Microsoft word programs such as the PowerPoint and Publishers program to present lessons. P4, P5, P7, and P9 indicated assessing digital tools' quality for instruction and learning choices. P7 said, "I do an informal and formal evaluation of the difficulty level of students using digital tools." P5 noted using learning standards to determine the quality of digital tools needed for a lesson. On the other hand, P3 indicated relying on the digital device design for enhanced instruction without assessing the quality of digital tools. |
| **Digital tools used in students' academic studies and assignments** |
| The descriptive theme for the SQ1 interview question 9 indicated that technology teachers used various digital tools in students' academic studies and assignments. Technology teachers noted that digital tools used in projects helped improve students learning, selecting suitable tools for their educational needs. Technology teachers revealed that digital tools that were user-friendly and interactive helped to build students learning experiences. P3 said, "Digital tools design enhanced educational programs irrespective of the learning task and situation." On the other hand, P1 noted using only digital tools that students could access. If students cannot access these tools for assignments, relying on digital tools for learning and doing tasks posed a challenge. P9 said that students learn to use digital tools in class and then apply digital tools in projects to show quality in understanding and using them. |
| **Students' performance using digital tools is used to measure the quality of digital tools** |
| The process theme for SQ1 interview question 9 revealed that technology teachers used students' performance to measure the quality of digital tools. Technology teachers indicated using students' achievement levels to compare quality in the use of digital tools. Technology teachers revealed evaluating digital tools applications for students learning styles and learning levels and coached students to ensure correct digital tools practice to improve the quality of learning. On the |

other hand, they noted that they could know the usefulness of the digital tool's quality by assessing students' performance. P8 revealed, "I do formative assessment of my students' work, using interactive learning programs with iPads or desktop computers, and coach students for better understanding of using digital tools." P2 noted, "Based on the performance levels of my students, I can determine if the tools that I select contributed to the quality of my lessons and students' learning."

## Appendix F: Educational Technology Products Discussed in Teacher Interviews

*Digital Tools Terminology used in this study, Website, Google.com*

- Amplify – digital platform for curriculum based on common core standards
- *Edmodo* – a digital learning network shared by teachers in K-12 schools to share content, distribute quizzes, assignments, and manages communication with students and parents
- *Flexton* – a digital learning management website for educators and businesses used for blended learning design, instructional design, eLearning development and training
- *Flipgrid* – a learning platform that allows educators to ask questions and share videos
- *GeoGebra* – an online mathematical software intended for teaching and learning mathematics and science using 3D enhanced components
- *Google Docs* – an online word processors included as part of a web-based Google Docs
- *Interactive White Board (IWB)* – also known as an interactive board or smartboard is a display that reacts to input from a user or other digital devices
- *Jamboard* – an interactive whiteboard developed by Google to give rich experiences
- *Kahoot* - a game-based online learning platform used in educational technology to share and play learning games or quizzes
- *myOn* – a digital reading resource that personalizes reading for students by recommending books based on their interests, reading levels and rating books read
- *NAMOO app* – a fun engaging exploration apps which enable kids to learn about the life and biology of plants
- *Nearpod* – an online tool that allows educators to use slide-based teaching both in the classroom and remote
- *Padlet* - an online virtual bulletin board where students and teachers collaborate.
- *Pear Deck* – an interactive presentation online tool used to engage students in individual and social learning actively
- *PopArt* – a digital designing class for innovative art work emerged in the United Kingdom and the US, in which common objects are used as subject matter
- *Promethean Board* – a specific brand of an interactive whiteboard that allows for a large interactive display of images, videos, and texts
- *SIM* - online Strategic Instructional Model - focused on making students active learners in problem-solving and critical thinking
- *Teacher Tube* – an online educational resource website for teachers to share for video, audio, photos, groups, and blogs
- *Thinkfinity* – an online lesson development resource website by Verizon, shared with educators, parents, and students to construct meaning and direct learning
- *Voice over* – a digital tool for the addition of voice as an auditory learning tool to increase information retention for learners

**Appendix G: SQ2 Interview Questions-Coding Data Patterns/Categories for Themes**

| SQ2: How do grades 3 through 8 technology teachers and coaches use digital tools to enhance pedagogy and content to create learning experiences? | | | |
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| Interview Questions for SQ2 | Coding for Data Patterns | Data Patterns /Categories | Derived Themes |
| 1. How do you incorporate digital tools in teaching models/styles/strategies to facilitate pedagogy and content? | Values placed on digital tools use | Apps and learning platforms-Flipgrid, Nearpod, Pear Deck, GoNoodle, Brain Pop, Jamboard, and Kahoot-digital platform-presents interactive learning content-classroom devices include IWB or Promethean Board-IWB/Promethean Board for preparing pedagogy and content for instruction-for PowerPoint presenting roleplay, skits, speech learning, creating posture, broachers, and writing essays to facilitate for learning styles-Students use computers for audio-visual slides and graphic organizers for real time learning-Nearpod, Amplify, Google Suite, Flipgrid, Flocabulary caters to all types of learners such as visual, auditory and kinesthetic, Edmodo or Schoology to deliver content-Desktop computers are students' workstation in the lab | Apps and learning platforms used to enhance pedagogy and content |
| | Descriptive use of digital tools | Digital devices to introduce new topic-students' friendly tools enable systematic learning-show pictures and text, and create posters-models lesson in Mathematics by step-by-step process-Students use computer for research projects -bring to the classroom places and activities that are impossible to reach-student-centered models, facilitating students friendly and interactive learning platforms for learning styles of seeing, auditory, kinesthetic- use the internet for teaching models, learning styles, and strategies for pedagogy and skills development-students use iPads to research content and context and for interactive learning projects | Digital tools enhance a step-by-step learning process in pedagogy and content |
| | Process of using digital | Technology teachers are trained to use Smartboard for pedagogy and content and demonstrate learning-IWB to model | Training with digital tools helps to |

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| | tools | mapping diagram to complete learning task-use VR set to integrate content and scenarios-use prompts, and clues to present complex contents-students use their iPads to work in their group-students-students also use the Promethean Board to demonstrate kinesthetic skills in understanding content, concepts, show images, and problem-solving | enhance pedagogy and content |
| 2. How do you use digital tools to ensure that pedagogy is facilitating for students with different learning styles? | Values placed on digital tools use | use IWB for presentation strategies accessing Websites, Apps, learning platforms, Kahoot, Flipgrid, Jamboard, Pear Deck, and software-digital platforms (Nearpod, Pear Deck, and Google Suite) allows for learning styles-use voice-over to help students to verbalize responses-use Google translator for students doing English as Second Language (ESL)-prepare my lessons by researching materials using Google search engine, the Yahoo search engine, and teacher tube-use educational apps, learning platforms, Digital Flashcards for pedagogical strategies | Digital tools choice enhances pedagogy and content for learning styles |
| | Descriptive use of digital tools | child friendly websites for modeling lessons- students use iPads and select manageable assignments tools in discussion-they learn at their pace and level also working in groups-at a higher learning level use iPad to do mini research with their iPads-students at lower learning levels use iPads to find vocabulary, word meaning-digital tool include YouTube and Teacher Tube for exploring differentiated learning materials-Flipgrid provides the mean for the students to take part in kinesthetic activities-student-friendly and interactive learning, auditory, seeing, and kinesthetic for hands-on, immersive games with colorful objects-students use cues on a step-by-step approach to research downloading pictures that connect to learning content | Digital tools used to enhance pedagogy and content for students' participation |
| | Process of using digital tools | Assessment of students learning styles enable understanding of how to demonstrate lesson to engage learners-students use the Reading 180 app for | Students' participation in pedagogy and content |

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| | | reading materials-work with students to participate in learning groups based on their learning styles of auditory, seeing and reading, and writing texts, kinesthetic motor skills development using the keyboard-engage students in interactive ways; questioning, prompts, and word search coach my students to use their iPads doing research, using their myOn learning platform reading at their Lexile level-set up a learning management system (LMS) that students can note their learning progress-improve digital tools in pedagogical presentation-use the Promethean Board to model lessons-students use PowerPoint to illustrate their learning | planning enhance active learning |
| 3. How do you use digital tools for pedagogy and content to search or discover, facilitating new learning experience? | Values placed on digital tools use | Presentation of new learning materials are by Google search engine-use IWB for presentation strategies with the Jamboard-Students use laptop iPads, Chromebook, and desktop do research for content material- utilize the internet and SIM to replace the hands explorations with search engines-Google Docs and slides Yahoo, and Teacher Tube, and Fire-fox to discover learning materials- Google, Lycos, Teacher Tube, YouTube Yahoo, and Firefox are the primary search engine for finding pertinent, accurate, and safe information for new lessons-these search engines maintain the currency of technology, lesson | The internet enables new digital learning materials for pedagogy and content |
| | Descriptive use of digital tools | Technology teachers consult with each other for use of new tools in collaborative learning exercises-enhance lesson presentation-on the other hand some technology teachers do not depend on digital tools 100% for lessons planning-download pictures and write texts using a Microsoft word page-do scavenger hunt, for concise content based questions-digital images, games and find a word-SIM mobile app allow students to explore content and investigation using simplified learning platforms for content-slides the use of concise texts and download | Apps and learning platforms used for creative pedagogy and content |

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| | | pictures on the internet and videos that students watch-New research methods now show color codes for laying out procedures and numerical functions on a step-by-step process | |
| | Process of using digital tools | Students use digital tools to engage in group learning and explore lesson content for immediate feedback-students use iPads to do researches- write content using the keyboard-present lessons on the IWB for instructional and presentation strategies of show and tell-they use the Socrative apps to learn to produce content and respond in doing assignments-use slides to format instruction for learning content-build virtual experiences using a digital mind-map diagram on the IWB-students are coached to use iPads in break-out rooms-they use Google and Yahoo search engines for their presentations in PowerPoint, Publishing, and writing narratives using Microsoft words program | Digital tools and search-engines for complex material in content and pedagogy |
| 4. How do you use digital tools for pedagogy and content and enable learning modalities (seeing, doing, auditory)? | Values placed on digital tools, use | use IWB and internet to access learning apps YouTube and learning platforms activities and learning models-use NAMOO app in Science class, with colorful audio and visuals-Zoom Platform allows all learning modalities, visually, auditory or kinesthetic-using the keyboard to develop motor skills dexterity-use the Jamboard, Pear Deck, Kahoot, Flipgrid, and Digital Flashcards for learning materials in color, objects, animated texts, and games designed to hold students' interest and focus-use Promethean Board in inquiry-based lessons in interactive ways to improve perception, memory, and sensation | Digital tools variety enables pedagogy and content for learning modalities |
| | Descriptive use of digital tools | Students use digital devices to join class at home- lesson not essentially consider to address learning modalities-digital devices used based on availability-digital divide in urban schools-enable learning by presenting colorful materials-iPad apps uses sounds, colors and is interactive-seeing (visual use graphs and visual aids), | Digital tools used in content and pedagogy for in-person and virtual learning |

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| | | doing (kinesthetic and investigations), auditory (listening, discussing, presenting)-do continuous research and coach students using the learning programs recommended at my school-Instruction enhanced with color objects and animated words for kinesthetic and motor skills | |
| | Process of using digital tools | Students gets feedback from doing interactive lessons on their progress-in math they assemble shapes in Geometry and match formulas for finding areas of circles, triangles, and squares- students use keypads to move around objects and pencils on digital screens to make drawings selecting objects with colors-integrate text, images, audio and videos that enhance learning modalities facilitating for diverse learning styles such as auditory, seeing and reading, and writing texts-voice-over for auditory-students encouraged to use the IWB to share their knowledge and then work on answering questions-students participate in lessons using iPads to facilitate learning styles | Digital tools in pedagogy and content enable students to focus on learning |
| 5. How do you use digital tools to combine pedagogy and content for concepts, skills, and problem-solving learning? | Values placed on digital tools use | Technology teachers use Smartboards and Promethean Boards in Google drive to instruct and showcase students work-some students use cellphones- others use iPads and access Starfall learning platform-Zoom platform allows for tech teacher to models engagement and interactions- use apps and learning platforms, Jamboard, Kahoot, and Pear Deck-use the internet to research concepts to understanding abstract ideas-use 3D colored objects and games in problem-based learning platform in for student-centered pedagogy and content | Digital tools and the internet improve pedagogy and content for concepts and formulas |
| | Descriptive use of digital tools | Technology teachers use interactive tools to bring concepts to life-application in simplified ways- provide puzzles for vocabulary development, finding pathways in multiple learning games that suits students learning styles-the IWB incorporate built in feature for enhanced | Digital tools used for pedagogy and content enhance learning methods |

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| | | pedagogy and content- SIM interactive, videos allows students to charge of their learning-students immerse themselves in games playing characters and learn step-by-step learning-the Promethean Board stores reference materials for students to recall previous learning contents including 3D interactive feature | |
| | Process of using digital tools | Technology teachers use whiteboards and Google Docs for Jamboard to incorporate learning styles in pedagogy and content-show concepts in a step-by-step procedure-enable problems solving in math for counting and subtracting-develop typing skills-students use computer to go on Thinkfinity websites to use arguments tools in assignment-presentation to motivate learners-students are coached to know the tools available on the desktop for doing research-students use friendly online programs-the internet connection allows downloading of apps such as My Math's Academy or the Adventure Academy to introduce students to concepts and build their problem-solving skills | Digital tools used in pedagogy and content enhance learning complex content. |
| 6. How do you use digital tools for pedagogy and content to empower students for extended learning - homework or assignment? | Values placed on digital tools use | use Google Classroom PowerPoint for Google Docs to coach students to use digital tools- post assignments in Google Docs-digital tools empower leaning-use Microsoft PowerPoint and Publishers Programs such as Google Docs, Jamboard, and using IWB for lessons-use graphic organizers, Kahoot and Padlet-students use their iPads to access their Google classrooms- computers for Kahoot learning hashtags team-learning centers with digital folders activities based on students' performance levels-students access their Google Classroom to see their homework-Synchronous and asynchronous learning facilitate class network learning, providing resources such as apps and digital platforms | Digital tools coaching in pedagogy and content improve students' performance |
| | Descriptive use of digital | remote learning empowered students using digital tools to sign into online classes-the interactive learning platforms | Digital tools in pedagogy and content |

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| | tools | and apps students use incrementally empower their use of digital tools in Google Docs to view, select, and do their assignments- students use digital folder with work that suits their level of learning- download picture and write a descriptive paragraph-selecting apps to complete assignments and homework-include team hashtags, conversational threads in networking to communicate-students can edit documents (visually) and communicate verbally via zoom or on Instagram-facilitate students' learning asynchronous guidance and also synchronous learning | improve online learning . |
| | Process of using digital tools | Digital tools use for pedagogy and content enable students to edit and submit assignments-students are given feedback on assignments-class use the Google browser for research-use PowerPoint or the Publishers program or the Microsoft Words for content - coach students to use computers for annotations, and do voice-over to explain content-coach students in class to use computers for blogs-students are coached to use digital devices and become familiar with using the devices to accomplish step-by-step instructions-using their digital devices to do their assignments or homework-students acquire daily skills using their digital technology by teacher enabling use of the Promethean Board and coach students to use their iPads | Digital tools in pedagogy and content enable students for online assignments |

## Appendix H: Derived Themes from SQ2 Interview Questions (IvQ) Data

| **SQ2-IvQ1 Themes** |
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| **Apps and learning platforms used to enhance pedagogy and content** |
| The value theme for SQ2 interview question 1 showed that technology teachers used apps and learning platforms to improve pedagogy and content. Technology teachers said they used several apps and learning platforms to improve pedagogy, including Flipgrid, Pear Deck, Jamboard, the IWB, and Promethean Board. Technology teachers pointed out that they enhanced pedagogy and content using PowerPoint for roleplay, skits, speech learning, and creating brochures. P1 noted attending workshops for learning to use apps and learning platforms to facilitate online classes during the COVID-19 pandemic. P2 stated, "When I do a new topic, I introduce digital media for pedagogy and content for interactive learning." P8 said, "After using learning platforms for pedagogy and content, my students use the student-friendly learning platform to interact and share their work." |
| **Digital tools enhance a step-by-step learning process in pedagogy and content** |
| The descriptive theme for SQ2 interview question 1 indicated that technology teachers revealed using digital tools to incorporate a step-by-step learning process in pedagogy and content. They suggested using digital tools for pedagogy and content to facilitate student learning using a student-centered model with digital tools in a step-by-step process. For example, students were encouraged in math class using digital tools that enabled learning styles to include visual, auditory, and kinesthetic learning on their iPads. P4 and P5 noted that they used the IWB in pedagogy and content to guide students using iPads in a step-by-step learning process to accomplish learning tasks, allowing them to go into break-out rooms for one-on-one attention. P9 noted using the Edmodo and Schoology apps to deliver pedagogy and content addressing students learning styles. |
| **Training with digital tools helps to enhance pedagogy and content** |
| The process theme for SQ2 interview question 1 revealed that technology teachers' digital tools training helped facilitate pedagogy and content. Technology teachers indicated having the training to use the IWB and the Promethean Boards for pedagogy and content. Technology teachers pointed out that they used digital tools to model mapping diagrams for presenting complex contents. According to technology teachers, students modeled their technology teachers' lessons presentation on iPads to demonstrate their learning. P6 noted attending workshops for instructions using digital platforms such as the Nearpod, Amplify, Google Suite, and Flipgrid to include pedagogy strategies for content delivery. P8 indicated using the IWB in strategic ways to enhance pedagogy and content for students in answering questions through prompts and cues. |
| **SQ2-IvQ2 Themes** |
| **Digital tools choice enhances pedagogy and content for learning styles** |
| The value theme for SQ2 interview question 2 showed that technology teacher' digital tools choice enhanced pedagogy and content for learning styles. Technology teachers noted that all digital tools could not facilitate students with different learning styles and selected digital tools to suit students learning styles. Technology teachers indicated selecting digital software and platforms that allow learning techniques such as Google translator for students doing English as a second language. They noted using Google, Yahoo, and Teacher Tube search engines to prepare pedagogy and content for learning styles. P1 noted utilizing many visuals such as pictured digital screens and child-friendly |

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| websites for students with visual preferences in learning. P5 reported using the Teacher Tube search engine for accessing materials for pedagogy and content for differentiated instruction using the Jamboard and Pear Deck. P8 said, "I used websites to enable me to develop pedagogy and content to facilitate students' learning styles for seeing, auditory, and kinesthetic for motor skills development." |
| **Digital tools used to enhance pedagogy and content for students' participation** |
| The descriptive theme for SQ2 interview question 2 indicated that technology teachers used digital tools creatively to enhance pedagogy and content for students' participation. Technology teachers said they selected digital tools for pedagogy and content and created lessons to explore differentiated learning materials. Technology teachers also indicated that they used apps and learning platforms that were student-friendly and interactive to enable hands-on games or immersive games connected to learning content. P8 noted, "In my digital lessons, I set my learning objectives and expectations and give my students cues on a step-by-step basis with selective information for downloading pictures that connected with learning content." P7 indicated that apps and learning platforms in pedagogy enabled interactive presentations for auditory, seeing, and kinesthetic with music that encouraged students to use digital tools. |
| **Students' participation in pedagogy and content planning enhances active learning** |
| The process theme for SQ2 interview question 2 revealed that students' participation in pedagogy and content planning encouraged active learning. Technology teachers said they involved students in lesson planning for pedagogy and content by discussing lesson topics in class and using iPads to create graphic organizers to suggest learning materials. They indicated using digital tools with the keyboard that engaged students in interactive ways. According to technology teachers, students provided research questions. They did word searches for 3D objects that could be used for visual learners, providing the learning activities for students to take part in kinesthetic activities modify lessons. P6 noted using learning suites with high visual elements that involved the missing component for hands-on learning. P7 stated, "Students involvement in planning pedagogy for immersive games helped develop lesson content and created exciting learning activities. P2 said, "I engaged students in the lesson after assessing their learning levels, asking them to use their digital tools to research learning materials to suit a particular topic. |
| **SQ2-IvQ3 Themes** |
| **The internet enables new digital learning materials for pedagogy and content** |
| The value theme for SQ2 interview question 3 showed that technology teachers used the internet for downloading new digital learning materials for pedagogy and content. Technology teachers noted that they depended on researching and downloading new and safe learning materials for pedagogy and content. They pointed out using the internet for Firefox, Yahoo, Google, and Teacher Tube search engines to find relevant, accurate, and safe information for pedagogy and content in lessons and exposed students to new learning. P5 said, "I research content material using digital tools to include the Chromebook, laptop, and desktop for presenting my lesson in interactive ways on the IWB." P7 noted, "I use the search engines Google, Yahoo, and Teacher Tube to discover new trends in technology to simplify my presentation using Google Docs and Slides." |
| **Apps and learning platforms used for creative pedagogy and content** |

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| The descriptive theme for SQ2 interview question 3 indicated that technology teachers utilized apps and learning platforms for creativity in pedagogy and content. Technology teachers said they downloaded pictures and did a scavenger hunt to find different learning material. They grouped and assessed for new methods that showed color codes for laying out procedures and numerical functions in math for a step-by-step process to develop pedagogy and content. P8 noted using digital tools to bring abstract ideas into a structured form to understand mathematical relationships and formulas. P9 said, "Apps and learning platforms help me maintain the currency of technology lesson content and added information to understand a topic better or to expand knowledge." P3 noted that working with students using digital tools did not depend totally on digital tools for planning lessons. |
| **Digital tools and search engines for complex material in content and pedagogy** |
| The process theme for SQ2 interview question 3 revealed that technology teachers used digital tools and search engines for complex learning material for content and pedagogy. Technology teachers indicated that they used search engines to simplify complex learning materials for science lessons activities. They noted using digital tools to build virtual learning experiences by exploring content using digital mind-map diagrams and students' participation on iPads. P4 reported applying Google word search for developing pedagogy and content and for discovering learning materials. P9 said, "I used the Promethean Board to connect with search engines for creating pedagogy and content and introduce new learning material to my class." According to P9, "Digital tools enabled explaining concepts and formulas such as the PEMDAS rule for numerical procedures in math" (PEMDAS is an Acronym for parenthesis, exponents, multiplication, division, addition & subtraction to help memorize the order of operations for mathematical expressions). |
| **SQ2-IvQ4 Themes** |
| **Digital tools variety enables pedagogy and content for learning modalities** |
| The value theme for SQ2 interview question 4 showed technology teachers used digital tools to develop pedagogy and content for learning modalities. Technology teachers stated that they developed pedagogy and content to access learning apps and platforms that supported learning modalities. The apps and learning platforms included Jamboard, Pear Deck, Kahoot, Flipgrid, and digital flashcards for interactive lessons to improve learning perception, memory, and sensation. P4 noted using learning platforms for assembling learning models of objects for math to include geometric shapes to do formula matching for finding areas. P8 indicated using the IWB to create PowerPoint lessons for learning content and challenged students to simplify complex material. P7 noted awareness of students learning habits and selected apps and learning platforms to respond to their learning needs. |
| **Digital tools used in content and pedagogy for in-person and virtual learning** |
| The descriptive theme for SQ2 interview question 4 indicated that technology teachers used digital tools for content and in-person and virtual learning pedagogy. Technology teachers pointed out that they facilitated online classes using Zoom and Google Classroom. They noted that students used digital devices to join online classes at home. Some technology teachers said they selected apps and learning platforms ideal for students' learning styles. However, other technology teachers indicated using available technology is not essentially chosen to address students' learning techniques. P1 said, "I |

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| used websites with interactive lessons that remote learning students can use at home" However, P3 said, "I do not consider digital tools to address the essential modalities of learning." Other technology teachers noted that finding suitable digital tools to facilitate different learning modalities is sometimes challenging. P6 said, "Throughout each lesson, conducted on Zoom, each student had the opportunity to engage in the content using all forms of learning modalities." |
| **Digital tools in pedagogy and content enable students to focus on learning** |
| The process theme for SQ2 interview question 4 revealed applying digital tools in pedagogy and content-enabled students to focus and learn. Technology teachers indicated their use of apps and learning platforms, including the Jamboard, Kahoot, and Pear Deck, to model students' engagement. According to technology teachers, students used the interactive learning platforms in lessons to facilitate their learning styles for coping with tasks using the keyboard to manipulate colorful objects used in math, to understand abstract ideas, concepts. They involved students participating with digital tools in problem-based learning in pedagogy and content. P8 indicated encouraging students and challenging their ability to modify lessons presented on PowerPoint slides using online dictionaries and word finds for synonyms. P9 said, "Students participated in classes using their iPads, which helped their learning styles, clarified content in lesson design for auditory, and voice-over to pose questions or give examples to illustrate a point." |
| **SQ2-IvQ5 Themes** |
| **Digital tools and the internet improve pedagogy and content for concepts and formulas** |
| The value theme for SQ2 interview question 5 showed that technology teachers used digital tools to access the internet to improve pedagogy and content for understanding concepts and formulas. Technology teachers noted utilizing the internet to download apps and learning platforms on their IWBs and Promethean Boards for instructing and modeling work in class for students to use their iPads and participate in lessons. They said students used their iPads for researching concepts and understanding abstract ideas using 3D-colored objects animations and playing educational games. P4 said, "I showed my class to use their iPads and access the Starfall learning platform with programs designed with multiple learning games and suited students learning styles to enable learning concepts and solving problems." P9 indicated using the internet connection with the Promethean Board to download apps and learning platforms, introduce students to concepts, and build their problem-solving skills. |
| **Digital tools used for pedagogy and content enhance learning methods** |
| The descriptive theme for SQ2 interview question 5 indicated that technology teachers used digital tools for pedagogy and content for enhancing learning methods. Technology teachers pointed out that they used interactive digital tools to bring a concept to life using animation and video roleplay in simplified ways, using puzzles for vocabulary development and pathfinding games. They noted that the IWB, with its built-in features to enhance pedagogy and content, downloading SIM interactive videos for students to immerse themselves in the lesson and take control of their learning. P6 said, "I incorporate SIM, allowing students to investigate natural phenomena using videos and interactive slides." P5 and P8 noted using the built-in feature of the IWB that stored application and step-by-step solutions for problems-solving and enabled the revision of content for background information for new issues and solutions. |

| **Digital tools used in pedagogy and content enhance learning complex content** |
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| The process theme for SQ2 interview question 5 revealed that technology teachers applied digital tools in pedagogy and content to enhance learning complex content. Technology teachers indicated that the IWBs, Google Docs, and the Jamboard facilitate students' learning styles for understanding complex learning materials such as concepts, formulas, and problem-solving methods. They said using digital tools gave them ideas to simplified instructions using step-by-step procedures to enable learning solutions to math problems for counting and subtracting and using formulas. Some technology teachers said they used the Thinkfinity website for arguments tools in discussions to motivate learners to participate in lessons. P1 indicated using interactive digital tools from websites that allowed students to write or draw directly on the digital application, on slides, to showcase their work and save on Google Drive. P4 noted that the Starfall learning platform provided puzzles for vocabulary development and finding pathways in mazes. It also used keyboard games for students with kinesthetic learning styles to develop their typing skills. P7 said, "I used apps and learning platforms in lesson presentations to motivate learners and encourage their participation." |
| **SQ2-IvQ6 Themes** |
| **Digital tools coaching in pedagogy and content improve students' performance** |
| The value theme for SQ2 interview question 6 showed that technology teachers coached students for digital tools through pedagogy and content lessons. Technology teachers said they coached students during classes to use digital tools for classwork and download apps and learning platforms in Google Classrooms. They pointed out that they engaged students with digital tools, encouraged them to participate in lessons, and used the IWB to make presentations using graphic organizers. According to technology teachers, students used learning centers with digital folders to save their work. P4 said, "I teach my class how to use digital tools to do mini-researches using the Google browser and type description of the procedure used." P5 said, "I empowered students, coaching them how to use their computers in selecting apps to help them complete their assignments and homework to include team hashtags, conversational threads, and networking to communicate with each other." P7 stated, "I facilitated students using their digital tools and coached them in doing classwork." |
| **Digital tools in pedagogy and content improve online learning** |
| The descriptive theme for SQ2 interview question 6 showed that technology teachers used digital tools for pedagogy and content to improve online learning. Technology teachers noted that they did remote classes with students and enhanced their knowledge using interactive platforms to communicate verbally via Zoom or Instagram. P8 indicated using classroom blogs with students and teaching them how to sign in and participate in continuously learning a particular lesson. P6 noted doing online classes with students for interactive reading lessons to access articles and other text materials. P3 said his students go online with their digital tool to access Google Slides for doing work and making presentations. |
| **Digital tools in pedagogy and content enable students for online assignments** |
| The process theme for SQ2 interview question 6 revealed that technology teachers applied digital tools in pedagogy and content to enable students to do online assignments. Technology teachers noted that students could download lessons, use student-friendly apps and platforms to edit and submit assignments, and share their hashtag projects. They |

revealed that coaching students to use digital tools allowed for online tasks and participation in synchronous learning, receiving direct technology teachers' assistance and feedback on assignments. P1 noted using Google Classroom in view mode for PowerPoint lessons and allowed students to edit slides, retrieve their projects and submit their work. P2 said, "I upload students' assignments online and encourage them to do research and present their work in their Google Classroom." P5 noted, "I provided a carousel of activities that students can access on computers to make choices and complete assignments."

## Appendix I: Abbreviation Codes

Master Code list of abbreviation used for subquestion themes to derive RQ themes

| **Values Codes for SQ1 & SQ2 Themes for RQ Themes** | **Descriptive Codes for SQ1 & SQ2 Themes for RQ Themes** | **Process Codes For SQ1 & SQ2 Themes for RQ Themes** |
|---|---|---|
| attitude(at), belief(br) self-efficacy(se), motivation(mt), plan(p), demonstrate(dm), illustrate(il), interest(in), enhance(en), train(tr), adapt(ad), utility(ut), differentiate(df), integration(int), meta-knowledge(mtk), digital tools (dt), introduce(int), design(dg), enhance(de), learning(le), dependency(dpe), apps(ap), learning(ln), platform(pf), pedagogy(pdg), content(con), learning(style(ls), digital devices(dd), capabilities(ca), facilitate(fca), modalities(md), qualities(qu), instruction (ins), dependent(de), pedagogy(pdg), lesson(ln), incorporate(inc), step-by-steps(sbs), significance(sg), dependence(dp), internet(int) | patterns(pt), content(con), pedagogy(pdg), concept(cc), objective(obj), procedure (pr), choice(ch), apply(apl), include(icd), interactive(iv), enhance (en) digital tools (dt), meta-knowledge(mtk), design(dg), enhance(en), learning(ln), process(pr), facilitate(fct), research(rsc), different(df), modalities(md), digital devices(dv), virtual(vt), in-person(ip), modalities(md), assignments(asg), ability(ab), academic(ac), studies(st), enable(en), learning styles(ls), consult(cn), share(sh), research(rs), simplify(smp), learning platform(lpf), step-by-steps(sbs), | patterns(pt), selecting(sl), researching(rs), applying (ap), reading(rdg), creating (cr), analyzing (anl), coach(ch), digital tools (dt) discussing(dis), listening(lst), coloring(col), matching(mt), clarifying(cl), differentiating (dfg), social learning(sl), access(acs), digital tools(dt), enhance(en), academic(acd), learning(ln), facilitate(fct), network(nw) teachers(tr), manage(mg), progress(pgr), different, strategies(stg), areas(as), pedagogy(pdg), content(con), focus(fc), learn(ln), step-by-steps(sbs), measure(ms), quality(qlt), learning process(lpr), search engines(seng) |

## Appendix J: RQ Themes Derived From SQ1 & SQ2 Themes

**Key:**
SQ1-IvQ#: Sub-Question1-Interview Question #
SQ2-IvQs#: Sub-Question2 Interview Questions #
Value Code: Color Green; Descriptive Code: Color blue; Process Code: Color Yellow

| **SQ1 Themes and SQ2 Themes** | **Abbreviated Codes for Deriving RQ Themes** | **Derived of RQ Themes** |
|---|---|---|
| SQ1-IvQ1 Themes<br>Digital tools variety enhances student-centered learning across different subject areas.<br>Digital tools enhance instruction and motivate students for learning.<br>Digital tools are used to enhance learning and facilitate remote classes.<br><br>SQ2-IvQ1&2 Themes<br>Apps and learning platforms used to enhancing pedagogy and content.<br>Digital tools enhance a step-by-step learning process in pedagogy and content.<br>Training with digital tools helps to enhance pedagogy and content.<br>Digital tools choice enhances pedagogy and content for learning styles.<br>Digital tools used to enhance pedagogy and content for students' participation.<br>Students' participation in pedagogy and content planning enhance active learning. | enable, learning, facilitate, student – centered<br><br>enhance, motivate, instruction, learning<br><br>interactive, learning, levels, facilitate<br><br>1*apps, learning, dependent, pedagogy, content, lesson, incorporate, step-by-step<br>*pedagogy, content, enable, learning styles competent, training,<br>*facilitate, digital tools, learning<br>2*dependency, digital tool,<br>apps, learning platform, pedagogy, content, learning style, enhance<br>*digital tools, research facilitate pedagogy, content, different modalities<br>*learning, teachers, manage, digital tools, progress, different, strategies, facilitate, | 1. Enhancing pedagogy and content with digital tools |

| SQ1 Themes and SQ2 Themes | Abbreviated Codes for Deriving RQ Themes | Derived of RQ Themes |
|---|---|---|
| SQI-IvQ2 Themes<br>Digital tools trusted to enhance instruction and learning.<br>Digital tools used in a variety of ways enhance instruction and learning.<br>Digital tools learning apps and platforms facilitate students' learning modalities.<br>SQ2-IvQ3&4 Themes<br>The internet enables new digital learning materials for pedagogy and content.<br>Apps and learning platforms used for creative pedagogy and content.<br>Digital tools and search engines for complex learning material in content and pedagogy.<br>Digital tools variety enables pedagogy and content for learning modalities.<br>Digital tools used in content and pedagogy for in-person and virtual learning.<br>Digital tools in pedagogy and content enable students to focus on learning | digital tools, trust, learning, enhance, instruction<br>digital tools, variety, enhance instruction, learning<br>digital tools, learning apps, platforms, facilitate, modalities<br><br>3*significance, dependence, internet, instruction,<br>*consult, share, research simplify, learning platform, process, content<br>*learning process, digital tools, search engines, content<br><br>4*digital devices, learning, capabilities, facilitate, modalities<br>*digital devices, virtual learning, in-person, facilitate, modalities<br>*strategies, areas, facilitate, pedagogy, content, focus, learn | 2. Selecting digital tools trusted for quality in teaching |
| SQ1-IvQ3 Themes<br>Digital tools are relied on for enabling understanding of complex learning materials.<br>Digital tools help to define concepts, formulas, | digital tools, understanding, concepts, formulas , problem solving enhance, understanding, concepts, formulas, | 3. Relying on digital tools for problem-solving |

| SQ1 Themes and SQ2 Themes | Abbreviated Codes for Deriving RQ Themes | Derived of RQ Themes |
|---|---|---|
| and problem-solving.<br>Digital tools enable teaching and learning across subject areas.<br><br>SQ2-IvQ2&5<br>Digital tools choice enhances pedagogy and content for learning styles.<br>Digital tools used to enhance pedagogy and content for students' participation.<br>Students' participation in pedagogy and content planning enhances active learning.<br>Digital tools and the internet improve pedagogy and content for concepts and formulas.<br>Digital tools used for pedagogy and content enhance learning methods.<br>Digital tools use in pedagogy and content enhance learning complex content. | problem solving, digital tools, teaching, learning, areas, easy, understand<br><br>2*dependency, digital tool,<br>apps, learning platform, pedagogy, content, learning style, enhance<br>*digital tools, research facilitate pedagogy, content, different modalities<br>*learning, teachers, manage, digital tools, progress, different, strategies, facilitate,<br>5*Teachers, internet, research, concept, strategies<br>pedagogy, content, interactive,<br>*incorporate, enhance, learning, methods, pedagogy, content<br>*coach, digital tools, step-by-step, understand, concept, problem solving | |
| SQ1-IvQ4 Themes<br>Digital tools apps and learning platforms enhance learning methods.<br>Digital tools varieties enabled different choices for teaching strategies.<br>Digital tools are designed for interactive learning to simplify complex material. | digital tools, apps, learning platform, simplify, complex, variety<br>digital tools, variety, enable, different, choice, teaching strategies, enhance<br>digital tools, design, interactive, learning, enable, learners, complex material | 4. Internet availability for learning platforms and apps |

| SQ1 Themes and SQ2 Themes | Abbreviated Codes for Deriving RQ Themes | Derived of RQ Themes |
|---|---|---|
| SQ2-IvQ3&5 Themes<br>The internet enables new digital learning materials for pedagogy and content.<br>Apps and learning platforms used for creative pedagogy and content.<br>Digital tools and search engines for complex material in content and pedagogy.<br>Digital tools and the internet improve pedagogy and content for concepts and formulas.<br>Digital tools used for pedagogy and content enhance learning methods.<br>Digital tools used in pedagogy and content enhance learning complex content. | 3*significance, dependence, internet, instruction,<br>consult, share, research simplify, learning platform, process, content<br>learning process, digital tools, search engines, content<br><br>5*tech teachers, internet, research, concept, ,strategies pedagogy, content, interactive,<br>*incorporate, enhance, learning, methods, pedagogy, content<br>*coach, digital tools, step-by-step, understand, concept, problem solving | |
| SQI-IvQ5 Themes<br>Digital tools learning apps and platforms facilitate student-centered learning.<br>Digital tools enable using apps to cope with students learning needs.<br>Digital tools interactive use promotes learning and understanding.<br><br>SQ2-IvQ3&4 Themes<br>The internet enables new digital learning materials | Digital tools, apps, platform, enable, student-centered, modalities, virtual, experiences<br>apply, instructional strategies, available, digital tools, difference, learners<br>Digital tools, instruction, learning trust choice, apps, learning platforms<br><br>3*significance, dependence, internet, instruction, | 5. Enhancing learning with learning-platforms and apps |

| SQ1 Themes and SQ2 Themes | Abbreviated Codes for Deriving RQ Themes | Derived of RQ Themes |
|---|---|---|
| for pedagogy and content<br>Apps and learning platforms used for creative pedagogy and content.<br>Digital tools and search engines for complex learning material for content and pedagogy.<br>Digital tools variety enables pedagogy and content for learning modalities.<br>Digital tools used in content and pedagogy for in-person and virtual learning.<br>Digital tools in pedagogy and content enable students to focus on learning. | *consult, share, research simplify, learning platform, process, content<br>*learning process, digital tools, search engines, content<br><br>4*digital devices, learning, capabilities, facilitate, modalities<br>*digital devices, virtual learning, in-person, facilitate, modalities<br>*strategies, areas, facilitate, pedagogy, content, focus, learn | |
| SQ1-IvQ6 Themes<br>Digital tools designs are trusted choices for apps and learning platforms.<br>Digital tools apps and learning platforms rely on the internet for usefulness.<br>Technology teachers explore the usability of digital tools for the class.<br><br>SQ2-IvQ2&3 Themes<br>Digital tools choice enhances pedagogy and content for learning styles.<br>Digital tools used to enhance pedagogy and content for students' participation.<br>Students' participation in | Digital tools, instruction, learning, trust, choice, apps, learning platform<br>Digital tools, apps, learning platform, internet, useful<br>Explore, usability, digital tools, introduce, class, comfort level<br><br>2*dependency, digital tool,<br>apps, learning platform, pedagogy, content, learning style, enhance<br>*digital tools, research facilitate pedagogy, content, different modalities | 6. Digital tools and the internet enhance learning styles |

| SQ1 Themes and SQ2 Themes | Abbreviated Codes for Deriving RQ Themes | Derived of RQ Themes |
|---|---|---|
| pedagogy and content planning enhance active learning.<br>The internet enables new digital learning materials for pedagogy and content.<br>Apps and learning platforms used for creative pedagogy and content.<br>Digital tools and search engines for complex material in content and pedagogy. | *learning, teachers, manage, digital tools, progress, different, strategies, facilitate, 3*significance, dependence, internet, instruction, *consult, share, research simplify, learning platform, process, content *learning process, digital tools, search engines, content | |
| SQ1-IvQ7 Themes<br>Digital tool are primary for student-centered learning.<br>Digital tools facilitate for students learning styles.<br>Students are coached to use digital tools in student-centered learning.<br><br>SQ2-IvQ2&4 Themes<br>Digital tools choice enhances pedagogy and content for learning styles.<br>Digital tools used to enhance pedagogy and content for students' participation.<br>Students' participation in pedagogy and content planning enhance active learning.<br>Digital tools variety enables pedagogy and content for learning modalities.<br>Digital tools used in | digital tool, introduce, design enhance, learning<br>digital tools, design, enhance, learning, process facilitate coach, access, digital tools, access, enhance, academic, learning, facilitate, network<br><br>2*dependency, digital tool,<br>apps, learning platform, pedagogy, content, learning style, enhance<br>*digital tools, research facilitate pedagogy, content, different modalities<br>*learning, teachers, manage, digital tools, progress, different, strategies, facilitate, 4.digital devices, learning, capabilities, facilitate, modalities<br>*digital devices, | 7. Digital tools facilitate students-centered learning |

| SQ1 Themes and SQ2 Themes | Abbreviated Codes for Deriving RQ Themes | Derived of RQ Themes |
|---|---|---|
| content and pedagogy for in-person and virtual learning.<br>Digital tools in pedagogy and content enable students to focus on learning. | virtual learning, in-person, facilitate, modalities<br>*strategies, areas, facilitate, pedagogy, content, focus, learn | |
| SQ1-IvQ8 Themes<br>The internet facilitates searches for students' backgrounds and learning styles.<br>Digital tools facilitate for students' background in learning.<br>Digital tools for keeping abreast of students' practices for lesson planning.<br><br>SQ2-IvQ4&6 Themes<br>Digital tools variety enables pedagogy and content for learning modalities.<br>Digital tools used in content and pedagogy for in-person and virtual learning.<br>Digital tools in pedagogy and content enable students to focus on learning.<br>Digital tools coaching in pedagogy and content improve students' performance.<br>Digital tools in pedagogy and content improve online learning.<br>Digital tools in pedagogy and content enable | Internet, facilitate, search, background, learning styles<br>Digital tools, lessons, relate, cultural experience, environment<br>Digital tools, abreast, culture, learning, interest planning<br><br>4*digital devices, learning, capabilities, facilitate, modalities<br>*digital devices, virtual learning, in-person, facilitate, modalities<br>*strategies, areas, facilitate, pedagogy, content, focus, learn<br>6*dependency, digital, learning, empowering, coaching, classroom practices<br>*online, empower, learning, digital tools, empower, direction, presentation<br>*coach, digital device, online, accomplish, assignment | 8. Digital tools facilitate students' learning backgrounds |

| SQ1 Themes and SQ2 Themes | Abbreviated Codes for Deriving RQ Themes | Derived of RQ Themes |
|---|---|---|
| students for online assignments. | | |
| SQ1-IvQ9 Themes<br>Digital tools quality evaluated for reliability to facilitate instruction and learning.<br>Digital tools used in students' academic studies and assignments.<br>Students' performance measure the quality of digital tools | Digital tools, qualities, facilitate, instruction, learning assignments, ability digital tools, academic, studies performance, digital tools, measure, quality | *9*. Students' performance used in digital tools' quality |
| SQ2-IvQ1&3 Themes<br>Apps and learning platforms used to enhance pedagogy and content.<br>Digital tools enhance a step-by-step learning process in pedagogy and content.<br>Training with digital tools helps to enhance pedagogy and content.<br>The internet enables new digital learning materials for pedagogy and content.<br>Apps and learning platforms used for creative pedagogy and content.<br>Digital tools and search engines for complex learning material in content and pedagogy. | 1*apps, learning, dependent, pedagogy, content, lesson, incorporate, step-by-step<br>*pedagogy, content, enable, learning styles<br>*competent, training, facilitate, digital tools, learning<br>3*significance, dependence, internet, instruction,<br>*consult, share, research simplify, learning platform, process, content<br>*learning process, digital tools, search engines, content | |

## Appendix K: Analysis of RQ Themes 1-9

Analysis of pooled SQ1 & SQ2 (value, descriptive, & process) theme for derived RQ themes

| |
|---|
| ***Enhancing pedagogy and content with digital tools.*** Digital tools enhanced pedagogy and content to enable student-centered learning and styles. P8 said," I used the problem-based learning platform for pedagogy and content to facilitate for student-centered learning to solve problems through knowledge acquisition and enhanced group collaboration for content-based learning." Technology teachers indicated that digital tools motivated students to learn using pedagogy in a step-by-step learning process in creative ways for students' participation. P7 noted, "I used digital tools for a step-by-step process to motivate students for learning concepts with games; students were immersed virtually in games as characters for problem-solving and doing research." According to technology teachers, digital tools were used in pedagogy and content for interactive learning and enabled remote classes. They indicated getting trained to use digital tools to enhance pedagogy and content and encourage active learning. P6 said, "In our professional development training, we incorporated digital platforms with someone having adept knowledge to guide us, and we thoroughly explored the tools to ensure that they were useable." |
| |
| ***Digital tools facilitate student-centered learning.*** Digital tools were primary for student-centered learning and learning styles with content variety to enhance students' learning techniques and creativity, enabling students' motivation and participation. P2 noted, "I used iPads with my students for student-centered learning and selected apps and learning platform to suit students' learning styles and encouraged their participation in the lesson. P9 said, "I coached my students to use digital tools to enhance their work by downloading videos making a shortlist of content material, and assessed for the context of presentation before suitable assembling in PowerPoint." Technology teachers noted that digital tools enabled in-person and virtual learning, and by coaching students, they could use digital tools to explore student-centered learning. According to technology teachers, in pedagogy and content planning, they encouraged students' active participation to develop lessons to engage their learning and focus in class. P5 noted, "In the online class, I assigned students using their digital device in break-out rooms to do research and projects, compiling learning material using iMovie, posters, and graphics for easy learning." |
| |
| ***Digital tools and the internet enhance learning styles.*** The internet and search engines enabled locating choice apps and learning platforms and facilitated new digital learning materials for pedagogy and content. P7 said, "I used search engines for Google, Yahoo, and Teacher Tube to discover new trends in technology for simplifying the presentation of content using learning platforms such as Google Docs and Slides. Technology teachers indicated that they relied on the internet for usefulness and creative ways to enhance content for students' participation and creative learning, explored the usability of digital |

tools for class, and encouraged content planning to promote students' active learning. P8 noted, "I used the internet to find appropriate teaching models and teaching strategies that included pedagogical methods to suit students learning styles." Using search engines enabled resources and complex learning material for content and pedagogy. P6 said, "I used SIM learning platform to enable virtual hands application of learning materials to reduce the complex nature and enhance students learning styles."

***Digital tools facilitate student-centered learning.*** Digital tools were primary for student-centered learning and learning styles with content variety to enhance students' learning techniques and creativity, enabling students' motivation and participation. P2 noted, "I used iPads with my students for student-centered learning and selected apps and learning platform to suit students' learning styles and encouraged their participation in the lesson. P9 said, "I coached my students to use digital tools to enhance their work by downloading videos making a shortlist of content material, and assessed for the context of presentation before suitable assembling in PowerPoint." Technology teachers noted that digital tools enabled in-person and virtual learning, and by coaching students, they could use digital tools to explore student-centered learning. According to technology teachers, in pedagogy and content planning, they encouraged students' active participation to develop lessons to engage their learning and focus in class. P5 noted, "In the online class, I assigned students using their digital device in break-out rooms to do research and projects, compiling learning material using iMovie, posters, and graphics for easy learning."

***Selecting digital tools trusted for quality in teaching.*** Technology teachers trust using digital tools for downloading new learning materials for pedagogy, content, and learning modalities. P9 noted, "Depending on my topic for a presentation, I downloaded apps or a learning platform on my Promethean Board and for interactive and cooperative learning with my students to simplify learning materials to enhance their understanding." Technology teachers pointed out that digital tool, in various ways, improved instruction and learning by utilizing apps and learning platforms for creativity for in-person and virtual learning. P5 indicated, "I used digital tools in my computer lab in creative ways for interactive teaching and learning to stimulate my students learning new content that shows real-world virtual application." According to technology teachers, learning apps and platforms facilitated students' learning modalities, and search engines enabled simplifying complex learning material, allowing the students to focus and learn. P1 revealed, "I selected digital tools based on my students' learning styles and used child-friendly websites with lots of pictures presenting complex material for easy and visual understanding."

***Students' performance used in assessing digital tools' quality.*** Digital tools qualities were evaluated for reliability to facilitate instruction and learning and build students' interest and confidence in pedagogy and content using the internet for downloading new digital learning materials for academic studies and assignments. P4 said, "I observed my

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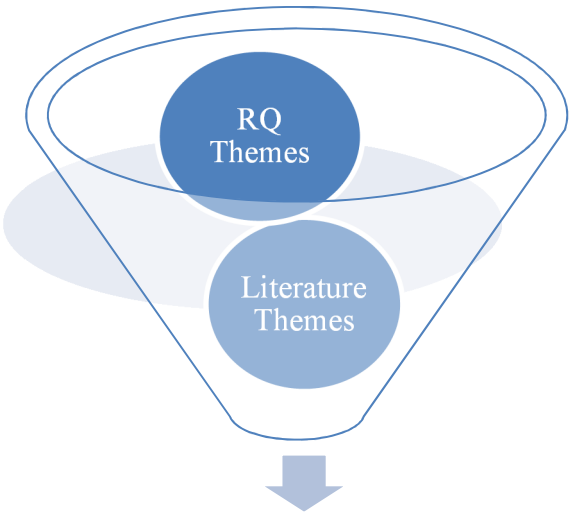
| students using their iPads to complete learning tasks given directions to follow. Then, I do a formative evaluation of their work, their learning challenges, and interest and determine how well they used apps and learning platforms so I can make better digital tools choices." Technology teachers indicated that they incorporated digital tools in a step-by-step learning process utilizing apps and learning platforms for creativity and measured the quality of digital tools. According to technology teachers, the internet and search engines find curriculum material for content and pedagogy. P8 said, "I selected apps and learning platforms based on students' ability to use their desktop computers and other learning programs, and coached them in step-by-step learning to develop their reading and vocabulary skills." P1 noted, "I used websites that have interactive lessons that students could build their confidence for in-person learning or in remote classes at home." |
| |
| ***Internet availability for learning platforms and apps***. Technology teachers used the internet to download apps and learning platforms finding new digital learning materials to improve pedagogy and content for concepts and formulas, and enabled different teaching strategies. P3 noted, "I used the IWB in mathematics because of its design to store models and application of formulas and images; however, my concern is to having internet and Wi-Fi without interruptions." Technology teachers noted that Google Classrooms, apps, and learning platforms allowed creative pedagogy and content-enhancing learning methods. P1 stated, "As a remote technology teacher, I post work in Google Classroom that I created using Google Docs or Google Forms that students can see on my share screen to retrieve and edit." Technology teachers revealed that digital tools were designed for interactive learning to simplify complex material using search engines for content and pedagogy that enhances learning complex content. P9 indicated, "I used the Promethean Board in inquiry-based learning to enhance my lessons in interactive ways to improve students' perception, memory, and sensation in a topic." |
| |
| ***Enhancing learning with learning-platforms and apps.*** Digital tools learning apps, and platforms facilitated downloading new digital learning materials for pedagogy and content to enhance learning modalities and cope with students learning needs. P6 noted, "The apps and learning platforms that we used in our classes were Nearpod, Pear Deck, and Google Suite, which allowed for voice-overs as well as to include students verbalize response, which was also high in visual and kinesthetic activities." Technology teachers pointed out that apps and learning platforms enabled creative pedagogy and content for in-person and virtual learning and promoted knowledge and understanding. P7 indicated, "I know how my students learn; therefore, I select apps and learning platforms that I used in in-person class and easily adapted to online class enabling students' learning styles for auditory, visual and kinesthetic learning." Technology teachers noted that search engines allowed finding problem-solving and annotating content examples to simplify complex learning material for content and pedagogy to enable students to focus and learn. P9 stated, "I used search engines for finding accessible learning content, for my students to interact and learn complex content in easy ways." |

| |
|---|
| ***Relying on digital tools for problem-solving***. Digital tools were relied on to understand complex learning materials and enhanced learning styles to improve understanding of concepts and formulas. P4 indicated, "I used digital tools to download apps and learning platforms that showed step by step procedures for solving complex problems, mirroring the use of formulas, concepts, and vocabularies, matching with geometric shapes." Technology teachers said digital tools helped to define concepts, formulas and enable problem-solving. They noted having confidence in using digital tools for downloading new learning materials for pedagogy, content, and learning modalities. P9 stated, "Depending on my topic for a presentation, I downloaded apps or a learning platform on my Promethean Board and for interactive and cooperative learning with my students to simplify learning materials to enhance their understanding." Technology teachers pointed out using digital tools in various ways improved instruction and learning by utilizing apps and learning platforms for creativity for in-person and virtual learning. P5 indicated, "I used digital tools in my computer lab in creative ways for interactive teaching and learning to stimulate my students learning new content that shows real-world virtual application." According to technology teachers, learning apps and platforms facilitated students' learning modalities, and search engines enabled simplifying complex learning material, allowing the students to focus and learn. P1 revealed, "I selected digital tools based on my students' learning styles and used child-friendly websites with lots of pictures presenting complex material for easy and visual understanding of formulas, and problem-solving across subject areas." P3 noted, "I used a variety of online learning resources such as student-friendly platforms and websites that helped to simplify complex learning materials making it easy for students to understand." Technology teachers said they encouraged students' participation and active learning through learning methods to enhance learning complex content. P2 said, "I used digital tools in simplified ways to give instruction, to make it easy for students to understand the content, making learning fun and interesting." |

**Appendix L: Model - RQ Themes & Literature Themes Proposed for Discussion**



## Appendix M: RQ Themes & Literature Themes for Interpretation of Findings

| RQ themes | Literature Review themes |
|---|---|
| Enhancing pedagogy and content with digital tools. | Digital tools are relied on for improving instruction and learning through technology pedagogy and content (Aflalo et al., 2018; Flewitt et al., 2015; Koehler et al., 2017; Monem et al., 2018). |
| Digital tools facilitate students-centered learning. | Teachers facilitating students' learning styles with digital tools enable them to improve academic learning in in-person and virtual learning to develop hands-on digital tools skills (De Vita et al., 2018; Palladino & Guardado, 2018; Segal & Heath, 2020). |
| Digital tools and the internet enhance learning styles. | Teachers using the internet as their primary technology resource enable meaningful planning for pedagogy and content to facilitate students' learning styles and comfort levels (Karim et al., 2019; Kaur et al., 2017; Tan et al., 2018). |
| Digital tools facilitates students' learning backgrounds. | Meaningful instructional planning for pedagogy and content includes students' background information and allows students to take responsibility for learning and improvement in academic performance (Dooley et al., 2016; Durdu & Dag, 2017; Konokman & Yelken, 2016). |
| Selecting digital tools trusted for quality in teaching. | Digital tools trusted for the knowledge shared among technology users helps to improve teachers' performance and students' learning (Chin et al., 2019; Kalonde, 2017; Öman, & Hashemi, 2015). |
| Students' performance used in assessing digital tools' quality. | Students' performance and academic learning with digital tools offer significant insight into digital tools' quality for interactive learning (Al-Abdullatif et al., 2019; Alqurashi et al., 2017; Sousa et al., 2017). |
| Internet availability for learning platforms and apps. | Teachers' effective use of the internet allows digital tools to improve pedagogy and content to simplify complex material and motivate students (Aflalo et al., 2018; Peterson et al., 2020; Segal & Heath, 2020). |
| Enhancing learning with learning-platforms and apps. | Incorporating apps and learning platforms in instruction allows for enhanced pedagogy and content to address multimodal learning styles and interactive learning (Alqurashi et al., 2017; Kaur et al., 2017; Von-Wangenheim et al., 2017). |
| Relying on digital tools for problem-solving. | Teachers facilitate learning styles with digital technology using apps and learning platforms to enhance the presentation and students' focus and understanding (Bingimlas, 2018; Chu et al., 2015; De Vita et al., 2018). |