Walden University

College of Education and Human Sciences

This is to certify that the doctoral study by

Ayana Paskins

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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2023

Abstract

Classroom Teachers' Perceptions of their Knowledge of Content and Pedagogy in Terms of a Technology-Driven Lesson

by

Ayana Paskins

MA, Cheyney University, 2008

BS, Rowan University, 2002

Project Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

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Abstract

The influx of technology in the high school classroom has increased the demand for technology integration. But teachers struggle to implement technology in their lessons, which suggests that there may be barriers in their knowledge of content and pedagogy in a technology-driven lesson design. The purpose of this basic qualitative study was to investigate teachers' perceptions of their knowledge of content and pedagogy for incorporating technology in lesson design as aligned with the TPACK framework. A basic qualitative design was used to answer two research questions focused on the high school teachers' perceptions of their knowledge, their pedagogy, and their barriers when designing technology-driven lessons. Data were collected using semi structured interviews of 13 certified core subject teachers employed by Public Magnet High School (pseudonym) teaching Grades 9–12. The process for analyzing the data started with a deductive analysis followed by an inductive analysis for themes to emerge. Results indicated that teachers were competent in their content knowledge but lacked sufficient knowledge in pedagogy and technology to create an appropriate technology-based lesson in their content area. Based on the findings, a 3-day professional development was created for teachers on learning objectives, types of pedagogies, and content-specific technologies, all based on Bloom's revised taxonomy. This study is expected to impact social change by providing administrators, instructional designers, and lead teachers with a more in-depth understanding of the barriers that exist within technology integration and its relationship with content and pedagogy to improve classroom instruction, thus improving students' academic achievement.

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Dedication

This project study is dedicated first to my Lord and Savior Jesus Christ. It was only with his help that I was able to accomplish this task. To my parents, Laverne and Burns Rose, for your continuous love, encouragement and drive that was instilled in me from the beginning. To my children, Alexis, Chad Jr., Chase, Alecia, and Chance for encouraging me and allowing space for me to finish. You can do anything through Christ who strengthens you. Lastly, to Lisa N. Wren, who took on this last lap with me for me to finish. Thank you for stepping in as an editor and for all the prayers, encouragement and pushes to finish. I could not have completed this without you.

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I would like to express the deepest appreciation to my committee chair, Dr. Esther Javetz, for her patience and faith in me. You are the one who guided me through this entire process by motivating, challenging me, and pulling things out of me that I did not know existed. I could not imagine having a better chair for this process.

I would also like to thank my second chair, Dr. Howard Moskowitz, for his guidance and input on my study.

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Section 1: The Problem

The Local Problem

Today's high school classroom dynamics have changed because of the influx of technology in the high school classroom. The U.S. Department of Education's Office of Educational Technology (OET, 2017) established a National Education Technology Plan stating that technology could be a powerful tool for transforming learning, which can help affirm and advance relationships between educators and students, reinvent approaches to learning and collaboration, shrink long-standing equity and accessibility gaps, and adapt learning experiences to meet the needs of all learners. The distinct types of technology in the learning environment motivate students already accustomed to using technology to visualize the content, making meaningful learning possible (Dinc, 2019). Despite the affordances of technology-enhanced learning, its integration into mainstream education is currently slow (Georgiou & Ionnou, 2019).

The problem investigated in this study is that teachers struggle to implement technology in the high school classroom, which suggests that there may be barriers in their knowledge of content and pedagogy in a technology-driven lesson design. Technologies often come with imperatives that constrain the content that must be covered and the nature of possible representations. Understanding how to use these components to drive meaningful instruction is essential for effective teaching. When problems arise in these areas, teachers must evaluate and decide how to approach the issue (Kale et al., 2020). The interplay of content, pedagogy, and technology knowledge is central to good teaching (Mishra & Koehler, 2006).

The study site is a Title I public magnet high school (PMHS) located in an economically disadvantaged suburb in the southern United States. The research site employs over 243 teachers, all content certified, to teach over 4,143 students in Grades 9-12th (Texas Education Agency, 2021). According to ABC School District, 39% of teachers stated inadequate support for technology, and 32% stated a lack of professional development. All teachers must integrate technology into their lessons but are comfortable with traditional teaching methods. Presenting the content area they have used for years and using the technology within their lessons has become troublesome (A. Burns, personal communication, February 5, 2021).

The district provides over 3,076 training sessions for central staff and teachers yearly, as teachers must complete 21 hours of professional development a year. The number of training sessions can fluctuate throughout the year. In the past, professional learning and development included professional learning academies, workshops, online learning, customized professional learning events, lunch & learns, and facilitated professional book studies. Example topics of training sessions can range from business academies for central staff to basics of Microsoft Excel or building a positive classroom for teachers. The professional development provided is limited because about one-fourth of the training sessions are geared toward high school teachers teaching a specific content area; that number dwindles when technology is added to the mix. There is limited technology professional development depending on grade and subject area as the district services PK-12th grade teachers and central staff. Among the district's diverse topics, not

all fit the teachers' needs, issues, knowledge, and different pedagogies. The professional development topics are at the teachers' discretion.

Depending on the technology tool, the district provides these various training sessions facilitated by district employees and outside contractors. Teachers can register or watch training sessions through Cornerstone, a learning management system the district uses. In Cornerstone, training sessions filter by grade, subject area, or interests. The modules in Cornerstone provide teachers with activities that they can use with students in the classroom to promote academic achievement. One of the online learning events is titled X Marks the Spot: Digital Scavenger Hunts, in which teachers learn how to blend the tried-and-true fun of scavenger hunts with mobile technology to create a learning experience for students. This digital scavenger hunt is a great idea to motivate, engage, and team build among students. The students are placed on teams and must work together and snap and upload photos to complete the mission, a wonderful way to enhance the content taught (S. Lafayette, personal communication, February 4, 2021). In the course, Your Favorite Strategy with Technology: It All Adds Up, teachers learn that effective technology integration means much more than creating a digitized worksheet in the online video course. Teachers will learn that technology can amplify the experience, feedback, and outcomes while adding favorite tech tools to high-impact instructional strategies. This workshop will take preferred thinking routines or learning strategies and analyze how technology can boost students' learning. However, these courses are not grade or content specific. The strategies or technology tools infused into the lesson design are general and not specific to the teachers' needs.

In its current state, in-person professional development has ceased due to the COVID-19 pandemic. Due to the global shutdown, school was no longer in person but virtual, which caused an unprecedented shift in the educational system. Professional development availability and scheduling also dropped. The pandemic has challenged teachers to teach completely virtual and integrate technology with limited professional development. However, the district school superintendent expects the teachers to enhance the learning environment using useful technological tools and instructional strategies. ABC School District stated that their goal is to create experiences for all students to utilize evolving technology to enhance their academic achievement, career readiness, and leadership in a global society.

For technology-enabled learning to occur in classrooms, a greater understanding of the process by which teachers develop this way of producing lessons is required, rather than just a novel approach but a pedagogical belief (Prestridge, 2017). There is a need for research on how to support teachers' technology integration in the classroom (Hutchinson & Woodward, 2018, p. 2). Teachers' pedagogical beliefs might hinder or prevent technology integration. Teachers with contented traditional beliefs do not believe using technology is necessary when traditional practices continue to work, and a better understanding is needed to improve learning (Blundell et al., 2020; Tondeur et al., 2017). Technology can empower educators by building new experiences for deeper exploration of content. Teachers can become engineers of collaboration, designers of learning experiences, leaders, guides, and catalysts of change (U.S. Department of Education's Office of Educational Technology, 2017).

Rationale

According to ABC school district's technology plan, educators and teachers need opportunities to align and refine curriculum content standards that will utilize technology to reach all learners anytime/anywhere and to produce graduates equipped to excel in the workplace and postsecondary education. For this to occur, the ABC district technology plan claims that educators need opportunities to gauge their technology proficiency, develop an individualized training plan, and improve classroom strategies that infuse technology applications and life-ready skills into the core curriculum (District ABC website). The district provides training for teachers, yet there remains a lack of training from teachers' point of view.

The PMHS profile stated that only 37% of students met their grade level on their State of Texas Assessment Academic Readiness (STAAR) Algebra I test for ninth graders, and 45% of students met grade level on their English I STAAR test. The school needs to improve academic achievement results, and technology integration can engage more students and improve their academic results. In a study on the relationship between integrating digital pedagogies and improving exam performance, over 89% of the students reported that digital pedagogy helped them prepare for the exam (Coovadia & Ackerman, 2021). The findings showed that students believed that the teachers' use of digital pedagogy and approach to technology integration significantly improved exam performance.

Evidence in Literature

The lacking digital pedagogy found in PMHS is mentioned in the literature. Even though progress in technology usage in U.S. schools has been made since the National Educational Technology Plan in 2010, which was established to allow teachers to integrate technology in practical ways, it is yet to be present in many classroom settings (U.S. Department of Education, 2017). The technology integration for teaching and learning in the classroom has transpired sporadically, even though it has been mandated for many years and schools are fully equipped (Williams, 2017). There is a need for teachers to learn how to improve their skill sets to integrate technology into their teaching.

Extrinsic and intrinsic influences limit teachers' use of technology in the classroom, even though there is a desire to do so. The following extrinsic factors delay the infusion of technology in the classroom: access to technology, time, support, and lack of professional development and training (Dinc, 2019). PBS Learning Media conducted a survey of 502 teachers, and half of them stated that the lack of training is one of the most significant barriers to incorporating technology (U.S. Department of Education's OET, 2017). Internet access, sufficient bandwidth, and access to technology hardware are other extrinsic factors teachers face (Durff & Carter, 2019).

Intrinsic influences may also deter teachers from using technology in the classroom. Intrinsic influences include genetic, physiological, and pathological characteristics, which are the traits internal to a person rather than determined by their environment. This includes teachers' practices and pedagogy (Prestridge, 2017). It also

includes teachers' knowledge of content and pedagogy. Pedagogy and efforts with technology build on the teachers' acceptance of technology and their perspective on using it as a learning tool in the classroom. But intrinsic influences such as teachers' confidence in using technology and their belief in the usefulness of technology relevant to this context are not well understood (Blundell et al., 2020; Dinc, 2019). Wang (2021) found that intrinsic obstacles were established classroom practices and a lack of teachers' willingness to change. However, there is limited research on teachers with experience utilizing digital pedagogies in established technology environments, consciously seeking to transform their practice. The relationship between training, teachers' pedagogies, and content is significant in technology integration (Mishra & Koehler, 2006). The lack of emphasis on digital pedagogy by teacher education programs has contributed to the lack of intrinsic motivation of teachers to use technology.

Historically, teacher education programs have focused on knowledge of content or pedagogy, and they were treated as two mutually exclusive domains (Mishra & Koehler, 2006). The programs do not emphasize the use of technology in lesson design. The technological pedagogical content knowledge (TPACK) framework challenges this archaic approach to instruction, focusing on the intersection of technology, pedagogy, and content knowledge. It provides the structure that shows how these three types of knowledge overlap and can be used to identify the areas lacking in technology integration.

The purpose of this qualitative study was to investigate teachers' perceptions of their knowledge of content and pedagogy for incorporating technology in lesson design

and any barriers they may be facing with the development of technology-driven lessons. A basic qualitative design is utilized as the design of this study. The study used semi structured interviews to determine the teachers' perceptions. The interviews uncovered the participant's in-depth point of view that guides their actions.

Definition of Terms

Active learning: An instructional method opposite from the traditional one which transmits content to be consumed by the student, but it is defined as an approach to learning that requires students to engage in its process by doing meaningful learning activities (Pantic & Cain, 2022).

Barriers for technology integration: Obstacles preventing teachers' success in technology integration (Dinc, 2019).

Conceptual knowledge: The basic knowledge about relationships and interconnection of ideas and network of information, enabling one to explain and bring meaning to procedures (Aytekin & Sahiner, 2019; McCormick, 1997).

Content knowledge: Knowledge about the actual content matter that is to be learned or taught (Mishra & Koehler, 2006).

Pedagogical knowledge: "Deep knowledge about the processes and practices or methods of teaching and learning and how it encompasses, among other things, overall educational purposes, values, and aims. Generic form of knowledge involved in all student learning issues, classroom management, lesson plan development, and implementation" (Mishra & Koehler, 2006, p. 1027).

Pedagogy: How the teacher delivers the curriculum to the class (Infinedo et al., 2020).

Procedural knowledge: It is the knowledge of sequences of actions to accomplish a specific goal (Vamvakoussi et al., 2019).

Technology integration: Effective use of technology, the inclusion of technology in course curriculum, increasing engagement, and visualizing the course content (Dinc, 2019).

Technology-driven lesson design: "A lesson that uses technology tools to facilitate students' learning" (Dewi et al., 2019, p. 93).

Significance of the Study

The purpose of this study was to investigate teachers' perceptions of their knowledge of content and pedagogy for incorporating technology in lesson design as aligned to the TPACK model. The study identified barriers that teachers face in the development of technology-driven lessons. The findings improve the understanding of teachers' perceptions of their knowledge of content and pedagogy for and barriers within their technology-driven lessons. Based on the findings, a research-based solution and an effective intervention plan were developed to address these barriers to implementing technology. Professional development may benefit teachers to improve their use of technology within the classroom. This may support teachers by homing in on what additional supports are needed to overcome the impediments to successful technology integration. Exposing teachers to digital tools, effective ongoing professional development (Jones & Dexter, 2018; Karlin et al., 2018), and opportunities for reflection

and support better prepare them to integrate technology within their classroom (Hutchinson & Woodward, 2018).

Research Questions

The purpose of this qualitative study was to investigate teachers' perceptions of their knowledge of content and pedagogy for incorporating technology into lesson design in alignment with the TPACK model. Due to the purpose of the study, the following research questions were formulated to guide the study:

1. What are high school teachers' perceptions of their knowledge of content and pedagogy in technology-driven lesson design?
2. What do high school teachers perceive to be barriers when designing technology-driven lessons?

I was able to identify any barriers they may be face in the development of technology driven lessons. Supports were developed to overcome any existing barriers and help teachers to become proficient in the components of the TPACK model if needed.

Review of Literature

The literature review was done to investigate the barriers teachers face with integrating technology and developing technology-driven lessons. The assumption is that technology integration is not occurring just because lack of knowledge in operating software, but other components of knowledge necessary to ensure that effective integration is transpiring is also absent. The literature review includes the TPACK framework, which explains how pedagogy, content knowledge, and technology intersect to teach and engage students proficiently.

The literature review was conducted by scholarly databases, including Pro Quest Central, Education Source, Sage Journals, Thoreau Multi-Database, and Education Resources Information Center (ERIC). The websites accessed were the U.S. Department of Education, the International Society for Technology in Education (ISTE), and Texas schools. I focused on the literature relating technology integration to content and pedagogy. The following phrases were used to search for literature on these topics: *technology integration*, *technology professional development*, *barriers in technology integration*, *pedagogy and technology*, *content*, and *technology*.

Conceptual Framework

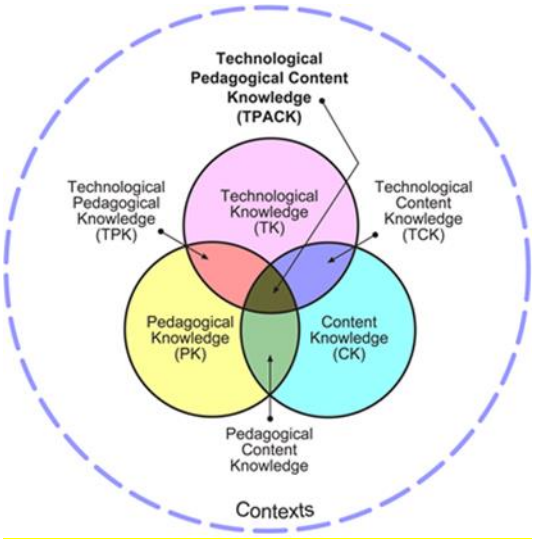
The framework for this study is the TPACK model because it connects the pedagogical and technological aspects of digital tools to create practical learning activities in the classroom (Doukakis & Papalaskari, 2019). This framework brings together the pedagogical, technological, and content knowledge teachers need to integrate technology within their lessons. Using the components of the TPACK model, I interviewed teachers and examined their knowledge to identify the deficiencies in pedagogy, content, or knowledge for effective technology integration. The TPACK model concentrates on three types of knowledge to ensure successful technology integration in the classroom: technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK; Mishra & Koehler, 2006).

Shulman (1986) was the first to present the literature on pedagogical content knowledge which TPACK is built on. In this model, knowledge about the content, pedagogy, and technology are crucial elements to possess for successful teaching

(Shulman, 1986). These types of knowledge should be blended, not independent of each other (Pringle et al., 2015). The components are observed in the overlap of two of the three types of knowledge: pedagogical content knowledge (PCK), technological content knowledge (TCK), and technological pedagogical knowledge (TPK). The TPACK model combines all three (see Figure 1). This culminates in three combinations of knowledge connections and one triad (Mishra & Koehler, 2006).

Figure 1

TPACK Model



An example of PCK is a student with prior conceptions about how to solve a math problem, and a teacher would address each of these prior conceptions and show the student why each one is inaccurate. A teacher using a smart board to work a math problem in front of the students without explaining the process is an example of TCK. A simple example of TPK is a teacher modeling how a student would answer a question on the smart board, then getting volunteers to come up to the board and answer a question.

An example of all three types of knowledge, TPACK, is a science teacher teaching cell anatomy. After walking through the distinct parts of a cell's anatomy, they could have the students break into small groups and collaborate on completing a "check for understanding" quiz via a learning management system. Then, an interactive question that provides a diagram of a cell with blank labels that requires students to drag and drop the proper labels in place from an answer key, which is available in Schoology, would be given.

TPACK is the baseline of quality teaching with technology and is vital to grasping concepts using technologies (Mishra & Koehler, 2006). It uses pedagogical methods intertwined with technology in a beneficial and valuable way to teach content, knowledge of what makes concepts easy or problematic to master, and how technology can remedy some issues students come against (Mishra & Koehler, 2006). The prior knowledge of a student can build on existing knowledge, which in turn will develop new knowledge or reinforce what is already known (Mishra & Koehler, 2006). Instead of fixating on specific programs or devices, it is time to present technology as a tool within the pedagogy (U.S. Department of Education's OET, 2017). The knowledge of technology as tool is not enough; teachers must know how to incorporate various technologies to enhance students' learning experiences in learning the content (Havard et al., 2018). A better comprehension of how teachers perceive technology integration is crucial for establishing a technology-enabled classroom because it is more than a new strategy but preferably a pedagogical belief (Prestridge, 2017).

Integrating modern technology or innovative approaches to teaching drives teachers to face educational issues since it changes the balance of the three elements. TPACK is the knowledge that master teachers bring into play when teaching. This may not be evident when standard technologies are involved. Newer technologies usually disturb the status quo, which demands that teachers revamp their comprehension of technology and all three elements (Mishra & Koehler, 2006). Understanding the multifaceted relationship among technology, content, and pedagogy and applying this understanding to improve approaches and strategies is essential for quality teaching (Mishra & Koehler, 2006). Assessing any of the three components separate and apart from each other is considered ineffective (Mishra & Koehler, 2006, p. 1030).

The TPACK framework can improve teachers' confidence in integrating technology, changing pedagogical practices, and impact learning outcomes by engaging students in content and differentiated instruction, which tailor instruction to meet the student's individual needs (Anderson & Putnam, 2020). This framework is a foundation for technology integration in that teachers need comprehensive support and training when adopting and implementing new tools within lesson design and instruction. TPACK is used to examine the types of knowledge needed to achieve effective technology integration and the applications of technological tools in teaching and learning (Greene & Jones, 2020).

The framework relates to the study because I aimed to investigate teachers' perceptions of their knowledge of content and pedagogy for incorporating technology in lesson design as aligned to the TPACK model. The study also identified if any barriers

exist that teachers may be facing in the development of technology-driven lessons. The TPACK model of technology integration in teaching and learning states that developing relevant content requires a thoughtful interweaving of technological, pedagogical, and content knowledge, which is a baseline for teaching with technology. This framework explains the interaction of the three types of knowledge for effective technology integration. TPACK requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technology in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn, and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old one (Mishra & Koehler, 2006).

The framework guided the research questions by providing a basis for understanding teachers' perceptions of content, pedagogy, and technology integration and the intertwined relationship of the three. It is connected to the research questions because TPACK concentrates on the connections, interactions, affordances, and constraints between and among content, pedagogy, and technology (Mishra & Koehler, 2006). The framework provided the means to investigate teachers' perceptions because it breaks down the types of knowledge and can assess teachers in those areas and bring any discrepancies or barriers that may exist to the surface.

The TPACK was also used to create the questions in the interviews in such a way that TPACK serves as an evaluation tool. Thus, the questions created for the interviews

were based on trying to extract this information and then using the TPACK framework as a checklist. Interviews provide insight into an individual's lived experiences, how participants make sense of and construct reality in relation to the experience in focus, and how individuals' experiences and perspectives relate to other participants or prior research (Ravitch & Carl, 2021). The TPACK further provided the predetermined codes for the deductive analysis. Deductive analysis utilizes terms from other sources, such as theory or prior research in the coding process (Ravitch & Carl, 2021). The study incorporated the predetermined codes to analyze the data further to focus on specificity.

The literature review also covers curriculum, pedagogies, instructional design, teacher education programs, and technology integration, recent studies on other technology barriers and successful practices with teachers and technology. The elements of this framework were used in the instrument for the study and are mentioned in further detail in Section 2. Specific questions from TPACK about their content knowledge, pedagogical knowledge, and technology knowledge were used for deductive analysis and will be discussed in more detail in Section 2.

Topics Reviewed in Literature

The research was reviewed around four topic areas. The first topic is content, and it will include content knowledge, pedagogical content knowledge, conceptual and procedural knowledge, and curriculum. The second topic is pedagogy, and it will include student-centered pedagogies, discovery learning, collaborative pedagogy, blended learning, teacher-centered learning, and instructional design. The third topic, technology, will include technology professional development. The fourth topic is integration and the

barriers to integration, and it will include teacher education programs and technology integration, recent studies on other barriers to technology, and successful practices with teachers and technology.

Content

Content is the subject matter that is taught to the students. They are the educational areas of any discipline, such as mathematics, science, and social studies, that is designated by the curriculum. The structure of subject matter can be separated into cognitive knowledge, skills, and affective domain. First, cognitive knowledge can include facts, topics, concepts, principles, theories, and laws from a specific discipline. Skills incorporate thinking and manipulative skills, such as problem-solving or music (Ntibi et al., 2020). The teaching of these facts, theories, and concepts requires the skill of recognizing the relationship among these to see the meaning.

Content Knowledge. Content knowledge is the knowledge of the subject matter to be taught and learned, which teachers need to have a thorough understanding of (Mishra & Koehler, 2009). This can include subject areas such as mathematics, science, and English. In-depth knowledge of the content area must be gained by teachers and presented logically and organized before mastering other aspects of teaching. Teachers must possess the knowledge of content to display extensive knowledge of the critical concepts in the discipline (Refugio et al., 2020). Content knowledge is the basis for teachers' instructional practices in the classroom (Lee et al., 2018). Teaching any content area is a complex cognitive undertaking that teachers gain from various knowledge sources to create the best learning experience for the students. Educators with limited and

incoherent knowledge about a specific content area cannot function as proficiently as those who attain differentiated, procedural, and conceptual knowledge. Differentiated means the teaching methods utilized vary to help teachers understand the relationships and principles, which is conceptual knowledge, and the procedural knowledge is gained by completing a series of steps in a process. Teachers with knowledge represented by a specific skill are empowered to exercise the profession. Teachers cannot teach what they do not know, and what they do not know limits their students' learning (Kim et al., 2018).

Scholars have also examined the relationship between subject matter knowledge and pedagogical content knowledge (PCK), arguing that teachers' selection and representation depend on their subject matter knowledge (Colley et al., 2021). Colley et al. (2021) conducted a study of middle/secondary school teacher candidates and the influence of subject matter knowledge on creating pedagogy and interacting with the curriculum. It was found that deep content knowledge is essential, yet the steps to enhance, build, or utilize that content knowledge have not been taken (Colley et al., 2021). This directly influences instructional decision-making and curriculum. Additionally, limited subject matter knowledge may lead to teachers developing a narrow and shallow curriculum. It was found that increasing content knowledge solely is not enough, and opportunities for reflection and growth are needed. It was suggested that teachers use a rationale-based pedagogy to assist teachers in developing critical pedagogy, which allows students to think critically, because content knowledge is not enough alone.

More than content area knowledge is needed, and preparation as a teacher is crucial (Kahan et al., 2003). Well prepared teachers tend to think of how to relate the material to student experiences (Grossman, 1990). Unprepared teachers try to instruct secondary students as the teachers themselves had learned in college seminars. Teachers' content matter expertise and disciplinary background influence what teachers choose to teach and how they teach the material (Colley et al., 2021). Its influence affects novice teachers because of their limited classroom experience. They tend to focus more on the subject matter rather than teaching in numerous ways. Insufficient content knowledge among teachers leads students to develop misconceptions, misunderstandings, and misinterpretations regarding the content subject (Lee et al., 2018).

Content knowledge is the actual knowledge of a specific subject area (Mishra & Koehler, 2006; Schmid et al., 2020). A teacher must demonstrate the knowledge of content to display extensive knowledge of the critical concepts in the discipline. Moreover, knowledge of the subject matter is crucial to learning but is only one component of the larger picture. Content knowledge is a barrier to technology integration, and there remains a gap in how content knowledge and technology affect one another. Content knowledge is the basis and should be built on and enhanced through pedagogy and technology. Both affect the teaching and learning in the classroom. Content knowledge is one of the domains within the conceptual framework, TPACK. One component blended with the other components of TPACK leads to successful technology integration.

Pedagogical Content Knowledge. Shulman (1986) proposed pedagogical content knowledge as a particular form and type of content knowledge and stated that it could be "described as different types of knowledge to be used for teaching". Pedagogical knowledge, which can be obtained through education practices and experiences, is related to the "how" of teaching, while content knowledge is the "what" of teaching. This concept is about how the combination of content and pedagogy creates an understanding for the teachers that assists them in effectively organizing, adapting, and conveying aspects of the subject matter to students (Bagheri, 2020). Pedagogical content knowledge is found in the instructional plans that teachers create and are the reasons behind their pedagogical decisions. Teachers bring the knowledge to design and reflect on instruction (Doyle et al., 2019).

Pedagogical content knowledge characterizes and identifies teachers' knowledge in terms of students' difficulty with content and ability to connect ideas, concepts, use examples, and apply strategies to the content taught (Lee et al., 2018). For example, this type of knowledge makes science teachers a teacher rather than scientists. The quality and quantity of subject matter content they encompass is the same, but how it is used and organized differs. The science teachers' knowledge is based on a teaching perspective and a basis for helping students to understand specific concepts. In contrast, a scientist's knowledge is from a research perspective and is used to develop new knowledge in the field. An example of pedagogical content knowledge is a teacher using analogies, illustrations, and demonstrations to teach about electricity because the various ways the

subject is represented. Another example is teaching a math lesson on one-step equations on the board and then using math manipulatives to solve the equations.

A review of pedagogy and content knowledge revealed that they work in partnership with each other when lessons are planned. The content and how teachers present their lessons are vital to learning. Student achievement is affected by the methods or strategies teachers use to present content. The literature research did not state how pedagogical content knowledge affects technology integration and its interactions. Teachers may need help understanding how to infuse technology into their pedagogy and content area, which could be a barrier to effective technology integration. These components, pedagogy, content, and technology, collide within the TPACK framework when technology is included by understanding the best practice for teaching content to specific students. Pedagogical content knowledge is one of the three combinations of knowledge within the TPACK framework that focuses on which teaching approaches fit the content (Mishra & Koehler, 2006).

Conceptual Knowledge and Procedural Knowledge. There are two types of knowledge, procedural knowledge, and conceptual knowledge. It is helpful to distinguish between the two types of knowledge to understand knowledge development better. The 'know-how' is considered procedural knowledge, which links to the problem-solving process and strategic thinking, requiring a level of procedures (Ayetikin & Sahiner, 2019; McCormick, 1997). It is the knowledge of sequences of actions to accomplish a specific goal (Vamvakoussi et al., 2019). For example, performing an operation with fractions; the ability to perform these tasks is procedural knowledge (Vamvakoussi et al., 2019).

Conceptual knowledge is the basic knowledge about relationships and interconnection of ideas and networks of information. It is acquired when one can identify, provide symbols, and give examples to explain and bring meaning to procedures given to them (Aytekin & Sahiner, 2019; McCormick, 1997). Examples of concepts are to correlate, manipulate, differentiate; to identify and apply the rules; to know and apply facts; to define and apply symbols; and interpret assumptions and their relationships (Vamvakoussi et al., 2019; Zulnaidi & Syed, 2017). Using fractions as an example, knowledge about how fractions are represented symbolically, their order, equivalences, their relation to natural numbers, the meaning of their operations, and their function as representing quantities is considered conceptual knowledge.

Relating procedural knowledge to conceptual knowledge is the ability to acquire and apply procedures and meaning to the concept. An ongoing argument is that procedural knowledge is vital but alone is not enough. Also, conceptual knowledge is necessary, but not enough alone (Ayetin & Sahiner, 2019). A teacher must possess both procedural and conceptual knowledge. Conceptual knowledge focuses more on associations, while procedural knowledge requires automated and unconscious steps to achieve a goal (Aytetin & Sahiner, 2019; Kadijevich, 2018). An example of a conceptual task in a mathematics lesson is estimating the perimeter based on length, width, and height to justify the estimate. This focuses more on the relationship and understanding the concepts. A procedural task would be finding the area of a triangle using the formula, Area = base x height, given the base and height of the triangle.

Procedural-oriented teachers learn associated rules by practicing and not focusing on the meaning; their conceptual knowledge will develop over time. A conceptual-oriented teacher strengthens their procedural knowledge by focusing on the interconnection of the idea concepts and inferring from this approach. The relation between procedural and conceptual knowledge does not commit to either's precedence, but that knowledge can trigger the learning process depending on prior experience (Vamvakoussi et al., 2019). In order to measure one's procedural knowledge, testing can occur by asking questions to carry out the procedures. Measuring conceptual knowledge requires a greater variety of tasks that articulate understanding. The two types of knowledge create a better understanding of the subject matter. To have complete knowledge, both procedural and conceptual knowledge is needed. Teachers may emphasize one more than the other, but both are essential.

Research has shown that conceptual and procedural knowledge influences pedagogy because it determines how the teachers learn and how they teach. We learned that when these types of knowledge coincide, a greater comprehension of content is created. These types of knowledge would determine the types of technology-driven lessons used in their classroom. There was a gap in research on how conceptual and procedural knowledge directly affects technology integration in lessons. This relates to the study because if teachers are not aware of the two types of knowledge, they may only teach one, which can limit student's understanding of the content.

While knowledge can be classified as conceptual or procedural, technology can enhance or fuse the two. If either conceptual or procedural knowledge is absent, it may be

difficult to maximize the benefits of the integrating technology. Conceptual and procedural knowledge relates to a teacher's pedagogy and content. Teachers' methods of teaching may be both procedural and conceptual and affect how teachers teach. This relates to the conceptual framework when infusing pedagogy and content knowledge. According to Mishra and Koehler (2006), TPACK, which includes PCK, centers on the representation and formulations of concepts which includes the knowledge of teaching methods to include conceptual representations to address learner difficulties and misconceptions.

Curriculum

The curriculum is the essential means of education, a scheme of an entire program of the school's work (Richmond, 1971). Curriculum is a sequence of outlined experiences based on academic standards where students apply and reach proficiency in a content area and application of skills. It is considered a primary guide for teachers to what is vital to be taught in the classroom and ensure students are exposed to academic rigor. The curriculum's structure, organization, and considerations are created to enhance student learning and facilitate instruction. The curriculum must include the necessary goals, methods, materials, and assessments to support instruction and learning effectively. "It ensures the learning goals are aligned and complement each other from one stage to the next. In standardized core curricula, teachers are provided a predetermined list of things they need to teach their students, along with specific examples of how these should be taught" (Schweitzer, 2020, p. 1).

Technology, in conjunction with the curriculum, can enhance the process of learning. Teachers who recognize the advantage of technology and its usefulness as a problem-solving tool change how they teach. However, professional development must support curriculum planning infusing technology for change to occur in the classroom (Liao et al., 2017). Effective professional development is needed to address the specific needs of school districts as teachers' perceptions and needs shift for teachers to learn and integrate technology in the classroom (Liao et al., 2017).

Curriculum guides for teachers to know what to teach in the classroom. Teachers are expected to use this guide and transform it into focused, enriched lessons. The curriculum is paired with technology, and technology-driven lessons are formed. In order to have technology-driven lessons using the curriculum as a guide, a teacher must understand the purpose and focus of the curriculum to ensure activities and technology are aligned with the topic.

A review of the literature found that curriculum is a tool used to guide teachers with a sequence of content to be taught. This guide and technology could create technology-rich lessons. There is a lack of literature on how curriculum affects the implementation of technology within a lesson, how curriculum may constrain teachers, or how to incorporate the curriculum and technology together. Teachers need to be aware of which topics can be enhanced using technology to improve student learning because of their lack of knowledge. The content is not the issue. It is the infusion of the content, pedagogy, and technology together. The TPACK framework helps outline how the content from the curriculum is taught. It responds to the blending of the content explained

in curriculum and pedagogy and how it is organized, adapted, and represented for instruction (Mishra & Koehler, 2006).

Pedagogies

Pedagogy is the heart of teaching. The rules and principles guide effective and efficient activities that lead to learning (Pritchard & Woollard, 2019). The once authoritative source of textbooks and teachers is now challenged by the arrival of technology. Classroom pedagogical practices and teachers' pedagogical competencies need to transform beyond excellent content delivery (Chai et al., 2019). Teachers' pedagogical reasoning relies on the merging of content and pedagogical knowledge bases as they design ways to transform their content in meaningful ways, including making connections for their students, beginning comprehension of content, and continuing comprehension after reflection on the instruction. Pedagogy is a discipline that deals with theoretical concepts and practical educational approaches. It includes a conceptual and procedural understanding of learning and knowledge, who should teach, when, where, and how. According to Pritchard and Woollard (2019), times before, the influence of technological tools in instruction was never considered when thinking about pedagogical reasoning, and now there is a reconsideration. The types of pedagogies teachers use in the classroom vary, and every teacher chooses their own.

How content is taught is crucial for student learning experiences. Pedagogy is one of the components of TPACK that is crucial for successful integration because it speaks to teachers understanding of how students construct knowledge, acquire skills, and strategies to evaluate student understanding and how they apply to their students (Mishra

& Koehler, 2006). "There is limited research of teachers with experience using digital pedagogies in well-established ubiquitous technology environments, consciously seeking to transform their practice, and hence, the intrinsic influences relevant to this context are not well understood" (Blundell et al., 2020, p. 178).

Student-Centered Pedagogies

Student-centered pedagogies are built on constructivism. Constructivism is the study of a learner's construction of knowledge. Learners construct their meaning of new content by processing it and connecting them with existing knowledge (Clark, 2018). Students are provided opportunities to learn independently in student-centered learning, and are involved in the activities, materials, and content (Serin, 2018). The student-centered classroom increases students' higher-order thinking, learning, and motivation (Keller, 2018). Educators have used constructivist theory to develop various student-centered instructional approaches, each with its research base and consistent positive student impacts (Keller, 2018). Examples of student-centered pedagogies are discovery learning, collaborative learning, blending learning, and one-to-one learning.

Discovery Learning. Discovery-based pedagogy is learning by discovery, in which students develop ownership of their learning by discovering and creating knowledge. This pedagogy focuses on identifying the inner-directedness or intrinsic motivation of learning (Cattanco, 2017). The student's exploration of their environment to inquire, discover and solve problems are the skillsets needed to maximize student experience in this pedagogy. The students direct the methods of discovery and include experiments, individual and collective problem solving, or individual inquiry or research

(Cattanco, 2017). This method helps students remember concepts and recall knowledge effectively. Discovery learning promotes motivation, active engagement, autonomy, and responsibility, develops creativity and problem skills, and tailors the learning experience to each student (Clark, 2018).

Collaborative Pedagogy. "Collaborative learning (CL) is an educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task, or create a product" (Laal & Laal, 2012, p. 491). Collaboration has three rich levels of interaction. The first is an emotional stance, which allows students to feel part of a group. The second is a co-operational stance, which refers to group work and it requires dividing tasks and roles during the activity. The third level is collaborative learning to construct new knowledge, deepen understanding, or invent new skills (Dukuzumuryi & Siklander, 2018). To achieve a classroom where a collaborative learning approach works, teachers must fully understand learners' preferred learning styles and views on learning. Classroom teachers should use the following strategies properly: Online - Collaborative Learning; Jigsaw Method; Think- Pair- Share; Peer Teaching (Laal & Laal, 2012). Online Collaborative Learning is the computer version of the traditional in-class collaboration in which students work in groups to develop knowledge in multiple ways. The Jigsaw Method is a strategy that makes students dependent on each other to succeed. The class is divided into home groups, and then each home group is separated into expert groups, in which a specific content piece is taught, and then the students return to their home group to teach their peers the content

they learned. Then, each group assembles to complete the jigsaw puzzle (Fu & Hwang, 2018).

Think-Pair-Share is a cooperative learning activity that entails students working on a topic or problem individually, pairing up with another student to discuss and compare their approaches, and then sharing with the class the report of their results (Mossayebi & Ekoniak, 2019). Peer teaching is a technique used to encourage students to have a more active role and sense of purpose. It involves students ensuring they thoroughly understand the content and then transferring this knowledge to their peers (Pechinthorn et al., 2020). Creating new knowledge is ingrained in the practices given, and knowledge is shared and jointly developed (Kangas & Seitamaa-Hakkarainen, 2018). Teachers orchestrate the classroom learning tasks, and the students engage in collaborative learning when using digital technologies because the technology tools facilitate interaction and collaboration (Dukuzumuryi & Siklander, 2018).

Blended Learning. Blended learning environment courses combine face-to-face/offline instruction and online forums. They combine online digital media with traditional classroom methods. “It requires the physical presence of both teacher and student, with some element of student control over time, place, path, or pace” (Al Noursi, 2020). Bakeer (2018) states that blended learning allows learners to visualize, listen, feel, and interact with the learning material. This can include face-to-face group work in a classroom, then transitioning to an in-home offline environment to analyze the work, and finally turning in a video as an assessment in an online forum.

Blended learning combines conventional face-to-face and online learning, adopted to foster active learning, interactivity, and collaborative learning experiences. Learners try to understand, develop knowledge, and be creative in the learning process. Blended learning is considered adequate and efficient because both face-to-face and online learning models have their advantages. Learning with a combination model, such as blended learning, requires educators to use online systems. Educators must prepare and manage time well so that face-to-face and online learning can be well integrated (Herayanti, 2020).

One-to-One Instruction. One-to-one instruction is individualized instruction for students. The teacher can make observations and monitor each student closely. The instruction is based on student's strengths and challenges, and the students are given focused attention with skilled guidance and immediate feedback. Appropriate material is selected for each student, and the teacher can intervene immediately when misunderstandings occur. One-to-one instruction is not interrupted by any group dynamic but focuses on individual students (Askew & Simpson, 2004).

Teacher-Centered Learning. Teachers prefer methods tied to their beliefs, preferences, and norms of their disciplines. Some believe lessons should be teacher-centered, where the teacher is the expert and deliverer of information. Mascolo (2009) stated that "it is defined as the teacher (a) is the dominant leader who establishes and enforces rules in the classroom; (b) structures learning tasks and establishes the time and method for task completion; (c) states, explains, and models the lesson objectives and actively maintains student on-task involvement; (d) responds to students through direct,

right/wrong feedback, uses prompts and cues, and, if necessary, provides correct answers; (e) asks primarily direct, recall-recognition questions and few inferential questions; (f) frequently summarizes during and after a lesson, and ; (g) signals transitions between lesson points and topic areas" (p. 4). The teacher-centered approach relied on the behaviorist theory, which was based on the idea that behavior changes are caused by external stimuli (Skinner, 1974).

According to Serin (2018), teacher-centered pedagogy positions the teacher at the center of the learning process and typically relies on methods such as whole-class lectures, rote memorization, and chorus answers. In this pedagogy, the teacher is active, and the student is engaged by listening and processing while working individually without hands-on activity (Kaymakamoğlu, 2018). The content is not collaborative; the teacher decides the content and learning tasks. The evaluation of the students is product-oriented. The teacher is the primary source of information and the textbook for activities.

Teachers who are knowledgeable in the content utilize motivational strategies while presenting in order to maintain students' attention. Students engaged by this style of pedagogy can become academically successful. Therefore, some researchers support using a teacher-centered approach because it allows teaching students in short steps (Serin, 2018). In this teacher-structured style, the students receive knowledge based on facts, skills, concepts and focus on content and production (Kaymakamoğlu, 2018). Teachers serve as talkers and custodians of knowledge, while students have a definite role as listeners (Ubulom & Clinton, 2017). While some researchers praise this style, some critics believe that teacher-centered, especially lecture-style focusing on rote

memorization, results in surface learning (Otara, 2019). The teachers talking to students, assigning them assignments in a textbook, and evaluating their work similarly is outdated.

For students to obtain a more in-depth understanding of the content, teachers must have a calculated pedagogy that can refine teaching and learning. Knowing how you teach can help you better understand how to help students achieve deeper learning. According to Yashuwantrao (2018), technology should be used as a pedagogical tool for teaching and learning, and its value is displayed in student engagement and participation. Yashuwantrao (2018) conducted a case study in two secondary schools proposing a framework founded on the TPACK model that builds on the premises of pedagogy, content, and technology. The study aimed to evaluate the framework encompassing an affective domain and investigate the extent to which the engagement of parents, students, and teachers via the developed pedagogical technological integrated medium deepened students' understanding of the content. The evaluation of the framework led to technology used as a pedagogical tool for teaching and learning, and the pedagogical value of a tool reflected in student engagement and the nature of participation garnered; it can significantly make a difference in classroom instruction (Yashuwantrao et al., 2018). The study showed that using of this model increased student engagement, ultimately resulting in increased academic achievement.

Ubulum and Ogwunte (2017) studied an evaluation of the effectiveness of teacher-centered and learner-centered methods in secondary schools. They found that learner-centered methods were influential in the secondary classroom. Learner-centered

methods included field trips, inquiry, critical thinking, and computer instruction, which included compelling theoretical and practical aspects. In the 21st-century education system, teachers are encouraged to use innovative strategies to acquire knowledge and skills to cope with the changing world. One innovative adopted strategy is the student-centered pedagogy, where learners are placed at the center of teaching/learning and are actively involved in the learning process (Otara, 2019).

The literature has presented the several types of pedagogies a teacher may use or combinations. Pedagogy is how teachers teach in their classrooms. Certain pedagogical styles will allow for technology integration in their lessons to flow more quickly than others that do not allow flexibility. Pedagogy has a significant impact on lesson design using technology. This relates to the study because pedagogy could be a barrier to technology integration in the classroom when creating a lesson. The research does not touch on which pedagogies work well with technology or how to adjust or expose teachers to new pedagogies.

Technology Professional Development

The role of professional development is to instruct teachers on how to transform their teaching and learning, to renew and invigorate their passion for teaching, to acquire the new pedagogical and technology skills they must have, and to understand how to successfully integrate technology into instruction across the curriculum and at all grade levels. An assumption that all teachers are capable and at ease with the onset of technology in the classroom is not substantive. Teachers need to strengthen their information and communication technology skills and confidence within the classroom

(Georgiou & Ioannou, 2019). The design for pedagogy and technology integration is familiar to the educational field, yet the adoption process is impeded (Ioannou, 2018). Studies of technology professional development revealed an insufficiency.

For example, Jones and Dexter (2018) year-long mixed-method study followed middle school teachers for one calendar year and examined their district's learning activities for technology integration. It was found that the professional development provided to teachers was beneficial but came with constraints such as a lack of ongoing support, lack of time flexibility, little customization in sessions provided, and lack of time provided during work hours. This is critical for implementing innovative technology initiatives and aligning curricula to create valuable technology-infused lessons. The study focused on the informal and formal learning activities of the teachers. Formal learning activities generally have a start and end date, and involve educational innovation introduced to teachers in a workshop-style presentation in an organized environment facilitated by an organization. At the same time, learning by experimenting, considering teaching practices, getting ideas from others, and learning by doing are informal learning activities. During the calendar year, 78% of teachers' activities were identified as informal learning. This included a discussion with peers about topics, lesson plans, possible technologies, sharing of lesson plans, external resources, and student work. These activities are not facilitated by an organization but are conducted with colleagues within an organization (Jones & Dexter, 2018).

Findings also indicated a gap in learning opportunities schools offer teachers and the learning activities needed to integrate technology into their instruction (Jones &

Dexter, 2018). It stated that formal professional development appropriately customized to the teachers' needs was challenging. Therefore, the district filled the gaps with informal and independent learning activities. Additionally, the range of experience in technology use, the various instructional nuances between grade levels and content areas, different teaching styles, and the evolution of technology made it difficult to develop adequate learning opportunities for technology integration for all teachers (Jones & Dexter, 2018). Teacher instruction may not significantly change if learning about technology is supported in a short length of time (Lee et al., 2017).

This study complements Karlin et al. (2018), who conducted a study on the design practices of technology leaders and examined how technology professional development is planned, implemented, and evaluated. The study found that professional development is not always based on the teachers' needs but on administrative or district requirements. They are not sustained or continuous (Karlin et al., 2018; Hutchinson & Woodward, 2018). The findings suggested that the leaders should plan and implement the technology professional development in ways that align with the everyday design purposes; hands-on, sustained, and continuous, situated in context, and supported by coaching and mentoring.

The lack of leadership skills necessary to provide "sustained, meaningful experiences" for teachers to master technology, and teachers' resistance and rejection of change contribute to the unsuccessful implementation of technology (Cole & Sauers, 2018). Furthermore, institutions responsible for teacher training and professional development should support teachers' content knowledge, pedagogical skills,

interdisciplinary work, teaching approaches, effective assessment practices, and the ability to use innovative technology (Kaya & Elster, 2018). Similarly, Ciampa (2017) conducted a case study to describe the outcomes and lessons learned from implementing technology professional development and stated that administrators should consider offering in-classroom training and follow-up support after studying the lessons learned from implementing technology professional development.

When the content of PD workshops focused on specific software or technology, as opposed to innovative integration strategies, studies have indicated that the PD was less effective in supporting teacher's technology integration practices (Liao et al., 2017). Greene and Jones (2020) state that a gap remains in understanding teacher knowledge at a deeper level. The professional development provided is in fragments and incapable of preparing teachers for day-to-day challenges. The teacher's level of expertise is rarely taken into consideration. The professional development for first year and veteran teacher are not exclusive nor focused on individual needs (Greene & Jones, 2020). The lack of time leads to a lack of time to explore technology tools efficiently (Ottenbreit-Leftwich et al., 2020).

Research has suggested solutions for effective technology professional development. According to Hutchinson and Woodward (2018), professional development focuses on providing: 1) sufficient ongoing support for integration (Jones & Dexter, 2018), 2) time to plan for integration with the support of integration experts and fellow teachers, 3) access to models and mentors, and 4) developing supports that are specific to each teacher's background knowledge and needs (Jones & Dexter, 2018).

Teachers have different abilities and experiences with technology. Some teachers are confident and have adequate knowledge of technology. In-service professional development to advance teachers' competence for efficient use of technology takes various forms, including workshops, face-to-face, and online courses, conferences, and training sessions (Gokbel & Alqurahi, 2018). According to a study by Love et al. (2020), it is crucial to make technology tools available to teachers and provide professional development that supports teachers in understanding how to integrate tools into their instruction. The authors state that professional development should first familiarize teachers with the tools available and their functionalities, which will increase their acceptance. Secondly, teachers must see the tool as easy and beneficial for instruction. Thirdly, professional development should provide a deep understanding of how, when, where, and for whom technology is appropriate. It should support teachers' planning of how to use technology for instruction. Personalized and sustained professional development is necessary for supporting teachers' technology integration practices to address the teachers' needs directly (Liao et al., 2017).

By the same token, Alemdag et al. (2020) conducted a study to design and implement professional development on technology integration and evaluate the program's impact on teachers. The study discovered two main themes: the contribution to the professional development of teachers and the practical characteristics of professional development. The lesson plans prepared by teachers showed an increase in their technological pedagogical content knowledge than their initial knowledge of technology integration. The results showed a change in teaching practices that included

technology-enriched lesson plans. Teachers' active role, collaboration with teacher groups, hands-on activities, and discussions on implementing the tools made the professional development effective. The professional development presenters convey new technology tools while considering their target learning group and use in education. The findings showed the importance of providing information that aligns with a teachers' specific need, giving them an active role, and allowing teachers to design lesson plans collaboratively. Understanding how knowledge of technology, pedagogy, and content informs teacher's classroom practices and professional development design is crucial (Greene & Jones, 2020).

Likewise, Hutchinson and Woodward (2018) introduced the Technology Integration Planning Cycle Model (TIPC) for teachers' instruction. This model guides teachers in planning instruction with technology in a recursive process that directs teachers in identifying their instructional goals before selecting digital tools. In this learning process, the teacher identifies the contributions of the digital tool, the barriers it may create, and other considerations that may change because of the use of technology. This design allows the teacher to see various pedagogical possibilities with each tool rather than designing lessons to incorporate a specific tool. Instructional goals are a priority, and student outcomes reinforce the possibility of the tool helping to achieve that goal. Professional development is the bridge between teachers and technology integration. The barriers must be addressed in professional development for successful technology integration.

Technology professional development directly affects how technology is used in a lesson. A review of the previous studies focused on successful practices of technology professional development and its impact in the classroom. They state the importance of addressing the teachers' needs when it comes to technology integration so that teachers can be successful, and they state that teachers have various needs. One size does not fit all because there are many levels of expertise with technology and experience. This relates to the study because teachers need training for successful integration. The TPACK framework addresses the types of knowledge required and its implementation into effective professional development. Technology professional development is vital to addressing barriers that may arise with integration. The research does not state how to address the needs of various teachers since one size does not fit all. Content, pedagogy, and technology should not be separate from one another but should work simultaneously, according to the elements of TPACK. This coordination within technology professional development may lead to successful integration (Mishra & Koehler, 2006).

Instructional Design

Instructional design is a system of planning, implementing, and evaluating instruction to make learning more efficient (Gagne et al., 2005; Summerville & Reid Griffen, 2008). Designers of instructional materials use instructional design. Gagne (1987) addresses instructional technology's role in learning and introduces different learning types and how they require diverse types of instruction. He identifies significant categories of learning outcomes: verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes, and that a set of variables influencing the learning

tasks in one domain may not influence the learning tasks in another. For example, learning names (verbal information) can lead to learning phone numbers, but it does not necessarily mean it will lead to learning a new concept (intellectual skills). How concepts are taught is as important as the concept itself. Concept teaching methods should ensure students' effective participation throughout the process, allowing students to learn by doing and learning involving a play style. Concept teaching techniques include concept maps, mind maps, concept cartoons, word association tests, concept puzzles, and fishbone diagrams (Cagir & Oruc, 2020).

On the other hand, for cognitive strategies learning to occur, there must be time to practice developing new solutions, and learning new attitudes, and the learner needs exposure to a role model or persuasive arguments. These strategies are used as procedural facilitators, procedural prompts, scaffolds, or thinking about thinking. Instead of providing knowledge, the teachers set the tasks and solve them with the student. Problem-solving is defined as a mental process that includes representing, planning, executing, and self-regulating to work through the details of a problem to reach a logical solution. It is a cognitive process that influences the learners to use and combine numerous cognitive functions to solve a problem (Govindasamy & Kwe, 2020). It can be launched individually or as a cooperative group (Bullock, 2020). An instructional sequence for learning will promote learning, creating instruction that will support it.

Motor skills comprise more advanced, complex movement required to engage in sports, games, and other physical activity (Cheung & Zhang, 2020). One of the most common instructional methods for teaching motor skills is modeling, which is adapting

an observer's behavior following another person's action (Sotoodeh & Taheri-Tabati, 2021).

Gagne's instructional design model is based on the information processing model that occurs when adults are presented with various stimuli and focus on the learning outcomes and how to arrange specific instructional events to achieve those outcomes (Gagne, 1987). Gagne has nine steps of instruction that are effective for learning (Sunduri et al., 2014). The first instruction is gaining attention, attracting the participant's attention using images, information, sound, or background screens. The second is to inform the learner of the objective, which describes the goal sequentially and clearly for the participant. The third instruction is stimulating prior knowledge, which can be a test or questionnaire to recall information from participants. The fourth instruction is to present the material that will be learned, which generates a stimulus that can include engaging material and visual elements to interest the participant. The fifth instruction provides learning guidance, in which the learning coverage and objective are shown so that participants can understand the steps that help the learning process. The sixth instruction is obtaining performance, which results from previous learning and the current learning shown at the end. The seventh instruction gives feedback, which provides positive feedback to participants for every interaction, if possible, and helps students understand the gaps. The eighth instruction assesses the learning performance, which consists of a post-test, for example, to evaluate the participants learning. The ninth instruction enhances retention and transformation, selecting references to extend knowledge and how participants can apply the gained knowledge (Kumar et al., 2019).

Gagne suggests that the designer or instructor controls the external events' fundamental processes, even though individuals always control their learning processes, which are internal events. The superior design of instruction can facilitate learning efficiency, instructional effectiveness, transfer of training, and interest. The designer has a certain amount of control by structuring the external conditions to facilitate internal learning and information processing (Richey, 1996). Gagne has proposed instructional prescriptions designed to facilitate learning in the various categories of learned capabilities he identified (Gagne, 1987; Gagne & Glaser, 1987). Gagne's instructional design addresses the role of instructional technology in learning. This model's process helps structure the strategies and create activities for training sessions to provide an effective learning process. Gagne directly relates to the elements needed for successful technology integration by teaching the teachers.

In the past five years, instructional design has shifted and evolved from its previous form in terms of technology integration. Infusing technology within the classroom requires educators to grapple with the constantly changing professional requirements and evolving technology resources across various disciplines in education. The ever-changing times and circumstances have caused a shift in its design. The instructional design model demonstrates the use of technology in lessons for teachers, emphasizes the alignment of instructional goals, and trains on the use of technology.

According to Korucu-Kiz & Ozmen (2019), instructional design models that increase technology integration efficiency aim to address teachers' awareness, beliefs, knowledge, and skills because of their influence. Hence, it increases awareness about its

value on their subject matter and intends to incorporate technology into their instruction. Kale et al. (2020) suggest that teachers become the designers of learning by developing, testing, and modifying activities to fit their needs and allowing teachers to create untapped resources and activities to use in their lessons. Their study, conducted on teachers from K-12 grade, explored the components of instructional design knowledge and TPACK that teachers draw from for successful technology integration. McMahon & Walker (2019) propose design models with multiple means of engagement, representation, actions, and expression for technology integration. It will enhance the ability to plan and implement technology to support diverse learners systematically. Conducting a study exploring the opportunities and challenges of new technology in the classroom is necessary for its success.

Jones & Dexter (2018) propose that formal, informal, and independent are three types of interdependent learning activities that will help teachers to integrate technology into their lessons effectively. Formal learning is effective for initial exposure to innovative technology. Independent learning time gave time for teachers to understand technologies for themselves to experience and create independently. Informal learning includes collaboration with colleagues to design instructional practices with technology and support each other in the implementation (Jones & Dexter, 2018). Observing, discussing, and reflecting collaboratively upon successful uses of technology help teachers see the utility, value, and feasibility of using a particular technology or teaching strategy, furthering their ability to differentiate between action and purpose, enabling more profound and more critical thinking around integration (Tondeur et al., 2017).

Liao et al. (2017) recommend that models for technology integrations should highlight the impact and realistic access to technologies rather than unrealistic technological requirements, such as 1:1 teacher-device ratios in poor communities. They should encourage adoption among diverse users for diverse purposes and yield valuable results crossing disciplines and traditional practices. Teachers should be provided with time and opportunities to explore newly introduced technology and offer new technologies within their school context and familiar instructional environments (Liao et al., 2017). Actively engaging teachers in the designing process makes it more likely for them to integrate technology into their teaching methods (Kale et al., 2020).

We learned that instructional design is how instruction is arranged and prepared. The methods and strategies for reaching and addressing the needs of the participants are of the utmost importance. It matters how the teachers are given information so it is preserved in translation and able to be implemented in the classroom successfully. The instructional design can focus on a particular subject area and how technology can be used in a lesson depending on the audience. A teacher's content and pedagogical knowledge must be considered for a successful instructional design process. The studies conclude that the current instructional design model better prepares teachers for using technology by creating opportunities for teachers to be exposed to new strategies and approaches to using technology within their lessons. TPACK, as a framework, has the potential to impact the design of professional development and its learning approaches, invoking new strategies to improve teachers' knowledge to integrate technology successfully with pedagogical expertise and technology in their teaching.

Teacher Education Programs and Technology Integration

Research has shown that if pre-service teachers understand the interrelationships among domain-related content, content-related pedagogy, and technology integration, they will want to use technology in their future classrooms (Scherer et al., 2018). Scherer et al. (2018) examined six hundred and eighty-eight pre-service teachers from eighteen different teaching institutions to identify their profiles to explore their readiness to integrate technology in education. It was found that pre-service teachers exhibited positive attitudes toward technology, including general attitudes, educational attitudes, and ease of use. Researchers claim that more teacher education programs should change how teachers have previously trained to deliver instruction. Teacher content knowledge is crucial for enhancing teaching and learning, yet many teacher programs infrequently connect content with pedagogy (Kaya & Elster, 2018).

Akampe et al. (2019) conducted a multiple case study of secondary pre-service mathematics teachers enrolled in a three-course experience using TPACK, designed to develop an integrated understanding of technology, pedagogy, and content in the teaching and learning in mathematics. The study found that the model of TPACK-inspired professional development in pre-service teachers was productive, beneficial, and distinct compared to the TPACK professional development among in-service teachers. It was found that the professional development process is influenced by prior experiences of technology use and the disposition toward technology with current teachers. At the same time, the pre-service teacher with no prior experience flourishes in learning and practicing with technology. The difference between pre-service and in-service teachers is

that in-service teachers already have the pedagogical content knowledge, and technological knowledge is conceived as a new domain in their learning. In contrast, pre-service teachers are novices at teaching and have yet to create a pattern for their teaching methods, but thrive in technology (Akampe, 2019). The in-service teachers expressed that if the exposure of technology integration occurred during their time as pre-service teachers, it would have assisted them at becoming more proficient users of technology and instill technology use as a career-long habit (Akampe, 2019). This professional development would fit the needs of the pre-service and in-service teachers as their needs are different.

However, a technology integration preparation gap exists in teacher education programs caused by teacher educators needing more proficiency in technologies. This could enhance instruction for their teacher candidates to transfer into the classroom (Parrish & Sadera, 2019; Dillon et al., 2019). The case suggests a disjoint in the teacher education program's understanding of the technology training needed for successful integration in the classroom. The U.S. Department of Education's Office of Educational Technology (2017) suggests that teachers ensure that pre-service teachers' experience with educational technology is program-deep rather than one-shot courses separate from method courses. The standalone technology integration course is limiting teacher candidates.

The U.S. Department of Education's Office of Educational Technology established four principles for technology use in teaching and learning for pre-service teacher preparation programs (see Table 1). Similarly, the ABC school district created

basic requirements for educators in technology to ensure academic excellence (see Table 1). The U. S. Department of Education's Office principal recommendations are consistent with the districts' requirements. The challenge is ensuring teachers' instruction transfers effectively into the classroom for teaching and learning.

Table 1

Principles and Requirements of Educators for Successful Technology Integration

U.S. Department of Education's Office of Educational Technology	ABC School District
Focus on the active use of technology to enable learning and teaching through creation, production and problem-solving.	Graduate from an educator preparation program that models current technology in instructional and administrative practices PreK-12.
Build sustainable, program-wide systems of professional learning and teaching. Ensure pre-service teachers with educational technology experiences are program-deep and program-wide, rather than one-off courses separate from their methods courses.	Exit educator preparation programs know how to use technology effectively in teaching and learning Develop new learning environments that utilize technology as a flexible tool where learning is collaborative, interactive, and customized.
Align efforts with research-based standards, frameworks, and credentials recognized across the field.	Ensure integration of appropriate technology throughout all the curriculum and instruction.

Note: From "Reimaging the role of technology in education: 2017 national education technology plan update, " by U.S. Department of Education's Office of Educational Technology, 2017 https://tech.ed.gov/files/2017/01/NETP17.pdf

In the classroom, content is taught utilizing technology at specific times. However, research shows teachers' lesson plans are built through their experiences as learners, teacher education programs, and professional learning communities. Therefore, teachers lack the understanding of technology that supports cognitive tasks and cannot take full advantage when creating lessons (Akampe et al., 2019; Green & Jones, 2020). Osman et al. (2014) stated that "due to frequent changes in technology tools and their increasing capabilities, course content, training materials, and curriculum inventories

often need to be updated" (p. 350). The teacher educator programs affect teachers' exposure to technology integration and its infusion into their instruction.

Nguyen and Bower (2018) conducted a study of pre-service teachers that participated in a collaborative technology-enhanced design project. The finding of this study stated that despite the intentions of the teacher education programs to infuse technology into the course study, the pre-service teachers rarely mentioned or thought about pedagogy while designing activities due to a limited understanding of pedagogy and its role. While the program modeled the use of technology for the pre-service teachers, it needed to properly instruct on pedagogy or make the connection between pedagogy and the integration of technology. Technology will continue to expand and evolve; therefore, teachers must be prepared to integrate technology within their lessons. Current teachers that did not have this exposure as teacher candidates now struggle to adopt this new role and style of pedagogy (Nguyen & Bower, 2018). Teachers' professional experience is a process that begins with pre-service training and continues with in-service training (Kaya & Godek, 2016). The programs must focus more on training teachers to consider pedagogy, content, and technology while planning instruction.

The research has shown that pre-service programs are adjusting to the times and trying to equip future teachers with the knowledge and strategies needed to use technology within their classrooms. There is a need for teacher preparation programs to ensure that their practices are aligned with what teachers in the classroom are currently dealing with. This relates to the study because pre-service teachers need to be exposed to

the various pedagogies and technology strategies that would enhance their technology-rich lessons. Teacher educators have increasingly looked to the theoretical framework of Technological Pedagogical Content Knowledge (TPACK), which describes what teachers need to know to effectively integrate technology into their teaching practice (Mishra & Koehler, 2006). In the last decade, the TPACK framework has quickly become a widely referenced conceptual framework within teacher education, particularly as teacher education programs redesigning their curriculum to effectively prepare teachers to use technology (Kaplon-Schilis & Lyublinskaya, 2020).

Recent Studies on Other Barriers to Technology

Studies of technology integration revealed various barriers that exist with integrating technology within classroom instruction. Francom (2020) conducted a three-year quantitative study on teacher perceptions of barriers with technology integration, how the perceptions change over time, and how perceptions vary between smaller and larger school districts. This study found that 60% of the respondents selected time to be the most persistent barrier to technology integration in all districts. Teachers felt like they needed more time to carefully plan for and test the implementation of technology in their lessons. This was followed by access to technology. Teachers felt like they needed access to the proper tools and devices necessary for use. Another barrier was the lack of training and technical support. Teachers were not properly trained on how to use technology and did not have the ability to service the devices being used. The absence of administrative support is another impediment to the use of technology. Leaders must be intentionally providing the necessary training and tools to encourage teachers to use technology.

Finally, teachers' beliefs can be a barrier to the effective use of technology. Teachers must believe that technology supports instructional goals and be confident in their ability to use it. Many scholars widely recognize these barriers. Similarly, Dinc (2019) determined from a qualitative study of pre-service teachers that time with technology is needed to increase the understanding of the content. Teachers lack time to test a technology tool or resource or plan for transformative teaching and learning. Teachers need time to plan and prepare for technology-enhanced lessons.

Solutions for Barriers to Technology

Cole and Sauer (2018) conducted a qualitative study to examine the key factors influencing implementing and sustaining computing initiatives from a superintendent's perspective. The barriers found were the lack of resources, professional development, poor planning, ineffective leadership (Cole & Sauers, 2018), and tech support required for effective technology integration (Francom, 2020). The study results revealed five themes from a superintendent's perspective that influence and impact successful technology integration: vision, teaching, learning, resources, a technology suffused world, and equity (Cole & Sauer, 2018).

The first theme is a vision focusing on strategic planning and aligning its program with the district's vision. This helped focus the planning infusing technology by including various stakeholders, such as teachers, parents, technology, and curriculum personnel. A sharp vision is needed in what is expected for teachers to accomplish and how to reach that goal. The second theme is teaching and learning, including personalized learning, collaboration, student engagement, and authentic projects for

successful implementation. It is not about the device for technology integration but how to use it as a tool to support instruction. The third theme, resources, includes devices for students and creating an infrastructure with increased bandwidth, wireless hotspots, security filters, and device insurance. It is crucial to prioritize a school's needs for successful technology integration. The fourth theme, technology-suffused world, prepares students to survive in a technology-rich environment. The classroom must embrace the technology that surrounds us daily to prepare our students to succeed. Lastly, equity focused on the needs of students from different socioeconomic backgrounds to level the playing field (Cole & Sauer, 2018).

The vision helped superintendents make strategic decisions regarding technology integration related directly to teaching, learning, and resources. It helped with preparing the students for a technology-enriched world. Equity was an essential component because it helped school leaders to consider how socioeconomic status impacts students' use of technology and that working with community partners and thinking creatively could improve equity between students.

Administrators, researchers, and teachers are advocates for educational technology in the public school classroom and its ability to initiate and create updates needed in the classroom. However, barriers to technology integration continue to make it difficult for teachers to use educational technology to transform education and improve teaching and learning because of a lack in the areas a mentioned earlier (Cole & Sauers, 2018). Cole and Sauers (2018) believe that leadership recognizes an issue and provides solutions when needed. Administration prioritizes resources to meet the needs of the

teachers, such as providing additional training and or additional devices. This relates to the study because if teachers state there may be a problem in a particular area, leadership addresses it and develops a plan. The explosion of technology in the classroom has caused an awakening for many teachers on what they may not know. These barriers need to be addressed, and it comes from the top. There was a lack of literature on how administrator's decisions trickle down to the teachers and the technology integration.

Numerous barriers exist that impact the quality and success of technology professional development or interventions. Technologies come with their imperatives that constrain the content to be covered and the nature of possible representations (Mishra & Koehler, 2006). These barriers must be considered in conjunction with teachers' levels of TPACK to ensure that what teachers learn during the professional development or interventions translates to their practice (De Freidas & Spangenberg, 2019).

Successful Practice with Teachers and Technology

Blundell et al. (2020) conducted an eight-month study of teachers seeking to transform their teaching practice to thrive in a technological environment with a specifically-developed professional learning framework. Three intrinsic factors were highlighted as contributing to the degree of transformation with technology integration: teachers' frames of reference; habits of mind, and modes of transformative learning. Teachers' frame of reference includes teachers' attitudes and beliefs in influencing their perceptions of technology use in the classroom. Habits of mind are the range of prior experiences with using technology in teaching and learning and their influence on teacher transformation. The modes of transformative learning are the teachers' degrees of

transformation. The findings confirm that intrinsic influences on teacher practices are gatekeepers to transformations, even for experienced teachers in a well-established technology environment. Teachers that redefined their practice and positively articulated pedagogical beliefs about the role of technologies had more experience with diverse roles, relationships, and actions associated with integrating digital technologies. The integration of technology allowed for a more student-centered pedagogy and personalized learning. The change in the teacher's role, relationships, and actions interact with the teacher's frame of reference, and habits of mind were all intrinsic influences (Blundell et al., 2020). Existing practice, knowledge and skill, attitudes, and beliefs are central to teachers' identities (Admiral et al., 2017). Teachers using technology associate with their experience, confidence, or beliefs about the role of technology in the classroom (Anderson & Putnam, 2020).

Moreover, Lui et al. (2017) conducted a study examining the effects of teachers' characteristics, school characteristics, and contextual characteristics on teachers' use of technology. These extrinsic factors have an impact on teachers' confidence and comfort using technology as mediators of classroom technology integration. The extrinsic influence on a teacher's confidence and comfort was years of training with technology and technological support. School variables include access to technology and access to physical devices. Contextual factors include grade level and the number of students per class.

The studies mentioned found that both intrinsic and extrinsic factors yield effective and productive technology integration. Linking technology to individual

experiences to make teachers confident and comfortable will make for a better infusion of it in the classroom. Targeted and intentional planning of resources and support will also support technology integration in the classroom. Teaching in the 21st century has shifted and it is essential that teachers are well-versed in integrating technology into teaching. Therefore, the TPACK framework addresses this need for teachers to be knowledgeable of technology and competent in teaching to ensure students can develop and practice these skills (Shafie et al., 2019).

Implications

"For technology-enabled learning to transpire in classrooms, a greater understanding of the process by which teachers develop this concept is required, emphasizing on pedagogical understanding as directing the integration of technologies" (Prestridge, 2017, p. 368). When teachers are engaged in professional development that integrates subject-area content, pedagogy, and a technology integration model, learner performance may improve (Prestridge, 2017). The research questions obtained a better understanding of teachers' perceptions of their knowledge of content and pedagogy in technology-driven lesson design and barriers.

According to Andrei (2017), it is crucial to understand how knowledge of technology, pedagogy, and content instruct teachers' classroom practices and how to design professional development that supports such practice. This implies a transformation among pedagogy, content, and technology intertwining. Green and Jones (2018) state that teacher learning is built through learners' experiences and professional development experiences. Professional development improves teachers' quality,

knowledge, and skills necessary for professional growth (Green & Jones, 2018). The implications for this study providing school leaders and administration with insight into teacher's perspectives of their knowledge of content and pedagogy to create technology-driven lesson. The research questions guided the study and brought recommendations to improve technology integration, pedagogy, and content to the forefront.

The findings were used to develop a technology professional development session to assist high school content teachers in designing a technology-driven lesson plan. The outcome of these technology professional development sessions is to equip teachers with the skills they lack in content, pedagogy, and technology to design technology-rich lessons. The TPACK model will drive the technology professional development. Teachers will receive individual help and training, then move to their particular content group for training in their subject areas. They will also move to same-age groups but in various content areas. This will allow teachers to work on the themes discovered in the study but across disciplines to gain experience because subjects cross disciplines.

Technology will be led by trainers, software professionals, or peer professionals on the current and new systems available for teacher use in the classroom. Examples of technology integration in several disciplines will be created, addressing complex concepts that students struggle with. The content issues will be determined, and the lead teacher will work with the content issues to strengthen this structure or an outside professional development to strengthen this component. Many different pedagogies and examples will be given across content areas, and how they can be incorporated with

technology. We will have all three components once this is applied to a specific content area.

In addition to the individual skills of content, pedagogy, and technology, examples will be given, intertwining all three simultaneously. Individual, group, and whole-class work will be given to strengthen comprehension of what is taught. Technological activities that allow students to interact and work collaboratively in the content areas will be shared with teachers. The concepts that students struggle the most with will be identified. Models will be built to share with teachers, videos, in-service, and ongoing in-service will be used.

Summary

Section I provides evidence of the local problem with technology integration barriers related to content and pedagogy as barriers with technology integration in the PMHS and then extended to similar education problems throughout the United States. The PMHS is an economically disadvantaged located in the southern United States. The rationale reviews evidence of the district's goals for integrating technology, its pitfalls with student achievement, and the lack of research on the relationship between pedagogy and technology integration within the PMHS. Definitions of important terms are provided for the study. The significance of the study discussed the potential benefits and purpose of the resulting from the study and the project. The research questions were developed to explore the teachers' perceptions of their content knowledge and pedagogy when constructing a lesson design.

The review of the literature began with the study's conceptual framework. The TPACK framework emphasizes the connections, interactions, affordances, and constraints between pedagogy, content, and technology. It focused on the interplay of the three bodies of knowledge, content knowledge, pedagogical knowledge, and technological knowledge. The literature review explored the larger significant problem in technology professional development, barriers with technology integration, pre-service teacher training with technology, successful practices, and instructional design. Finally, the implications are addressed and future endeavors from the research. The remaining components of the study include the Methodology, Section II. The project-based on the finding is in Section III, followed by Section IV, reflections and conclusions of the study.

Section 2: The Methodology

Qualitative Research Design and Approach

This study followed a basic qualitative design to explore the perspectives on and barriers to knowledge of content or pedagogy in terms of a technology-driven lesson. This design with interviews concerning everyday experiences was deemed most appropriate for the research questions. Basic qualitative research is the most common qualitative design in education (Merriam & Tisdell, 2016). A qualitative study is used to understand how meaning is constructed and people make sense of their lives and experiences; words are the data (Merriam & Tisdell, 2016). The main goal of a basic qualitative study is to uncover and make sense of these meanings and to interpret the ways humans' approach and make meaning of their experiences, contexts, and the world (Ravitch & Carl, 2021).

The qualitative, quantitative, and mixed methods designs were examined, and it was concluded that this interpretive inquiry, access to possible participants, and the resulting data aligned best with the criteria of a basic, qualitative design. In a quantitative study, numbers are the data to understand how people interpret their experiences at a specific point and context. A quantitative design uses surveys to sample populations and find numeric descriptions of trends, attitudes, or opinions to statistically analyze and interpret the numbers (Creswell, 2009). The quantitative research design was rejected because the collection methods utilized closed-ended questions that would not open the participants to an in-depth experience. The design is based on the analysis of numbers, whereas themes, patterns, and interpretations were needed in this study. Quantitative

research analyzes deductively, whereas qualitative research builds on the themes and patterns (Creswell, 2009). The quantitative design measurement critical because it reveals a relationship among quantitative variables. This design can also use experimental research where treatment to one group and withholding from another influence outcomes (Edmonds, 2017). An experimentation component is unnecessary for this study, as I conducted a study in a natural setting. I also wanted to determine the underlying meanings when gathering and collecting information (Creswell, 2009).

The mixed methods research combines qualitative and quantitative research to gather data and draw conclusions from both data sets to understand the research problem. The quantitative survey would give general information to explore the statistically significant difference in gender, race, or economic disparities. The qualitative portion would interview a subset of the survey participants based on purposeful criteria (Merriam & Tisdell, 2016). The mixed methods consist of open and closed-ended questions; it uses multiple forms of data to formulate possibilities and statistical and text analyses (Creswell, 2009). The mixed-method research design was rejected because it did not align with the current study. Observation of the participants in their local setting and open-ended interview questions were needed to gain perspective and build on themes. The quantitative portion of the mixed method design did not fit with the direction of the study and other barriers.

Participants

The participants consisted of certified core subject teachers employed by PMHS and teaching Grades 9-12. The core subjects include: English, Social Studies,

Mathematics, and Science. The participants were employed in the high school with 5 or more years of experience in the classroom and volunteered to participate in the study with a response by email agreeing to a 60-minute interview. The participants have participated in technology professional development within the district and utilized technology within their lessons to be eligible to participate in the study.

Sampling

Purposeful sampling is the most suitable strategy to attain a deeper understanding of a specific group (Merriam & Tisdell, 2016). This type of sampling allows for deliberate selection of participants for specific reasons because they have a particular experience, know a specific phenomenon, or reside in a specific location (Ravitch & Carl, 2021). The teachers employed at PMHS provided a scope into content knowledge, pedagogy, or other barriers in a technology-driven lesson design. The goal of purposeful sampling is to obtain cases deemed information-rich for study (Sandelowski, 2000).

The sample size was adjusted according to the responses and data received. Determining the definite sample size is predicated on having adequate opportunities to accumulate relevant data until no new information is surfacing from the data (Johnson et al., 2020). During the interview process, I continued to question participants to notice if new data were generated because of the interview. If participant responses became redundant, additional interview participants were not needed. When no new information is discovered, saturation has been achieved. Smaller samples will allow the researcher to examine the data more deeply and explore with more attention to detail than a larger sample (Yurtseven & Bademcioglu, 2016). This sample of participants were information-

rich subjects who aligned with the criteria and answered the research questions. Individuals are selected intentionally because of their exclusive ability to answer a study's research questions (Ravitch & Carl, 2021).

Gaining Access to Participants

Access to the participants requires permission to conduct the study from Walden University Institutional Review Board (IRB). I obtained approval from the school district to conduct the study at the school site. A letter of cooperation was given to the high school principal, including the purpose of the study, data collection methods, and an overview of the project study. A copy of the email invitation and consent form was given to the principal. A mass email inviting participants to participate in the study and a consent form was sent to all teachers that teach academic core subjects and meet the previous inclusion criteria. Teachers who responded from each academic core subject area returned the consent form. Researchers should allow potential participants to read an informed consent form before deciding to participate in the study (Ravitch & Carl, 2021), because it ensures that potential participants understand the nature of the research, are aware of any risks, and are not forced either covertly or overtly to participate (Rubin & Rubin, 2012).

A follow-up was completed with participants by email or phone call to talk more about the study and a set time and date of the teachers that have responded. People are more likely to talk with an interviewer if they build rapport (Rubin & Rubin, 2012). A date and time were scheduled for the interview, at which time the developed interview questions were used to collect data to support the established research questions. Semi

structured interviews were conducted utilizing open-ended questions until saturation had been met. A post-interview was scheduled during the first interview to allow teachers to validate transcription by member-checking. I restated or summarized information and then questioned the participant for accuracy; the participants either agreed or disagreed that the summaries reflected their views, feelings, and experiences. If accuracy and completeness are affirmed, then the study is said to have credibility (Creswell, 2007; Lincoln & Guba, 1985).

Protection of Participants' Rights

The participants were informed that participating in this study is voluntary and entirely confidential and their protection is important. As the researcher, I was the only one who knew the participants' identity. Each participant was assigned a number to correspond with their transcribed responses to protect their anonymity. The participants' identity was not at any time revealed. The participants need to be reassured that ethical guidelines are followed, they will remain anonymous, and all information provided will be confidential (Gill et al., 2008). Each participant signed a consent form prior to data collection to ensure confidentiality. These measures ensured the participants' protection and no harm would befall them. The data were collected and stored electronically in a password-protected folder and will be kept until 5 years after completion of the study.

Researcher-Participant Relationship

I do not know the teachers who were selected. I have no supervisory role over the participants. Although researchers are trained to be as neutral and facilitative as possible to guard against overly influencing participants' responses, participants nonetheless

apprehend multiple aspects of the researcher's personhood from their manner, physical appearance, and personality characteristics (Harvey, 2017). My goal was to establish a trustworthy relationship with participants by thanking them for their participation, engaging in conversation about the school, and making them feel comfortable sharing their responses with me. It is vital to establish a rapport with the person being interviewed by being friendly and impartial (Johnson & Christensen, 2004). Participants were explained that no identification would be attached to their responses, and each was assigned a number to correspond with the respondents to keep them anonymous. Trust and reciprocity are vital to and at the center of healthy relationships (Ravitch & Carl, 2021). I was attentive to participants' responses to ensure their information benefits the study. The participants gave informed consent to participate in the study to protect their rights and views. The participants were reminded that they might withdraw at any time if they no longer wanted to participate. I also answered any questions participants had about the study.

Data Collection

The main methods to collect and generate data for qualitative research can include interviews, observations, focus groups, documents, or archival data (Ravitch & Carl, 2021). The research questions were considered to select an appropriate data collection method for responses for this study. The best data collection method was interviewing to provide deep, rich, and individualized data to answer the research questions. The purpose of an interview is to obtain unique information that cannot be directly observed to find out what is in one's mind (Merriam & Tisdell, 2016). Its primary focus is to gain insight

into an individual's lived experiences, how participants make sense of and construct reality to the event, phenomenon, or experiences, and how their experience relates to other participants in the study (Ravitch & Carl, 2021).

The three domains of the TPACK framework were utilized to drive the questions in the interview. To create a technology-driven lesson, TPACK laid the foundation for the specific questions about pedagogy, content, and technology and its usage. In the study, the selected teachers participated in semi structured interviews to explore the barriers in the knowledge of content, pedagogy, or other barriers in terms of a technology-driven lesson because teachers struggle to implement technology in the classroom in the PMHS. The interviews provided in-depth viewpoints of teachers' various grade-level and subject areas at PMHS. Interviews describe experiences in depth and perspectives while describing the processes and how they interpret their experiences. (Ravitch & Carl, 2021).

The data collection took about 2 months to complete. The interviews were face-to-face at the participants' convenience. The interviews were recorded on a recorder for in-person interviews, which offers a recording feature to create an artifact for transcription and analysis. Each interview was dated and stored. The interviews were transcribed using computer software.

Once a teacher responded to the email invitation and met the criteria, they were sent an informed consent form, and a request for an interview date and time was placed. The participant agreed to an interview of about 60 minutes. Follow-up interviews were requested if needed for clarification. In addition to the interview, a research journal was

kept for the accuracy of the information, thoughts processes, ideas, and follow-up questions about the research. The research journal entries allow a researcher to reflect on experiences, the perspective of concepts, and current and past readings to develop deeper connections (Ravitch & Carl, 2021).

Member checking was used with the participants for validity and to establish credibility (Ravitch & Carl, 2021). The participant reviews data collected to make sure that it expresses their views and experiences, proving credibility in the study (Creswell, 2007). During the interview, I restated and summarized the participants' responses to check for understanding and ensure the accuracy of the summary. The participants checked to see whether a "true" or authentic representation was made of what they conveyed during the interview. Member checks establish credibility with the participant and increase the study's validity (Ravitch & Carl, 2021).

Instrumentation

I as the researcher was the primary instrument for data collection that can immediately respond, adapt, read verbal and non-verbal communications, clarify, and summarize information that will lead to a more robust analysis and understanding of the phenomenon (Merriam & Greneir, 2019). Therefore, the researcher shapes the research in terms of processes and methods and shapes the data and findings (Ravitch & Carl, 2021). This basic qualitative research study used interviews as the data collection instrument. Interviews provide a "deep, rich, individualized, and contextualized data that is central to qualitative research" (Ravitch & Carl, 2021, p. 126). Semi structured interviews were utilized to organize and guide the interview. This type of interview allows for specific

questions to be asked, the order of questions and wording to be customized, and tailored follow-up questions within and across interviews (Ravitch & Carl, 2021). The TPACK framework guided the interview questions. The interview questions addressed each element—content, pedagogy, and technology—and the relationships among them. Rather than treating the three types of knowledge as separate bodies, this model emphasizes the interplay of the three in which good teaching requires an understanding of how technology relates to pedagogy and content (Mishra & Koehler, 2006).

Field Testing

Field testing ensures that the instruments utilized are accurate and can collect the data needed explicitly for this study (Ravitch & Carl, 2021). It allows for adjustments and corrections necessary for the instrument utilized. Field testing can develop and refine data collection instruments and help hone interview skills and how researchers approach and frame the study with participants (Ravitch & Carl, 2021). Since interviews were utilized in the study, field testing of the interview questions was needed. Two to three teacher volunteers from another high school field tested the interview questions with a mock interview. The time frame for the mock interview was checked to ensure it was sufficient for the number of questions. The field testing helped decide if any edits needed to occur with the interview questions.

Role of the Researcher

My role as a researcher was the interviewer of the participants. Currently, I work as a teacher/facilitator at the PMHS. I was formally under the mathematics department at PMHS, but I am no longer a part of any core subject departments. The school selected for

the study is the school where I am employed. The teachers selected for the study were teachers whom I do not know and with whom I have no relationship. I have taught mathematics for 8 years but am no longer a part of this department. I am not in any administrative role and am not competing with any of the participants. The researcher is present in the community of the people to engage in a natural setting (Ravitch & Carl, 2021).

Data Analysis

Data analysis entails making sense of data by preparing the data for analysis, conducting inductive and deductive analyses, and moving into a deeper understanding of the data (Creswell & Miller, 2000). The data were collected through semi structured interviews aligned with the research questions. Analyzing the data started with a deductive analysis followed by an inductive analysis. Qualitative research is explorative, and inductive approaches are commonly practical; however, deductive approaches can be used (Kim et al., 2018).

Deductive Analysis

A deductive analysis is a top-down approach with predetermined terms searched for in the text (Ravitch & Carl, 2021). The data was re-read, and a deductive analysis began from the patterned line of questioning, and the responses used the vocabulary from the questions. The deductive analysis includes terms from the interview questions: Teacher-Centered, Pre-Service Education, Content Knowledge (CK), Pedagogical Content Knowledge (PCK), Learner-Centered, Barriers, Pedagogical Knowledge (PK), Technological Content Knowledge (TCK), Instructional Goals, Cons of Technology Use,

Technological Knowledge (TK), Technological Pedagogical Content Knowledge (TPACK), Technology-Driven Lesson Design, Pros of Technology Use, Technological Pedagogical Knowledge (TPK). These terms are directly related to the TPACK framework and were searched within the text to allow an understanding of the teachers' skills or ideas related to the TPACK model. The terms were established before the analysis, which is the predetermined codes. Deductive coding involves reading the data and looking for something specific from prior literature or research (Ravitch & Carl, 2021). Themes were extracted from this type of analysis. According to Saldana (2016), "A theme is an outcome of coding, categorization, and analytic reflection, not something that is, in itself, coded" (p. 24).

Inductive Analysis

Creswell (2018) stated that analyzing data inductively with qualitative research develops from the bottom up, and categories and themes are revealed. An inductive analysis was completed noticing repeating ideas or vocabulary outside the frame of the questions. The inductive analysis will include diverse types of coding.

Coding. Coding is primarily an interpretive, heuristic, and exploratory process requiring problem-solving and data synthesis. It connects the qualitative data collection with the data analysis to determine the emerging data. According to Richard & Morse (2007), coding is the starting point for a more meticulous analysis and interpretation; it links the data to ideas and the data concerning these ideas. The three types of qualitative coding utilized were: open coding, axial coding, and in vivo coding.

Open Coding. According to Miles et al. (2014), open coding summarizes portions of the data. I read the text multiple times, and open or first-level coding will be utilized. I highlighted, labeled, and tracked by hand, searching for common terms or phrases in the text. This determines what stands out from the data, and the second round may determine something more specific (Ravitch & Carl, 2021). Miles (2014) stated that coding data requires reading for reoccurring terms, phrases, strategies, and patterns. After the codes were determined, the codes' definitions were defined from the various interview responses combined into a clear definition. The codes and definitions were posted in a table created. According to Ravitch and Carl (2021), the code definitions should be brief and precise in understanding. This type of first-level coding allowed a productive breakdown of the data into clear concepts, categories, and headings.

Axial Coding. According to Ravitch & Carl (2021), axial coding is coding more significant portions of data into coding categories or clusters. It examines open coding to determine more extensive codes or themes that can develop. Axial coding focuses on the concepts and categories while reading the text to find the connections or relationships amongst the open coding. The text will be re-read, once the interview transcriptions are read multiple times and open coding is completed. I identified any concepts or categories and their relationships while reading the text. The concepts or categories found will be transferred into a table created. This type of coding furthered the analysis and interpretation of data by finding the relationship between concepts and categories.

In Vivo Coding. The NVivo is computer software used to further the inductive analysis. In vivo coding is a qualitative data analysis that emphasizes the actual spoken

words of the participants. This coding is used as the starting point of an analysis to lead to more sophisticated analysis techniques but may be used exclusively (Ravitch & Carl, 2021). The recorded interviews were entered into the NVIVO system to help organize and develop themes. The responses were grouped by question number. The system organized the codes, allowing a thematic analysis to be conducted to determine the common themes among the data. Then the connections among the themes were determined, and responses to the interview questions were compared.

This type of coding is helpful in understanding the participants' stories or ideas through their words. The codes can be in vivo, where the words or concepts are from the participants or determined by the researcher and grouped to form categories and themes (Howitt, 2019). It focuses on the words of the participants, which means consideration must be taken on how language and social interaction come together to form the social scene (Rogers, 2018). The coding was continued until there were no new recurring themes. The inductive and deductive methods used in the data analysis focus on the inseparability of methods and findings. The questions we ask and how they are asked shape the data (Ravitch & Carl, 2021). This type of coding enhanced the data collected through the interviews by organizing the data by key phrases or words and allowing excerpts from the interviews to be placed under the correct codes.

Data Analysis Results

This basic qualitative study aimed to explore the perceptions of teachers' content and pedagogy when creating a technology-driven lesson design. The following research questions were used to guide the study.

RQ1: What are high school teachers' perceptions of their knowledge of content and pedagogy in technology-driven lesson design?

RQ2: What do high school teachers perceive to be barriers when designing technology-driven lessons?

In this chapter, I provided the setting of the study with relevant participant demographics. The description of the data collection and data analysis follow the setting of the study. The details of the study results are presented next with evidence of trustworthiness.

Setting

The study participants were from a Title 1 public magnet high school in a suburb in the southern United States. The participants were all high school core content teachers within the ABC school district. The teachers all met the criteria outlined in Section 2. The years of teaching for each teacher varied from 5 years to over 38 years. The teachers taught within the district for 5 years to over 15 years. The participants had a various degrees ranging from a bachelor's degree to a master's degree (see Table 2).

During the proposal, all the participants experienced the effects of the Covid-19 pandemic. This included the challenge of teachers to teach completely virtual and integrate technology with limited professional development. Even though the Covid-19 pandemic was not a barrier, it was mentioned by some of the interviewees and impacted their technology usage in the classroom because of the forced use. During the interview process, the participants were teaching in 100% face to face with students with some of the pandemic utilization of technology still in place.

Table 2

Participant Demographics

Participants	Grade-Level	Number of Years in Education	Number of Years in the District	Degrees Held	Content Area
P1	High School	15	10	BA in Biology MBA and MHA Healthcare Administration	Science
P2	High School	9	7	BA in History MA in History	Social Studies
P3	High School	21	19	BA in Criminal Justice MA in Educational Leadership	Social Studies
P4	High School	15	15	BS Electrical Engineering MBA	Math
P5	High School	14	14	BA in English and Italian	English
P6	High School	14	10	Ba in Math/Computer Science MA in Education Administration	Math
P7	High School	17	17	BA in Applied Technology	English
P8	High School	9	8	BA in Sociology MA in Educational Leadership	Science
P9	High School	20	19	BA in Social Studies	Social Studies
P10	High School	3	3	BA in History MA in Museum Science	Social Studies
P11	High School	38	5	BA in Life Sciences MA in Education Administration	Science
P12	High School	20	17	Ba in Electrical Engineering	Math
P13	High School	10	9	BA in Mathematics	Math

Data Collection Processes

Before recruiting participants, I received approval from Walden University Institutional Review Board. After receiving approval, a mass email with the invitation (see Appendix E) to participate in the study and a consent form was sent to all teachers teaching academic core subjects and that met the previous inclusion criteria. Teachers

who responded from each academic core subject area returned the consent form. Thirteen emails were received with a reply of “I consent”. They were also encouraged to keep a copy of the consent form for their records.

Once the potential participants responded, a follow-up was completed with participants by email or phone call to discuss the study and check availability for the 45–60-minute interview. A date and time were scheduled for the interview, at which time I used my developed interview questions to collect data to support the established research questions. Two of the participant’s dates and times for the interview were rescheduled because of unexpected circumstances. The interview was scheduled according to their availability.

Field testing of the interview questions was conducted with three teachers from different high schools within the district. A mock interview was conducted to check if any edits were needed for interview questions. It also checked the time frame of the interview to ensure all questions could be answered in the allotted time. Before starting the interview process, permission to record the interview using a recorder was asked. All participants agreed to have their interviews recorded.

Initially, the interview was supposed to last 45–60 minutes. The times for the interview varied between 25–45 minutes. All the participants were interviewed after hours in a closed classroom for privacy and comfort. I reiterated that participation in the study was voluntary and that steps would be taken to protect their confidentiality. Each participant was given a pseudonym for their protection. The participants were asked 42 open-ended semi structured interview questions that prompted descriptive details. I used

a hard copy of the interview questions for reference and note-taking. I also took notes during the interview process in a journal based on participant's responses. Follow-up interviews were conducted with each participant for clarification and understanding of responses. This occurred based on the participant's availability.

Once the interview process ended, the participants were thanked for participating in the study. The interviews were recorded on the voice recorder app on my cell phone and IPAD. Both devices are password-protected to ensure participant confidentiality. After the interview, all audio recorded files were transferred to my password-protected computer. The audio files were then uploaded in the NVIVO software for transcription and then downloaded, saved, and stored on a password-protected computer. Minor edits were done to the transcription because of misspoke words or spelling errors to reflect the accuracy of the audio recording. A coding process was used to analyze the transcripts, including patterns, meanings, and themes.

Data Analysis

The data analysis process consisted of reviewing and uploading the collected data into the coding software for transcription. NVIVO transcription was the software used to transcribe the audio recording of interviews. Analyzing the data started with a deductive analysis followed by an inductive analysis. For the deductive analysis, each interview was read and re-read several times. The deductive analysis terms were searched for within each interview. Any phrases, quotes, or words related to the deductive analysis terms were given a specific highlighted color, underlined, or symbols were used to decipher them in each interview. Then, I reviewed and analyzed the annotations in each

interview transcription to determine if they were related to the research questions. Themes were extracted from this analysis and placed in a Microsoft Word document.

The inductive analysis process analyzed the data without any pre-existing terms. A new copy of the interview transcriptions was reviewed multiple times for each participant. I highlighted, underlined, and used symbols to emphasize any words, phrases, or quotes that were related and meaningful to the study. A review and analysis of the data continued in relation to the research questions. The data related to the research questions were coded in the margins and a Microsoft Word document. There were initially 61 codes from the transcripts. A spreadsheet was created with the codes, and I began to gather any related codes on the spreadsheet. Some codes were repetitive and were made into one code. After assigning codes, the interview transcripts were reviewed to begin categorizing the data. Using the NVIVO software assisted with the organization of codes, categories, and themes during the inductive analysis. Patterns were developed from codes that were gathered. As the data was reviewed and analyzed multiple times, new codes were added, and others were fused with existing codes. Patterns were created to reflect the data. Direct quotes from participants transcripts were added to support the data. The patterns were reviewed and combined for the themes to emerge. No new information, codes, patterns, or themes emerged from the participants so recruiting ceased. Data saturation was met at the 13th participant.

The discrepant cases were used to strengthen the data related to the research questions, which helped eliminate any biases. Member checking was used with the participants for validity and to establish credibility (Ravitch & Carl, 2021). During the

interview, the participant's responses were restated and summarized to check for understanding and ensure the accuracy of the summary.

Results of Research Question 1

A deductive (Analysis A) and inductive (Analysis B) was conducted to reveal data related to research question 1. The results will follow.

Deductive Analysis

Table 3 shows the deductive analysis (Analysis A) of the predetermined terms used and the categories developed from the data. The themes and patterns were all supported by quotes from the participant's interview transcripts.

Table 3

Results of Analysis A Related to Research Question 1

Terms	Categories	Quotes
Content Knowledge (CK) 13 out of 13	Master of subject area Understand all content of subject matter	"I teach English and know and understand the different standards that are set forth by the state in regard to English and what is required for the students to know" P5 "It's how well I know my subject and could show up at a whim at a department meaning and a question about Precalculus came up and I would be able to engage in conversation about the topic without a textbook or resources." P6
Pedagogical Knowledge (PK) 3 out of 13	Lack of understanding of how to reach students Unable to teach at different levels	"I have learned how to teach by trial and error and by copying others for the most part." P4 "I went through alternative certification, so I learned a little bit of Marzano and stuff like that, but a lot of how I teach is based on trial and error and just learning on the job." P5
Technological Pedagogical Knowledge (TPK) 6 out of 13	Present content in limited ways with technology Not able to use technology to enhance teaching effectively	"I pair all my lectures with Google slides all the time." P10 "I use technology basically for looking things up that are current in the news, and it opens up discussion with the students, that is the extent in which I use it." P11
Pedagogical Content Knowledge (PCK) 3 out of 13	Teaching by modeling Know how to teach effectively	"I would make lessons up at home and present them, and there was always a disconnect with the students, I learned by picking things up along the way to improve." P7 "We do, and then you do, then there is an independent practice with observation and more clarification if needed. Usually, three to four examples with that pattern when its I do then you do pattern." P13

Technological Content Knowledge (TCK) 7 out of 13	Technology helps teach the content Technology opens up ways to teach content	"All of the lessons are in a PowerPoint presentation and everything they need for the day is within the PowerPoint, which can include videos and readings." P2 "I utilize a QR code for the students to access a recording of a lesson on the topic for that day if they are absent or need extra help." P10
Technological Pedagogical Content Knowledge (TPACK) 3 out of 13	Technology used as a tool to enhance teaching Know what technology works with certain subject area	"I use technology not to just solely teach the students so much but to help them to guide and practice and for quick turnaround feedback." P12 "I use a virtual escape room which is a way for students to check their work without me having to check it constantly. If they got it wrong in the escape room, it would tell them to try again." P13
Teacher-Centered/ Learner - Centered Learning 12 out of 13	Depends on topic or content Students need direction and also group time	"I try to keep thirty-percent teacher-centered and 70% learner-centered" P8 "It's more of 50/50 for me for teacher-centered and learner centered, students don't know how to solve for variables or other algebra skills, and they have to be explained a lot more than usual." P13
Pre-Service 2 out of 13	Not available in pre-service Depended on degree	"I did not have any technology education in my pre-service education, it was not even around during that time." P11 "No, I had not trained in my pre-service education." P9 "Yes, I did have training in technology because I was a computer science major." P4
Instructional Goals 10 out of 13	Assessment tool for students Enhances teaching of content	"It allows me to get the information to the students and be able to monitor the classroom at the same time." "It enhances meeting my instructional goals in teaching". P11

Theme 1: Content Knowledge. This predetermined theme was present in the data from all the participants. There were 13 out of 13 participants that expressed they are proficient in their content knowledge in their specific content area. P5 and P6 stated that they have a thorough understanding of their content area and what is required of them to know and be able to answer any questions related to their subject areas. P1 also shares that. "Having content knowledge is knowing your subject area, being the expert in your subject area and being able to answer questions." P7 also states." Understanding the content is something you already know for yourself, like you have that you understand the content and know the content." P11 also shares that having content knowledge is when your able to explain it to someone else. P12 shares," Having the skills to be able to master the subject.

Theme 2: Pedagogical Knowledge. The pedagogical knowledge theme deals with the type of knowledge unique to teachers and is based on how teachers relate their pedagogical knowledge (what they know about teaching) to their subject matter knowledge (what they know about what they teach). There existed 3 out of 11 participants that felt adequate about their level of pedagogical knowledge. P10 states that "I had a two-week teaching course which did not help much, so I learned a lot from people telling me through observation saying this or that works and then just putting some of my personal style to it." P11 states, "Learning how to teach goes back to when I was in high school and my English teacher and her way of teaching I liked, so I emulated that for the most part." P12 shares, "Your taught one way to teach, but once you get in there, the expectation changes, and you have to make adjustments."

Theme 3: Technological Pedagogical Knowledge. Technological Pedagogical Knowledge refers specifically to knowing what technological tools to use and how to use them in developmentally appropriate ways to help teach your content. There were 6 out of 13 participants with technological pedagogical knowledge. The teachers could have been stronger in this area, there were some issues found. P10 states, "I pair my lectures with Google Slides. I am very confident with this program, so I stick to this mostly." P11 also shares, "I use technology basically for looking things up that are current in the news, and it opens up discussion with the students, and that is the extent in which I use it." These two participants only used what they were comfortable with and confident using in the classroom. They explained that there are other ways to try incorporating technology in the classroom but that they were not knowledgeable enough to infuse them. They were

unsure of how certain technologies would fit with their content area. P12 states, “When we are given new technology to utilize in the classroom it’s up to us to play with it to see where we can incorporate it. If you do not know how to, you most likely not use it.” P12 shares, “When we attend technology professional development to help us infuse the technology in our teaching, it’s not curriculum or content-based, so then we struggle. P13 states, “I many handout worksheets because it seems to work best in my classroom, and not sure how to infuse technology to enhance the lessons.

Theme 4: Pedagogical Content Knowledge. Pedagogical Content Knowledge is the relationship between understanding content in a specific field and selecting teaching approaches and strategies. There were 3 out of 13 participants with this type of knowledge. This theme was apparent in this data. The teachers were able to develop a plan of teaching a specific content area. P13 stated, “ It’s we do then you do, then there is an independent practice with observation and more clarification if needed.” P2 shares, “When I plan lessons with others it’s about pacing and making sure we are all on the same track and covering certain areas. But, how we get to that point is all up to us. I put all my lessons on a PowerPoint and students go through it independently. P3 states, “I go through the lesson cycle, I’m old school. Then I try to make real-world connections because I know history can be dry.

Theme 5: Technological Content Knowledge. Technological Content Knowledge is how to use technology within a specific content area. There were 7 out of 13 participants with this type of knowledge. The teachers use the technology that they feel the most comfortable with to use in the classroom. P2 states, “All of the lessons are

in a PowerPoint presentation, and everything they need for the day is within the PowerPoint, which can include videos and readings." Most of the teachers were able to infuse some type of technology to help teach their content. P4 and P11 stated that they make use of the TI-Inspire calculators for their math classroom. P4 shares , "I use the Promethean whiteboard which, connects to the IPAD to teach content, and walk around the room and the TI-Inspire calculator to help the students." P11 states, "I use the TI-Inspire calculators in class for an interactive activity at times but not too much, so they get dependent on the calculator. Not all teachers agree with technology. P5 states, "Honestly, beyond just typing papers and doing a quick Google search on stuff, I don't see technology as this immersive experience in my English class; it can't replace reading." Even though P11 utilizes the calculator at times, she stated, "The use of calculators at this moment is minimal, and students rely on it too much. Paper and pencil work just fine." P6 stated, "There is a great program to teach the unit circle online, and you can manipulate and play with the graph. It's a great visual for the students." P8 shares, "I use an online game Kahoot to help teach the content and assess students."

Theme 6: Technological Pedagogical Content Knowledge. The theme of Technological Pedagogical Content Knowledge is the ability to apply a set of knowledge and make it truly meaningful and deeply skilled teaching with technology. There were only 3 out of 13 participants that were proficient in TPACK. The majority did not meet all the marks to be proficient in TPACK and lacked the set of knowledge to teach their students a subject, teach effectively, and use technology all at the same time. The teachers may have been well knowledgeable in a few of the other six areas, but not all

areas meet the standard of TPACK. P3 shares, “While certain aspects of technology can be easy, like my class loves Kahoot, some of the technology is not user friendly or effective with my content area. I’m definitely old school relational and I would think technology would be the place where I can improve the most.” P5 shares, “I know with English Literature, technologies is not really going to change a whole lot. It can save on paper but that’s it in my classroom.” P11 shares, that” I may put notes on the board and give examples or artifacts, I do not need to use technology all the time, I think sometimes technology is a teacher’s escape instead of them planning where they are.” P13 states, “For me technology has mixture of usefulness, but I don’t care for it or use it as much because it’s a distraction for the students because they are always caught doing something other than what they are supposed to be on the technology.”

Theme 7: Use of Teacher-Centered/ Learner-Centered Learning. The type of learning teachers utilize in their classroom was both teacher-centered and learner-centered. There were 12 out of 13 participants utilized both teacher-centered and learner-centered learning. Most of the teachers allotted more time for learner-centered learning than teacher-centered learning. P2, P3 and P8 allot more time to learner-centered learning. P2 states, “Probably 90 percent is going to be learner-centered activities, so that the students can take more of an initiative, and I will just be there answering questions for clarification.” P5 also says,” I try to keep the teacher journal for probably 30 percent of the class and then the rest of the time the kids are doing the work.” P3 and P5 were adamant about their direction instruction and teacher-centered learning time as a very important part, not for it to take the entire class period but very necessary for the students

to learn and take notes. P3 shares, “So it’s probably 25 % teacher-centered and 72 % learner-centered; like I said I think there is a place for lecture and direct instruction.”

Theme 8: Preservice Education Lacked Technology Integration. Preservice education relates to any formal training in technology integration during their college days. Only 2 out of 13 participants received some type of preservice education with technology. Most of the teachers had no formal training on technology integration before starting their career in education. P4 and P11 stated that technology was not even an option when they were in undergraduate school. P1, P3, P6, P8 stated that their undergraduate experiences only dealt with their specific content area and education, technology was not introduced. It was not mentioned in a formal class. P8 and P12 state they are pretty good with technology as a whole so it is easy for them to catch on quickly to new technologies, but that is not how it is for everyone. P3 and P11 stated that the shift to technology occurred while they were teaching, and it was a struggle for them to get acclimated.

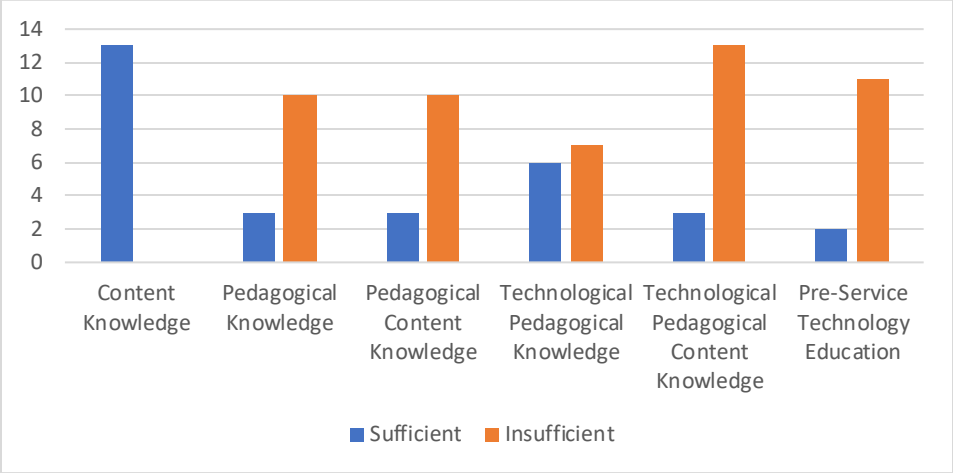
Theme 9: Instructional Goals in Teaching with Technology. An instructional goal is a clear statement of observable behaviors that learners are to demonstrate as a result of the instruction. Instructional goals relate to the teachers’ content and how they present it to the students for learning to take place and this learning able to be assessed. There were 10 out of 13 participants agreed that technology helps reach instructional goals. Those teachers that used technology with their pedagogy to help teach their content stated that it helped enhance their teaching. P4 states, “Technology use in my lessons is useful for my instructional goals because it allows me to get information to the kids and

be able to monitor what is going on in the classroom at the same time." P6 shares, "Technology is a great tool and asset to achieve your instructional goals in the classroom." It also helped assess what was taught to the students and to see what progress has been made if any. P12 share, "It's a good way to assess the kids quickly so they get instant feedback and can make corrections, so it helps with my instructional goals."

Summary of Deductive Analysis. By conducting Analysis A as related to Research Question 1, I gained insight into teachers' perceptions of their knowledge of content and pedagogy in a technology-driven lesson design. The classification of sufficient, represented by a blue bar, or insufficient, represented by an orange bar of themes is highlighted in Figure 2. Participants shared that they are competent and experts in their specific content areas. The participants see themselves as master teachers, and content knowledge was not an issue. The participants usage of technology within their lesson was not nonexistent, but they needed more direction on what works best for their classroom. The teachers, however, lacked pedagogy, which meant there was a lack of understanding with how to reach students and difficulties teaching at different levels.

Figure 2

Results of Deductive Analysis Related to Research Question 1



Inductive Analysis

Table 4 shows the inductive analysis (Analysis B) of the data and the categories, themes, and patterns that were developed. The themes and patterns were all supported by quotes from the participant's interview transcripts.

Table 4

Results of Analysis B Related to Research Question 1

Category	Patterns	Themes	Quotes
Content and Real-World Application	Teach the content but also relate to the real world; Foundational concepts are essential to accomplish tasks but also to connect your content in a real-world setting; knowledgeable of my content 12 out of 13	Teachers were knowledgeable of Content Area and its application to the Real-World.	"Especially in science it's important to relate what is going on in the real world to what is taught in the classroom" P1 "I try to look for as many real world or modern events that connect to what we are learning" P3
Teaching and technology meshed well	Teaching and technology mesh well; Technology and teaching beneficial; Exposes students to various ways of learning. 6 out of 13	Teacher are not comfortable with pedagogy enough to use technology as a tool in the classroom	"My teaching style and technology mesh well and it allows students to succeed in different ways." P6 "My teaching style and the tech I use in the classroom works for me." P11
Trial and error	Learned how to teach by copying other teachers; Learned by trial and error to see what works and what does not. 10 out of 13	Pedagogy was formed by being exposed to others	"I learned how to teach from copying others and emulate then fine-tune as things go along" P4 "I had a really good team at a previous high school, and I took a lot of tricks from them and put them in my classroom." P7
Learner-centered learning	Teaching is mostly learner- centered; wants students to take the initiative with learning; the teacher is a facilitator; about 60 minutes is learner-centered and 20 direct teaching; problem-based learning, student groups/activities 10 out of 13	Problem-based learning Student groups/activities Interactive activities	"My classroom is 25 percent teacher-centered and 75 percent student-centered." P7 "I do not like to just stand in front of the class, and just talk, so I'm talking maybe 15 min and then students are working in groups." P8

Theme 1: Teachers were Knowledgeable of Content Area and its Application to the Real-World. Theme 1 emerged as 12 out of 13 participants conveyed their competency of knowledge in their content-specific content area and their ability to relate that content to real-world applications. The teachers expressed that they were experts in their content area and able to answer any questions pertaining to this content area. Many of the teachers could take their content and apply it to the real world. They can infuse how their content relates to the outside world and life. Many real-world applications were examples from the internet, news, budgeting, and jobs. These applications would give meaning to their content area, how it can be used in the real world and why it was important to know.

P6 shares, "I know my content well enough that if I was to show up on a whim at a department meeting or anywhere across the district and someone could bring up a Pre-Calculus topic, and I would be able to engage in the conversation without having to consult a textbook to remember anything, any formulas, or any vocabulary." P9 states," I know my content area and am an expert in this area and able to answer questions covered in this area." P11 states, "I am able to express myself about the specialty I'm in. You are able to express it and present it where other people can understand it. Most of the educators were very knowledgeable about their specific content area and able to answer any questions related to that area without question.

The teachers were not only knowledgeable but able to take this content and relate it to the real world to make a connection. P6 stated, "If you're trying to create a budget and you want to buy a car. If you only learned how to solve things using a calculator,

you're going to have a harder time figuring it out. So, if I want to buy a car, it matters whether I have cable or whether I just get the rabbit ears, whether I have Netflix, Hulu, and just understanding that there's different variables that make a budget work and manipulating those variables can get different results for what you want." P3 teaches a government course and states." We start with voter empowerment and then switch to a project on the three branches and how they share power and hold each other accountable, and really the only way we, the citizens, have any power is through voting. So, voting and voting empowerment is one of my real-world applications for the government course."

The teachers always were thinking about how to relate their content to real-world when planning their lessons so that there is always some connection to peak interest of students. P4 states that, " I try to show the students or give them some explanation of what we are going to be covering and give them an opportunity, give some ideas on how it affects them in real-life or some real-life examples of how they can use it so they can see that it's not just something that they are learning, it's something that they are learning to be able to use, not only here in the classroom, but later in life as well."

Theme 2: Teachers are not Comfortable with Pedagogy Enough to use Technology as a Tool in the Classroom. Theme 2 emerged from the data as 7 out of 13 participants were not comfortable enough with their pedagogy to utilize technology as a tool in the classroom. Many of the teachers expressed a gap between their specific pedagogy and the utilization of technology within their classroom. Because of forced technology integration of technology during the pandemic, there was a rushed learning

process to infuse technology for teachers that did not use it every day in their classroom. Using technology as tool can be Google Classroom, Smart Board, Schoology, Interactive games, for example. P3 stated that," I think there is a place for direct teaching. I am on the lower end of using technology in my lessons because I am a Gen-Xer, so I'm a digital immigrant and I am sometimes stubborn." He also shares that technology does not always translate to my content. Participant 4 states that, "While technology is good is some ways, I teach Algebra and technology is not always the best answer. We use Algebra tiles, dice, and other manipulatives in the classroom that work perfectly for teaching that topic and for students understanding. The way its taught works for me without the use of technology." Participant 5 shares that, "I know with the way I teach English literature, technology is not going to change a whole lot, like the kid can highlight on the computer and that's it, there is no need to involve technology into this." Teachers expressed varying sufficiency with their pedagogy and technology as a tool. After reviewing the data, teachers with less experience in the classroom were more confident to infuse technology as a tool in their pedagogy. Those teachers with more experience in the classroom were more likely not to utilize technology as much within their lessons.

Theme 3: Pedagogy was Formed by Being Exposed to Others. This theme emerged as the teachers explained how they came up with the pedagogy they utilize in their classroom. There 10 out of 13 participants in which pedagogy was formed from others. All the teachers have various backgrounds and experiences with teaching. P5, P7, and P10 all stated that they learned how to teach by copying other teachers. P5 stated, "I went alternative certification, so I learned a little bit of Marzano, but a lot of how I teach

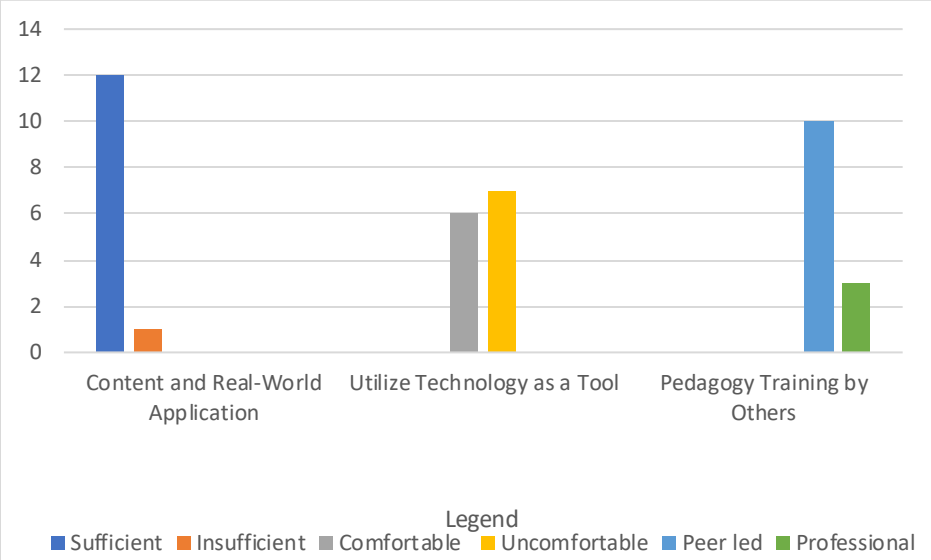
was just based on trial and error and just learning on the job." P7 states, "My first year of teaching I watched Ms. Carter, and she became my mentor. My classroom was modeled after hers and then tweaked when needed." P10 states, "I have learned how to teach from a lot of observation and knowledge of others." P12 and P state that their pedagogy was formed by trial and error, seeing what works and what does not. P12 states, "My pedagogy was developed from trial and error. The teacher you see teaches one way, and then when you get your expectation of what is key, it changes. So the expectation to get them there has changed and now you have to improve as go in and see what needs to be adjusted." P4 states, "Well, trial and error or copying off another teacher for the most part. In some ways I emulate then fine tune as I go along."

Theme 4: Teaching is Mostly Learner-Centered Activities. This theme emerged from the data, with 10 out of 13 teachers focusing more on learner-centered teaching than teacher-centered. Most teachers agreed that students need to be involved in interactive, group, or collaborative activity. P1, P2, and P5 allotted more time in their classrooms for learner-centered time. P1 states, "In a 90-minute class about 15–20 of the class is me talking directly and then the rest of the time is student-centered. I use project-based learning in my classroom." P2 stated, "90% of the classroom time is student-centered. The students take on more of the initiative and I am available to answer any questions for clarification. P5 states, "My classroom is 20% teacher-centered and 80% learner-centered. Most of our research is done either in partners or in groups." P7 shares that. "Obviously, it's' 25% teacher-centered and 75% learner-centered. I show them how to do and then turn them a loose to see how they do."

Summary of Inductive Analysis. By conducting Analysis B as related to Research Question 1, I gained insight into teachers' perceptions of their knowledge of content and pedagogy in technology-driven lesson design with this "bottom-up approach". This analysis revealed that teachers were confident enough in their content that they were able to relate their content to the real world by giving examples of how it is used in everyday life. Figure 3 shows the sufficiency, blue bar, and insufficiency, orange bar, of teachers able to relate content to real world applications. Technology is utilized in the classroom, but there was a gap in using it as a tool in the classroom to enhance learning. As shown in Figure 3, the gray bar shows the number of teachers comfortable with utilizing technology as a tool and the yellow bar represents those not comfortable. In terms of pedagogy, teachers were still not strong in this area because of how they gained their knowledge of pedagogy, which was mostly trial and error. Teachers with professional training on pedagogy is represented by green bar and those who learned about pedagogy by peers is represented by a light blue bar (See Figure 3).

Figure 3

Results of Inductive Analysis Related to Research Question 1



Results of Research Question 2

A deductive (Analysis A) and inductive (Analysis B) was conducted to reveal data related to research question 2. The results follow.

Deductive Analysis

Table 5 shows the deductive analysis (Analysis A) shows the predetermined terms used and the categories that developed from the data. The themes and patterns were all supported by quotes from the participant's interview transcripts.

Table 5

Results of Analysis A Related to Research Question 2

Terms	Categories	Quotes
Technological Knowledge (TK) 7 out of 13	Ability to use technology efficiently. Able to learn how to use technology for their subject matter	"Technology use is very easy for me" P1 "I am able to use the Promethean Whiteboard to explain steps to solve math problems and also use the pen connected to the board so I can walk around the room to observe" P4
Barriers 11 out of 13	Barriers with tech in classroom Extrinsic-Intrinsic Barriers	"Students not having access to internet is a problem in my classroom" P1 "I think it's both extrinsic and intrinsic because you have teachers who are old school who a very resistant to technology and then with technology at times it does not always work." P2
Cons of Technology Use 6 out of 13	Effect of technology on student learning Downfall of Technology	"From a student perspective, I think sometimes they rely more on the technology than their own learning." P4 "Sometimes the technology doesn't work, and your whole lessons is built around it." P10
Technology driven lesson design 10 out of 13	Coming up with tech-based lessons(how) How do I include technology Great lessons infusing technology Activities used in classroom Background in technology(degree)	"So, depend more on the content. So, if it's something where I want them to do an activity online, it's more of I have to kind of take a guess of how long it would take the kids to get on it. Log in, do like do a lot more time management more than the actual lesson planning itself is kind of timing it to make sure everyone can get where I want them to go." P13 "I use the smart board in just about every way possible. Have kids come up and ride on it? Also, the kids use their devices for research and for creating multimedia presentations." P9
Pros of Tech 12 out of 13	Pros of using technology Great lessons infusing technology	"it's almost like what the online textbook stuff, because the kids can like, translate it. If they're English learners, they can have the audio like here being read to them, you know, if they need those.: P5 "I was given the Promethean smartboard and I'm able to use and connect my iPad it to write things out as I'm walking around and making sure students are engaged and taking notes. It has a timer on it, so it allows me to be able to set time constraints on when a specific task is due to be completed." P4

Theme 1: Technological Knowledge. Technological knowledge describes teachers' knowledge of, and ability to use, various technologies, technological tools, and associated resources. There were 7 of the participants out of 13 that stated they had this knowledge. P1, P4, and P6 state that technology use is not a problem in their classroom, and they feel very comfortable using it. P1 shares, "Technology use is very easy for me". P4 shares, "I connect my IPAD to the smartboard to write things out as I'm walking around to make sure students are taking notes." P3, P11, P14 express that they can learn technology, but it may not be as easy for them as their colleagues. P3 shares, "I'm probably on the lower end of using technology. So, I am a digital immigrant, and I am sometimes stubborn."

Theme 2: Barriers Relating to Technology Use. The theme of barriers with technology use stretches from issues with technology to the intrinsic barriers in the teachers. There were 11 out of 13 participants that expressed there existed barriers relating to technology use. P1, P2, P3, P5, P6, P11 and P12 shared that student access to the internet in the classroom is a serious and recurring problem that hinders their lessons. P1 shares, "Students not having access to internet is a problem in my classroom." P4 and P12 voice their concern over the network and bandwidth issues within the building. P4 states, "If you're teaching a lesson and then you were inundated with a number of network issues, then it kind of takes away from your whole lesson. We have encountered a lot of technology issues and bandwidth issues with the internet even when state testing is occurring." P5, P7, and P8 share concerns about the equity of the technology to the

students and how there is a disparity. P2, P8, and P12 share extrinsic and intrinsic factors affect technology use in the classroom. P2 shares, "I think there are both extrinsic and intrinsic barriers. You have your old-school teachers who are very resistant to technology, and then with technology, at times, it doesn't always work." P12 states, "I believe there are both intrinsic and extrinsic barriers because some teachers are quite good with technology, but it does not help that we do not have a one-to-one system and then we have our older teachers who are resistant."

Theme 3: Types of Tech Used Within a Technology-Driven Lesson Design.

Teachers must decide which technologies will be used in a particular lesson for their content. There were 10 out of 13 participants that could infuse technology within their content area but were uncertain if it was the most effective in their classroom. P4, P6, and P12 each have a background in technology from their college years. These participants were coming in with experiences that their colleagues did not possess. All the participants were able to give an example of how they use technology in their classroom. The usage ranged from minimal, for example, a quick search on Google, to utilizing a program to manipulate the unit circle in a Pre-Calculus course and explain the changes. Even though technology was utilized, was it used correctly and meaningfully to enhance the lesson and make it technology driven. P11 shares her thoughts as she decides whether she can fit technology in, "So it depends more on the content. So, if it's something where I want them to do an activity online, it's more of I must take a guess of how long it would take the kids to get on the website and log in. It takes a lot more time management more than the actual lesson planning itself is kind of timing to make sure everyone can get where I

want them to go." P5 states, "When I use technology it's just honestly to replace paper in the classroom." P2, P3, P4, and P9 use the same technology every day without any variety. They use what is comfortable for them to use for their lesson. P4 and P3 shared that they came up with their technology-driven lesson from learning from peers, coaches, or department heads.

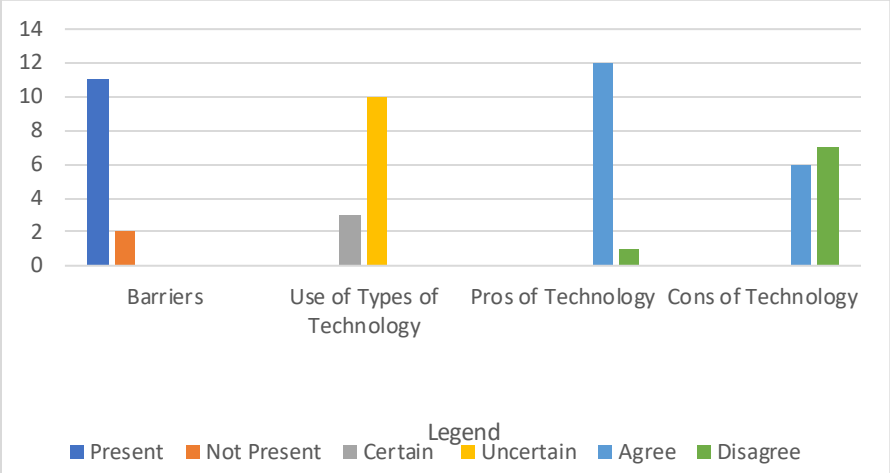
Theme 4: Pros and Cons of Technology. Technology use in the classroom can be beneficial within the classroom. There were 12 out of 13 participants with pros for technology use. P1, P7, and P11 share how certain websites enhance their content area and give students access to various types of information they would not otherwise experience. P1 shares, "There was actually a live website for a particular lesson that I was using in my astronomy class. The students were able to access the website and collect current data." P2, P5 and P10 share that the types of technologies they use in the classroom allow them to save their information to be used in other class periods or next year. P4 shares, " I can save the work for one class and know exactly where we left off and pick up from there to finish because the information is saved. P6 shares, "I started recording my lessons for the students and created a QR code with the notes for students that are absent, the QR code pulls up the YouTube video." P9 states, "I use the smartboard in just about every way possible and the students can come up and write on it. They also use their devices to create multimedia presentations for my class to present." Conversely, there are also pitfalls associated with the use of technology in the classroom. There were 6 out of 13 participants who express a downside of technology in the classroom. P2 and P3, share how students become easily distracted while using

technology and go to other websites and watch movies instead of completing work and staying on task. P6 states, “If you only learned how to solve things using a calculator, you are going to have a harder time figuring it out without one in life.” P9 and P12 share that the use of technology within the classroom heightens cheating because of the access the students have.

Summary of Deductive Analysis. By conducting the Analysis A as related to Research Question 2, I uncovered what teachers perceive to be barriers when designing technology-driven lessons. Teachers also had to deal with network, bandwidth, and hardware issues with the technology, which made it difficult to conduct a lesson. The number of teachers that believed barriers to technology were present is represented by the blue bar and the number that did not is represented by the orange bar (See Figure 4). Teachers were unsure of the benefit and the best fit technology in their content area. Figure 4 highlights the number of teachers uncertain about technology use represented by a yellow bar and those certain by a gray bar. Most of the teachers were able to praise how technology could be helpful if it works correctly and fit their content better. However, they expressed downfalls of technology use within the classroom. The light blue bar represents the number of teachers that agree and the green bar represents those that disagree with the pros and cons of technology (See Figure 4).

Figure 4

Results of Deductive Analysis Related to Question 2



Inductive Analysis

Table 6 shows the data's inductive analysis (Analysis B) and the themes and patterns that were developed. The themes and patterns were all supported by quotes from the participant's interview transcripts.

Table 6

Results of Analysis B Related to Research Question 2

Patterns	Categories	Themes
When internet is down it can interrupt lesson plan and blocked websites. There are network issues and bandwidth issues when testing is happening which affects our lessons utilizing technology If internet fails or computers do not power on its very difficult to continue with a lesson 13 out of 13	Hardware and Wi-Fi Issues Network Issues Unequal distribution	Technological Barriers
Students get distracted and download games and streaming services instead of completing work. Can turn out badly without any supervision. Students rely on technology more than own learning and it becomes a crutch. Teachers gripe about cell phone use in the classroom. Teachers utilizing technology as a substitute for teaching. 12 out of 13	Students distracted by other technologies than planned one Students relying on technology for answers Technology used as babysitting students Less of student use of own mind	Cons of Technology
No access to technology in the classroom. Do not know what students have available outside of classroom. Technology not working properly. 12 out of 13	Network Issues Technology availability Troubleshooting technology issues Failure of technology during lessons	Extrinsic Factors
Teachers are resistant to use technology because its uncomfortable for them. There is nothing wrong with the way we used to do things. I have issues implementing the use of technology. 7 out of 12	No use for technology Do not see benefits Pedagogy works fine without technology use and hinders it	Intrinsic Factors
Step by step guide provided to teachers. Modeling what you need to do in the classroom. Where I feel confident to use on my own. 13 out of 13	Content-specific One-to-one Subject-related Follow-up Hands-on Limited number of attendees	Technology Related Training/Professional Development
Teachers are all on different levels when it comes to utilizing technology in classroom, one size does not fit all. Follow-up not provided because I have questions later once using tech. Most of PD is content-based and does not infuse technology. 12 out of 13	Not content-specific Unrelated One stop shop No follow ups	Training/Professional Development Related Barriers
I utilize the clicker system to assess students and collect data or other various programs. All the lessons are on PowerPoint/ Google Slides and student can go through them at their own pace. The students love Kahoot for a review of the lesson because it is competitive. The smartboard is used every day in my classroom as well as videos. 12 out of 13	Google slides Smartboards Internet Access Student Assessment Videos Diagrams	Ways technology is used

Theme 1: Technological Barriers. There were 13 out of 13 teachers that stated they had experienced some technological barrier within the classroom when utilizing technology. The barriers were categorized into four areas: Hardware Issues and Wi-Fi Issues, Network Issues, and Unequal distribution. Hardware issues were one significant problem that arose. The students' laptops are not functioning correctly to be used in class to complete work. P1, P6, P8, and P10 focused on hardware issues as a technological barrier. This included the students' laptops not working properly, laptop screens cracked, laptops having no charge or won't charge at all. Students not having access to passwords to get into the laptops also came up. P5 and P7 discuss the barrier of no access to the technologies needed within their classrooms, and no availability. P8 and P9 expressed a technological barrier as Network and Wi-Fi issues or failures. The Wi-Fi would be spotty at times or not work at all. They expressed that if their lesson revolved around using technology they were put in a bind if there were network and Wi-Fi issues. Also, students would have trouble connecting to the Wi-Fi in certain rooms. P10 and P13 spoke on unequal distribution. They expressed that not all students have a laptop during the class period and that sometimes half or less than half of the students have their laptop in class. The process of getting a laptop is very lengthy and challenging. Students are not guaranteed to have a laptop when they get to class or have a laptop to use at home. This also includes if students can access to Wi-Fi at home to complete assignments. Some students have Wi-Fi, while others do not.

Theme 2: Cons of Technology. There were 13 out of 13 participants who believed that there were cons to technology. Technology can be useful but, as I learned,

also a hindrance. P2, P4, P5, P6, P9, P11, and P12 all stated that the misuse of technology was a prominent issue in the classroom that alters the teaching within the classroom. They gave examples of inappropriate cell phone use, access to Hulu and Netflix during class time, playing games on the phone, cheating with the use of the phone, and just an overall distraction for students in the classroom because of all of the access, which hinders teaching. P4 and P12 shared that calculator uses in their math classroom caused the students to rely on it, which can become a crutch. They want the students to be independent of the calculator for simple math facts, something they should know. P6 talked about how technology can be used as a substitute for teaching for some, where they do not have to teach at all, and students can watch a video of someone teaching. So it can, in turn, take away the physical teacher in the room.

Theme 3: Extrinsic Factors. Extrinsic factors are influences from the outside. There were 12 out of 13 participants that expressed there are extrinsic factors when utilizing technology. P5 and P11 share that available technology affects the types of lessons they prepare with technology. If there is no access to technology needed for that day, then the lesson must be revamped to something else. P9, P10, and P11 express concern over the technology not working correctly. Many things can happen in a classroom, and if the technology planned to use that day suddenly is malfunctioning it throws the entire lesson off. Unless you are a tech savvy person or know someone who may be able to fix it quickly, Plan B goes into effect. We may not receive help troubleshooting the problem for about a week, so if the lessons for that week were based on that technology, you must revamp.

Theme 4: Intrinsic Factors. Intrinsic factors are factors related to an individual. There were 7 out of 13 participants that believed that intrinsic factors influenced technology use in the classroom. P2, P8, P10, P11 stated that they are always resistant to use technology because it is just too uncomfortable for them, and what they do works for them. They are resistant to learning new technologies or if they learn them, they should utilize them more. P2 and P12 share that there is nothing wrong with how they teach and do not see the benefit in changing what works for them. P5 and P12 state that they have issues implementing the technology. They need to be more supported in understanding how it works and how it can be used in their classroom.

Theme 5: Technology Related Training/Professional Development. Technology professional development is an important piece of the puzzle to technology integration in the classroom and for lesson design. There were 13 out of 13 participants expressed that technology training plays a crucial role in utilizing technology in their lessons. P1, P3, P4, P5, P6, P8, P9, P12, and P13 stated that they needed more content-specific technology training. P12 states, "Most of the technology PD is not curriculum-based, so it irks me because it's a waste of my time." P2, P5, P7, and P8 expressed that they need to see how this technology can be used in my classroom, so modeling how to use it. P3, P4, P12 state it would benefit to have an interactive, hands-on session with the technology without a large number of participants where the ratio of teacher to student is low, so that questions can be answered.

Theme 6: Training/Professional Development Related Barriers. There were 13 out of 13 participants who expressed barriers with professional development existed.

The trainings also presented barriers for the participant in the professional development. P2 expressed that the trainings were all on one level. Teachers are at different levels when it comes to technology; some know nothing, and others are tech savvy. The one size fits all does not work. P2 and P12 stated there is no follow-up, once the trainings are over. Basically, this is how you use it, try to work it out on your own. This is where much frustration comes into play because there is no one to answer questions about the new tech and if you are having problems implementing it. P5 and P11 state that most PD is content-based and not on technology. A small portion of professional development is geared to technology; if it is, it's just a video to watch and learn from.

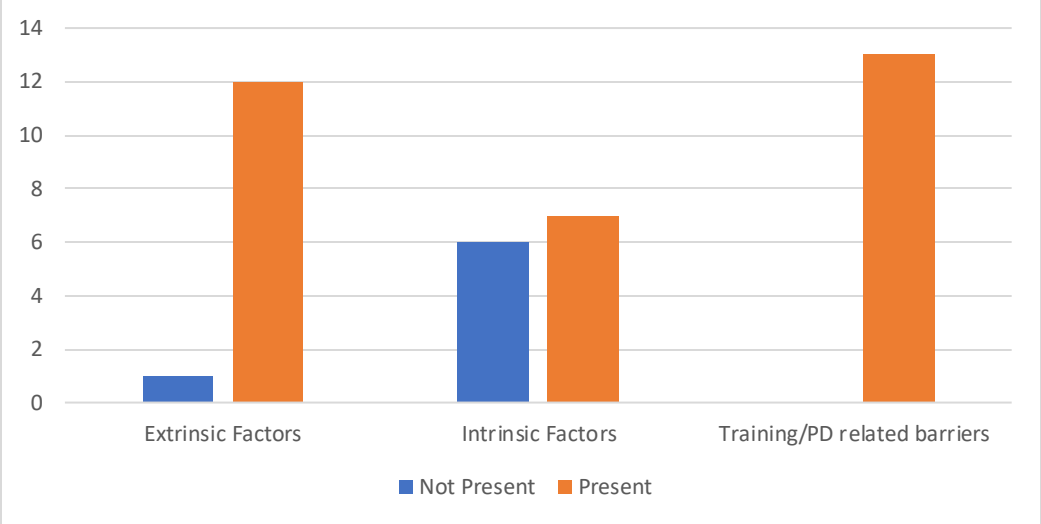
Theme 7: Ways Technology is Used in the Classroom. There were 12 out of 13 participants utilized some technology within their classroom. There are many technologies used in the classrooms. P2, P5, P6, P7, and P9 state that they all use their Smartboard almost every day and use videos in their classrooms. P3 an P8 express how in their classroom they use games, such as Kahoot, to review their lessons. Kahoot is an online gaming system. P2 and P10 utilize PowerPoint and Google Slides in their lessons.

Summary of Inductive Analysis. By conducting Analysis B as related to Research Question 2, I uncovered what teachers perceive to be barriers when designing technology-driven lessons. This analysis revealed not only the technological barriers, such as hardware and internet issues, but also the issues with student ill-use of technology during class and the distraction technology can bear during a lesson. The classification of the presence of factors or barriers is represented by an orange bar, or the lack of presence is represented by a blue bar is highlighted in Figure 5. There were both extrinsic and

intrinsic factors that contributed to the amount of use of technology in a teachers' classroom. Each teacher had their way of infusing technology in their classroom but needed more guidance in this area. It was expressed that the technology professional development provided was a disappointment because it was not content-based and suitable for all types of learners at different levels.

Figure 5

Results of Inductive Analysis Related to Question 2



Analysis A (Deductive) and Analysis B(Inductive) worked hand in hand in this data analysis. The two analyses working together uncovered a wealth of data and information. Analysis B revealed more substantiated data from the participant's view than Analysis A. I was able to get more of a feel of the teachers perceptions in context. Although, Analysis A was able to hone in on the predetermined specific terms and the specific data related.

Summary of Findings

This chapter presents a description of the setting and participant demographics. The processes of data collection and data analysis were reviewed. The results were also presented. The two research questions that drove the study were teachers' perspective of their content and pedagogy when creating a technology-driven lesson and what teachers perceive to be barriers when designing a technology-driven lesson design. The results were presented with many themes that emerged from the data.

The data revealed that teachers were highly knowledgeable of their specific content area. The teachers were experts in their field and could answer any questions about it and apply their content to real-world applications. The teacher's pedagogy was very weak when compared to their content knowledge. Many of the participant's pedagogy was formed by trial and error. They needed to be more fully equipped in their type of pedagogy or other types of pedagogies to utilize in the classroom. Most of the teachers used some technology in their classroom and it was only what they were the most comfortable with. The teachers were open to utilizing technology in the classroom. They needed more guidance on how to infuse it into their lessons and understand how it would benefit their classroom.

It was also revealed that within the teacher's preparation programs, the majority had yet to gain experience with technology use in the classroom. Technology was not even around when most of the teachers were in college, so there was no course provided to them on how to utilize technology in a lesson. Teachers who are not tech savvy rely on the technology professional development provided by the district. It was found that the

technology professional development provided was not content-specific, not hands-on, and no follow-up sessions were provided.

The participants revealed that the technology professional development provided by the district was not meeting the needs of the teachers. Many teachers stated they were willing to learn and get trained to utilize technology in their classroom if it was more content based. The teachers' needed to know how technology can work in their classrooms. Modeling is one of the missing components of professional development in order for teachers to implement technology within their lessons. It was stated that all teachers are not on the same level regarding technology use, so it needs to be presented for all levels. One-size does not fit all when it comes to technology professional development.

It was also revealed that using technology enhanced the content taught by using the smartboard and various websites. Technology can be a door to a multitude of information for student's benefit. On the other hand, technology has its issues, such as hardware and WI-FI problems and can become a distraction for students in the classroom. This concluded that the teachers may need to learn the educational benefit that technology offers in their classroom and subject area. While some teachers saw the benefit of technology in some areas, issues arise that are beyond the control of teachers and are extrinsic factors. Lastly, the participants were willing to learn how to infuse technology within their lessons to enhance their content if beneficial.

Section 3: The Project

This basic qualitative study was conducted to investigate teachers' perceptions of their knowledge of content and pedagogy for incorporating technology in lesson design. Based on the study's results, teachers would benefit from professional development on various types of pedagogies to utilize with their content area as well as choosing the appropriate technology to enhance their teaching of content. The findings of this study informed the following two research questions.

- RQ 1: What are high school teachers' perceptions of their knowledge of content and pedagogy in technology-driven lesson design?
- RQ 2: What do high school teachers perceive to be barriers when designing technology-driven lessons?

The findings indicated that teachers were knowledgeable and master teachers in their content area but lacked pedagogy and effective use of technology in their lesson designs. The results also showed distinct reasons for the need for more technological use in the classroom such as the lack of support, guidance, and distractions. Moreover, it brought to the forefront the disappointments and failures of professional development in technology. The results suggest teachers can benefit from enhanced technology professional development based on all the levels of Bloom's taxonomy, which has a hierarchical framework that categorizes learning objectives based on their complexity, ranging from basic information and comprehension to higher evaluation and creativity. This taxonomy, in conjunction with pedagogy and technology integration to formulate practical learning

objectives and outcomes. This focus would be able to be implemented into their instruction in the classroom.

To respond to the study's findings, a professional development plan (Appendix A) was created to help teachers adjust or make necessary changes to their approach when creating their lesson designs in their content area. This project is designed to address the needs of the teachers because of the study's findings: additional education, support, and resources in pedagogy and technology used for their content area. The components of the project, including the professional development materials, implementation plan, and evaluation report, are detailed in Appendix A. In this section, a detailed project description is provided to address the strengthening of the teachers' use of pedagogy and integration of technology in the classroom, to enhance a technology driven lesson design.

Rationale

Based on the findings, teachers would benefit from professional development based on Bloom's taxonomy focusing on pedagogy and technology integration in the classroom. Bloom's taxonomy would encourage advanced thinking methods by teachers involving assessing and evaluating concepts, methods, procedures, and principles. Bloom's taxonomy requires deeper learning and transference of the learning to create something novel or original, wherein educators continually seek insights into how various pedagogical techniques engage students and impact their learning (Jaswail & Arun, 2021). The data collected from the interviews suggested that teachers are teaching with some form of technology. The effectiveness and the choice of tech utilized and how it accompanies their pedagogy was unclear. During the interview process, the data showed

that most teachers cling to what they know because of learning how to teach by trial and error. Based on my findings, I created a professional development that will stimulate the teachers' approach to teaching their content. The professional development can provide teachers with the tools needed to create learning objectives related to their content area that challenge students, and the ability to choose the pedagogy and technology component that best fits them and their classroom.

Review of Literature

I reviewed peer-reviewed articles from scholarly databases, including Pro Quest Central, Education Source, Sage Journals, Thoreau Multi-Database, Education Resources Information Center (ERIC) and Google Scholar for the literature review. Key terms were used to reveal relevant literature on these databases: *technology professional development, educational technology, professional development and technology integration, quality professional development, Bloom's taxonomy and technology integration,* and *best practices in professional development*. This section will discuss the following topics: effective professional development, technology professional development, Bloom's taxonomy in education and technology, and pedagogy used in technology.

Effective Professional Development

Teachers are lifelong learners who must adapt to and adopt new teaching practices and tools over time, and professional development is the vehicle used to expose teachers to these practices and tools (OECD, 2019). Professional development can enable teachers to gain new skills and improve their instructional practices (Kalinowski, 2020).

Professional development is a teacher's participation in formal and informal learning opportunities to strengthen and expand their skills and competency (Futterer et al., 2023). Effective professional development should include a content focus, active learning (or opportunity to engage with the content), coherent (or the extent to which teacher learning is consistent with teachers' knowledge and beliefs), duration (or sufficient time), and collective participation (or an opportunity for interaction with colleagues; Pantic & Cain, 2022). It should be developed as a process with relevant knowledge (Rodriguez et al., 2022). Professional development activities are effective when they prompt teachers to question their professional routines and learn innovative approaches to their teaching practices (Sims, 2021).

Technology Professional Development

Technology professional development should be a tool used to support standards-based learning, integrated throughout daily classroom activity as seamlessly as textbooks and student discussion (Paulus et al., 2020). Based on the findings in the study, teachers were frustrated and disappointed with their current technology professional development provided by the district because of its design. The district's design did not fulfill the needs of the teachers or present them with proper instruction to integrate technology. As citizens, teachers need to be equipped with this competence to participate in different spheres of society; as professionals dedicated to teaching, they need to be able to use digital technologies with well-founded pedagogy to enhance students' learning and facilitate their digital competence (Lucas et al., 2021). Technology-related professional development is crucial in preparing in-service teachers for high-quality technology-

enhanced teaching (Futterer et al., 2023). Thus, it is determined to develop a technology-based program for teachers according to their opinions and based on their needs (Elmali & Kiyici, 2022). Components of effective technology, such as active learning, collaboration, and content-focused professional development, will be discussed in the following sections.

Active Learning

Active learning allows teachers to connect new ideas and experiences to what they already know. Learning about learning theories is not enough alone; putting them into practice is also essential (Rodriguez et al, 2022). Active learning includes experiences such as reviewing and reflecting, being observed and providing feedback, and adapting experiences to unique classroom situations (Parrish, 2020). The activities in active learning depend on the content area and the context it will be used (Parrish, 2020). Professional development is more effective when it involves opportunities to use, practice, or apply what has been learned in real classroom situations (Sims & Fletcher-Wood, 2021).

Collaboration

Collaboration of participants in professional development provides peer support and develops a shared understanding of skills and concepts learned in professional development (Parrish et al., 2020). It also increases the cohesion of the participants as they have a shared profession and content area (Parrish et al., 2020). Its rationale is that it allows teachers to clarify any misunderstandings and challenge each other (Sims & Fletcher, 2021). The participants in the study stated that they were open to trying various

pedagogies and learning innovative technologies that pertain to their content area. Collaboration provides the opportunity for common ground specific to teaching and with content to confer or brainstorm about what works best in their classroom and in their content area given the tools.

Content-Focused

Professional development activities should focus on the content area teachers teach in their classrooms utilizing technology (Lo, 2021). Professional development should enhance teachers' content knowledge and the flexibility they give on the best way to apply new understanding within their classroom (Parrish, 2020). Teachers learning to integrate technology within their classroom benefit from opportunities to collaborate with their peers in the same content area (Rosenberg & An, 2019). The pedagogical approaches available utilized to teach content are interdisciplinary and cut across grade levels. When pedagogy is addressed, the focus on how best to teach that content to students (Gore & Rosser, 2022). Content knowledge and pedagogical techniques complement and are most effective when delivered together (Sims et al., 2021).

Blooms Taxonomy Infused in PD

While teachers are knowledgeable of their content, Bloom's taxonomy can assist teachers in developing their learning objectives related to their content. Bloom's Taxonomy framework classifies learning objectives that educators intend for their students to learn. The original Bloom's taxonomy describes the cognitive processes of learning and developing mastery of the subject (Bloom, 1956). With the progression of pedagogy, Anderson & Krathwohl (2001) revised the original Bloom's taxonomy, which

provides a framework for determining and clarifying learning objectives by revising categories once nouns to verbs, so they are now measurable and visible (See Appendix B). This version continues to help create learning activities involving low-order to higher-order thinking skills as the original version. It is comprised of six major categories, which are referred to as cognitive processes. It ranges from lower-order skills (remembering, understanding, and applying) to higher-order skills (analyzing, evaluating, and creating) that require deeper learning and transfer of learning to create something original or novel. (Karanja & Malone, 2021; Jaiswal & Arun, 2021). Humans acquire and learn knowledge from experience due to their ability to think and reason (Jaiswal & Arun, 2021).

One way to measure the quality of technology integration practices is to analyze teachers' technological instructional strategies within the cognitive domain, that is, the use of technology to facilitate lower- and higher-order critical thinking tasks to facilitate student learning experiences and outcomes (Bowman et al., 2022). A well-designed professional development should be aligned with intended Bloom's cognitive processes to create lessons that reach all types of learners. Teachers attempt to implement each level of cognition through different pedagogical methods and materials, such as technology and manipulatives, to match the curriculum requirements (Liva & Sadiq, 2023).

Pedagogy and Technology Integration

As a teacher is planning a lesson, they consider the best way to communicate relevant information to their students, it can depend on the content and their teaching

preference. A thoughtfully developed pedagogy improves the quality of teaching, can reach students at all levels and abilities, and helps students develop a deeper understanding of content. Technology integration should incorporate the technological skill and ability to use pedagogical knowledge as a base for integrating technology into teaching and learning. This suggests that teachers should develop teaching strategies to motivate students to keep them focused as the instruction progresses and to consider that every student learns differently and at various rates (Infinedo et al., 2020). Teachers must explore the technology integration process and seek for ways it can be attained effectively, which will develop the rationale to determine the appropriateness of the technologies they are using and whether it is compatible with their lesson plan. Exploring the relationship between technology in education and pedagogy will encourage critical thinking on the part of teachers as they practice technology integration (Infinedo et al., 2020).

Summary of Literature Review

In this section, we discussed the topics: Effective Professional Development, Technology Professional Development, Bloom's Taxonomy in Education and Technology, and Pedagogy used in Technology. First, effective and technology professional development should include active learning, collaboration, and content-focused to equip teachers with the digital competencies to use technology as a tool in the classroom. Secondly, Bloom's revised taxonomy assists teachers in creating learning objectives using lower and higher-order thinking skills utilizing technology as an effective mechanism. Lastly, Pedagogy and technology integration can work conjointly.

Technology aligned correctly with a pedagogy can ultimately enhance teaching strategies when appropriate technology is chosen. The information collected for this literature review were derived from peer-reviewed scholarly articles.

Therefore, in this literature review, some ideas were already researched and proven true, yet some ideas that are assumed to be true. The confirmed ideas were as follows: professional growth, intentional and purposeful training, the importance of digital competence, addressing teachers' specific needs, to content-focused professional development. Numerous studies were conducted on effective professional development and technology professional development. The OECD (2019) conducted an international large-scale survey of teachers and school leaders, including fifteen countries and twenty schools from each country. The goal of the study was to collect internationally comparable information pertinent to developing and implementing policies focused on school leaders, teachers, and teaching, emphasizing the effect on student learning. The results rendered the characteristics of training that teachers found most impactful are those based on strong subject and curriculum content, collaboration, and incorporation of active learning and collaborative approaches to instruction. OECD (2019) found that considering teacher perspectives on how teaching and learning can be organized enables professional growth and aids in the support of teachers to drive the success of teaching and learning.

Similarly, Futterer et al. (2023) and Pantic &Cain (2022) found that for the growth to occur formal and informal training, independent learning, and learning from peers are essential, as well as, interventions put in place for the learning of new

technologies and its instruction in the classroom to have an impact on teaching and learning, which was founded in their studies of 902 teachers examining their teaching practices along with needs of professional development. They examined how much 321 additional teachers' will, skills, and conscientiousness predicted their intentions to participate in technology professional development.

Furthermore, Lucas et al. (2021) studied 1071 teachers on a reliable instrument to measure digital competence and the relation between teachers' digital competence and personal and contextual factors. Digital competence is teacher's ability to use digital technologies effectively and creatively to enhance all areas of professional activities. Contextual factor examples are classroom equipment, students' access to technology, network infrastructure, and school facilitation. Whereas personal factors include age, gender, teaching experience, confidence in using digital technology, and openness to new technology. The study yielded that personal factors reigned over contextual ones, and the number of tech tools in the classroom was the strongest predictor of their competence. In addition, Lucas et al. (2021) stated that measuring a teacher's digital competence and examining the relationship between the competence and the in-service can direct the training to address the needs of the teachers. After reviewing Emali and Kiyici's (2022) study of 12 science teachers and their expectations of technology-based professional development it aligned with Lucas et al. (2021) by noting the expectations of a teacher from a technology-based professional development, once knowing what level they are and what is needed for them specifically.

Finally, Parrish (2020) focuses on the components of effective professional development: content-focused, utilizing active learning, and collaboration. This study explored 43 teachers and their reasons for non-participation in content-focused professional development, ranging from content beyond specific grade level and school-related responsibilities. Similarly, Lo (2021) stated that the factors found in effective professional development were content-based, including modeling and hands-on activities, and problem-solving activities with other participants, according to their review of 48 studies identifying the elements of effective professional development.

Information was collected by the authors in which a study was not completed, and the instructions and directives are assumed to be true. That information spanned out to effective professional development, transformative technology integration, and principles of effectiveness. Effective professional development is structured professional learning that changes teacher practices and impacts student learning outcomes. Whereas transformative technology integration involves a systemic change in classroom teaching implemented by a precise plan on specific behavioral and learning outcomes that builds the skills needed for successful technology integration Paulus et al. (2020). Lastly, principles of effectiveness include the characteristics of effective professional development by defining the most crucial characteristics. Sims and Fletcher-Wood (2021) started with a consensus view on effective professional development that would identify six characteristics of effective professional development and its effects in the classroom. It was identified in the review that weakness existed within these characteristics in terms of teacher outcomes. It was stated that a better alignment is

needed among the evidence of teacher knowledge and skills acquired to prove that the six characteristics are effective. Also, Paulus et al. (2020) acknowledged an issue with meaningful technology integration and the need for more professional development and proposed a plan for transformative technology integration using a PLC model. The plan introduced consists of five steps: (a) create a shared vision, (b) initiate situated professional development and collaboration, and (c) support sustained and meaningful classroom implementation. Lastly, Rodriguez et al. (2022) suggested that analyzing current professional development for those proposed effectiveness principles to guide professional development programs would lead to identifying the most effective and useful principles. Eight principles are described: teaching for learning, focusing on knowledge, inquiry and reflection, external links, time, communities of practice, classroom data collection, and provision of experts. Evidence of the principles would lead to an impact on teaching practices. In conclusion, the literature review revealed relevant information about the study's professional development project. The literature upholds the choice of professional development to drive the project.

Project Description

The project described in this section is designed to address teachers' needs when designing a technology lesson design. Teachers lacked knowledge in pedagogy and appropriate technology usage that best fits their classroom and content area. The project revealed a need for additional teacher training on pedagogy and technology use in the classroom and in their specific content area. Based on the findings of the study, professional development was chosen for the project. The project is designed to increase

the teachers' pedagogical knowledge to teach their content in a challenging way that reaches all types of learners. This pedagogical knowledge is designed with technology utilization in mind to be used cooperatively for teachers to choose the most appropriate tech in their classroom. Bloom's revised taxonomy guides the project by helping teachers create higher and lower-order learning objectives in their content area to create meaningful instruction. The taxonomy describes the six levels of human thinking, learning, and understanding (Anderson & Krathwohl, 2001).

The project created is a 3-day full-day professional development. At the conclusion of the professional development, teachers will have exemplary lessons with learning objectives utilizing various pedagogies in their specific content area utilizing technology appropriately. The project is in the right direction and is not considered a one-stop shop. A follow-up of the professional development would be during content teacher's monthly professional learning community meetings.

Resources, Supports, Potential Barriers, and Barrier Solutions

The ABC School District has resources available to permit the implementation of this project. Teachers are provided with district laptops which will be necessary for the training. The laptop will be needed for planning, web resources, digital collaboration, and tech tools and software connectivity. The district provides various of Edtech programs, apps, assessments, and ways to share data for teachers on Clever, the district's digital platform. Another resource is technology hardware, such as access to smartboards, clickers, projectors, and tech-based calculators. Teachers can share for collaboration

using Google Workspace or OneDrive. The district has ample space to accommodate this type of professional development.

Each content area has a team lead that will support any issues the teacher may have in their content area. Many of the participants wanted to learn more about technology use in their classrooms. However, the professional development provided needed to be more effective even though they were open to new opportunities to learn new ways of teaching. Teachers in the district support each other and collaborate. With teachers learning how to use tech in their specific content area will create a support base for all those teachers.

One potential barrier is the time to implement the project. The project would work best before school begins for the year, so teachers are prepared beforehand. The district already has set times and days for specific training in logistics for the beginning of the year and may see this professional development as something other than a priority. The professional development could be offered on a Saturday morning or during PLC times. Another potential barrier is teacher attitudes and beliefs toward learning various types of pedagogy different from what they are accustomed to and toward technology use within their lessons. Incentives can be given for participation in professional development, such as gift cards and extra paid time off.

Proposal for Implementation and Timetable

The project will be presented over three consecutive full days lasting for eight hours. The training should occur during the district-required professional development days, prior to the first day of school. This will allow teachers time to plan and prepare for

the school year while implementing the concepts learned during the training sessions. Additional training, observations, evaluation, and feedback from administrators should help teachers become more comfortable with these skills. The additional training would occur during the content teachers' professional learning communities. The observations would take place monthly with a one-week evaluation and feedback turnaround to teachers.

Roles and Responsibilities

The proposed professional development will require well-established roles and responsibilities. The three-day professional development will focus on the following areas: creating meaningful learning objectives, pedagogy training, and content-specific use of technology with the lesson design. The teacher's role is to participate in the training with the necessary tools to contribute to the project's outcomes. The administrator's role will be in the implementation process. They will be responsible for acquiring the resources at that school site and designating a location for professional development. Administrators will direct teacher participation, deliver expectations of teachers, and provide support for the teachers in training. They will also provide feedback and observations of how professional development has impacted teachers' instructional practices.

Project Evaluation Plan

The professional development seeks to meet the following objectives:

- Ensure teachers can create higher and lower learning objectives to drive lessons.

- Ensure that teachers have sufficient knowledge of the practices and methods of teaching to further student learning.
- Ensure that teachers understand the benefits of the use of technology in instruction.
- Provide teachers with content-specific training for the effectively using technology within the lesson design.

The evaluation method for this project will be outcomes-based, which is appropriate because it will assess the extent to which a program has achieved its intended result. The outcomes would determine the participant's beneficial changes, including skills, knowledge, behavior, attitude, status, or life condition. After the training, teachers will have lessons to take with them that they and their colleagues have created. They will also share how the training has changed or enhanced their instructional practices. Teachers will be given a survey with questions to answer and return at the professional development's end. Teachers will be asked to reflect on their perceptions of professional development and overall experience. Teachers will provide scaled and open-ended responses to each survey question. The open-ended responses will allow the teachers to rate the usefulness of information provided, the presentation of the content, and how they can implement new learning into their classroom. The collected evaluation data will provide additional support for teachers that they can attend throughout the year (see Appendix F).

Stakeholders

The primary stakeholders in this project are the teachers and administrators. The teacher will have an equitable interest in professional development due to the incentives provided. The teachers will also be invested because of the wealth of information and tools to improve their instructional practices utilizing technology.

Project Implications

The professional development was designed to provide teachers with sufficient knowledge of practices and teaching methods, understanding of the benefits of technology use, and content-specific training to effectively utilize technology within the lesson design. The project could show evidence of social change, including teachers' instructional practices and changing methods. Teachers should be able to implement technology within their content area more effectively to enhance their lessons. The impact of this professional development would increase student engagement and learning experience in this tech world. The strategies, methods, and tools can be used to promote social change by benefiting student learning and outcomes and serve as an example for other school districts that present similar disparities with technology integration. Helping teachers with teaching methods and technology utilization within their lessons will affect students and make them more employable and career-ready in the future. Students will be able to use technology, understand the various learning disciplines, and be more successful in the workplace and in society. In turn, students will be more self-sufficient in adulthood and embody the knowledge to succeed in society.

Section 4: Reflections and Conclusions

In this section, I will discuss the project's reflections and conclusions, which include the strengths and the limitations of this project. Recommendations for alternative approaches and scholarship, project development, and leadership and change are also discussed. Finally, I discuss reflections on the work's importance and implications, applications, and directions for future research.

Project Strengths and Limitations

Project Strengths

The project has various strengths and limitations. One strength of the presented project is that it addresses teachers' needs, which was the lack of pedagogy and utilization of technology within their lesson design revealed from the data. Another strength is that the professional development provided to teachers is collaborative, interactive, and engaging. Professional development for teachers is a systemic effort that provokes change in teaching practices, attitudes, beliefs, and learner outcomes (Huber et al., 2022). Exposure to various pedagogies driven by Bloom's taxonomy to use within classroom with examples and appropriate technologies to use within their content area is another strength. Additionally, teachers are actively learning and able to practice and apply what was learned through professional development. Finally, active learning is an approach to learning that requires students to engage in the process of learning by doing meaningful activities.

Project Limitations

A limitation of this project is that it could be considered a one stop shop for professional development. It covers the topics of learning objectives, pedagogy, and technology integration. However, because of the length of the professional development, it is difficult to know how much information was absorbed by teachers to implement into their classrooms. Teachers are exposed to only a portion of pertinent information that is not ongoing throughout the year. A significant constraint found is that teachers may need to be open to changing their methods and intertwining the new technologies within their lesson plans, which speaks to their level of comfort for using technology or the lack thereof in their classroom. Lastly, some professionals may be overwhelmed by the wealth of information.

Recommendations for Alternative Approaches

This study addressed the teachers' perception of their pedagogy and content when integrating technology into their lesson design. An alternative approach for this project could be a series of ongoing professional developments throughout the school year. Teachers would receive training in smaller increments allowing for constructive feedback throughout the year up and down the chain recognizing progress and any interventions needed. The continuous sessions for teachers would be broken into small group sessions by content areas with topics like research, production, web tools, and types of pedagogies. Separating teachers by content area would provide much-needed collaboration among colleagues and ensure they receive what is needed for their specific content area. This approach would allow for continuous training throughout the school

year and encourage the constant use of technology and the variety of pedagogies in the classroom. This approach would limit the frustration of the teacher and increase the interaction and learning of the student.

Scholarship, Project Development, and Leadership and Change

Developing this project has expanded my learning and knowledge base. I have learned about research and the processes striving to complete this project study. My newly acquired skills gained during my study required a massive amount of reading, analyzing, and critical thinking, which helped me to be organized and focused on countless other ways of life. The project study challenged my writing skills to be refined and enhanced for the scholarly writing required. As an educator, I was able to be a student and became more knowledgeable in many areas of the research and writing process.

As the researcher, I gained access to content teachers and spoke directly with them about their perceptions of their content and pedagogy when integrating technology into their classroom. This challenged me to become a leader of change for my colleagues to help them increase their knowledge base about diverse types of pedagogies that they had yet to be exposed to and could implement in their classroom instruction. I gained insight into their thought process and perspectives when dealing with pedagogy and technology in the classroom. As a leader, I thought I could most usefully help teachers implement technology into their lesson design that would benefit them and not discourage them from utilizing it.

This project can change the instructional practice of veteran to newly hired teachers and their outlook on their practices and the benefits of other innovative ways. Though teachers' views of technology integration varied from teachers' perspectives, change is imminent and was forced, especially since the pandemic. Technology is a part of everyday life and must be used in the classroom to enhance teachers and engage students who were brought up with many technologies that their teachers did not. Thinking about technology integration must change, and teachers need the support and information needed on their level to implement change.

Reflections on the Importance of the Work

The influx of technology within these past years has been immense. The way of teaching and access to information differs from how it used to be done. Districts have invested in their schools for technology integration to occur in the classroom. Technology opens doors that we would not have imagined being opened years ago. Even though there has been a shift in teaching because of technology, it does not mean that it is an automatic understanding for teachers, especially veteran teachers and those not exposed to technology during their college years. Teachers must be given a chance to re-examine their instructional practices and willingness to learn and incorporate new knowledge received and technologies within their lesson design. There must be a specific opportunity for training for teachers on their specific needs with a designated, continuous timeframe for this to occur with support for our teachers from their leaders.

The findings revealed a lack of knowledge in various pedagogies and utilization of technology within the classroom. These findings indicated that the teachers would

benefit from professional development addressing these specific needs found. This led to a 3-day professional development course which included sessions on (a) learning objectives, (b) pedagogy, and (c) content-specific technology. The teachers would engage and collaborate with colleagues during all sessions. The collaboration would allow teachers to brainstorm, exchange ideas, and share insights because teachers are at various levels with their knowledge base of pedagogy, technology, and its implementation. Teachers will design a technology-rich lesson design at the conclusion of the professional development to apply what was learned and share with others in their content area.

School districts must keep up with the ever-changing world and its devices. Technology is now a part of everyday life for everyone. Districts buy into the new technologies for their schools, but how it will benefit or enhance the classroom, especially for content teachers, needs to be addressed and understood for change to occur in instructional practices. Teaching practices must update as other things update with the times to be effective.

Implications, Applications, and Directions for Future Research

This study impacts social change by providing administrators, instructional designers, and lead teachers with a more in-depth understanding of the barriers that exist within technology integration and its relationship with content and pedagogy. Addressing the barriers and improving technology integration in the classroom will improve classroom instruction, thus improving students' academic achievement. Social change may begin with providing the faculty with appropriate technology professional development, and peer collaboration, which can affect the students and their

performance. A development program led by educational professionals or peers was designed to allow for collaboration across content areas that could benefit the teachers, administration, and the district by providing opportunities to enhance their skills on bonding pedagogy, content, and technology. Positive social change can occur as many more teachers will be equipped with the skills needed to solve larger problems at various other districts around the United States and beyond. Helping teachers change and learn new skills will affect students and make them more employable and career-ready in the future. Students will be able to use technology, understand the various learning disciplines, and be more successful in the workplace and in society. They will be more self-sufficient and not depend on society to care of them, because now they embody the knowledge needed to succeed.

This project study results include teachers' perceptions of their knowledge of content and pedagogy in terms of a technology-driven lesson design. During the research process, I pinpointed the deficiency areas among teachers within their pedagogical and technological knowledge. To resolve the issue, a 3-day professional development was designed for the teachers in the areas of lack to help build their knowledge on pedagogy and technology utilization, then opportunity to practice and apply what was learned. The project's goal was to impact teachers' instructional practices within the classroom to enhance their teaching and improve student learning. Addressing the needs of the teachers in these areas will impact the goals the district has set to accomplish in the areas of student learning and outcomes. The district's goal is to prepare our students to be college and career-ready in this day and time.

There are methodological implications that emerged from the interviews. The interview process allowed for the collection of data from interview questions but also allowed for unprompted responses from interviewees, which revealed additional information. It is recommended for future research to create focus groups in addition to individual interviews. The focus groups would be content based. The groups would prompt even more discussions into that specific content area in terms of pedagogy and technology use. Additionally, increasing the pool of participants to include content teachers from other schools within the school district would open the discussion on school environment and administration. High school teachers were strong in their content and lacked pedagogy and technology since technology is consistently changing.

Investigating the preservice programs and how they prepare our future teachers in this everchanging, developing classroom is suggested. Additionally, exploring students' knowledge of content and motivations before and after technology is worthy of future research. This could lead to an inquiry into graduation rates and what support is needed that could increase the graduation rate as well as the effects of technology and teaching practices on the graduation rates. It is also recommended to focus on teacher age, teaching experience, digital competence, and its effect on learner outcomes. Lastly, an inquiry into technology integration and its impact on state standardized testing is also worthy of future research.

Conclusion

The education system and workforce must evolve to become more inclusive regarding technology. Students need to keep up with digital trends and the infusion of a

deep understanding of classroom content. The appropriate use of digital tools can create an engaged environment, boost collaboration, and support learning in many ways. This study addressed a disparity in pedagogy and technology use within a lesson design among high school content-area teachers. I examined teachers' perspectives of their content and pedagogy knowledge regarding a technology-driven lesson design. The findings revealed a lack of pedagogical knowledge and technological use within the classroom. Barriers that impact technology integration and could deter teachers from implementing technologies in the classroom are addressed.

The 3-day professional development was developed to enhance their knowledge on diverse types of pedagogies and how to utilize them in their classroom with examples. It exposed teachers to the several technologies available that can be used as research, productive, or tutorial tools. Lastly, it allowed teachers to learn technologies content specific and apply them by creating a lesson design. The outcomes from this professional development can launch many more interventions that impact instructional practices and technology use, impacting student outcomes.

Teachers need to be exposed to innovative ideas and practices that can cultivate and develop their teaching practices in this technology age so that change can occur. Once this occurs, teachers can expose students to challenging learning objectives, so they possess content understanding and application, which is the knowledge and understanding of a subject and the ability to apply it. In addition, students must acquire digital literacy to create, evaluate, and share information. Digital literacy prepares students for the workplace environment.

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Appendix A: The Project

Professional Development: Curriculum and Materials

Title: Improving teaching methods and the use of digital tools in the classroom

Purpose: The purpose of the 3-day professional development is to address the disparities in teachers' instructional methods and technology utilization within their lesson design. Teachers within the Public Magnet High School lacked knowledge in various pedagogies available to them and the usage of the most appropriate technology to use within their specific content area. The teacher's level of use of technology varied and was inconsistent overall. Teachers will be provided with the opportunity to become more knowledgeable of pedagogy and technology tools and collaborate, develop, and create technology-based lessons for their specific content area.

Goals: The goal of this professional development is to provide teachers with knowledge and tools needed to enhance their instructional practices to create a technology-based lesson design in their specific content area.

Learner Outcomes:

1. Introduce Bloom's Taxonomy
2. Build teachers knowledge on the various approaches to pedagogy along with Bloom's taxonomy and what it looks like in the classroom.
3. Explain the benefits of technology and address barriers.
4. Create a content-specific lesson utilizing technology effectively.

Target Audience: Core-Content Teachers, Grades 9-12

Day 1 Agenda**:** Bloom's Revised Taxonomy

8:00-8:30	Introduction Overview of Agenda/ Day 1 Learning Objectives: Teachers will be able to: • Understand Bloom's Revised Taxonomy • Create learning objectives using the taxonomy
8:30-9:30	Bloom's Taxonomy Explanation
9:30-9:45	Break
9:45-11:30	Bloom's Taxonomy Examples
11:30-12:30	Lunch

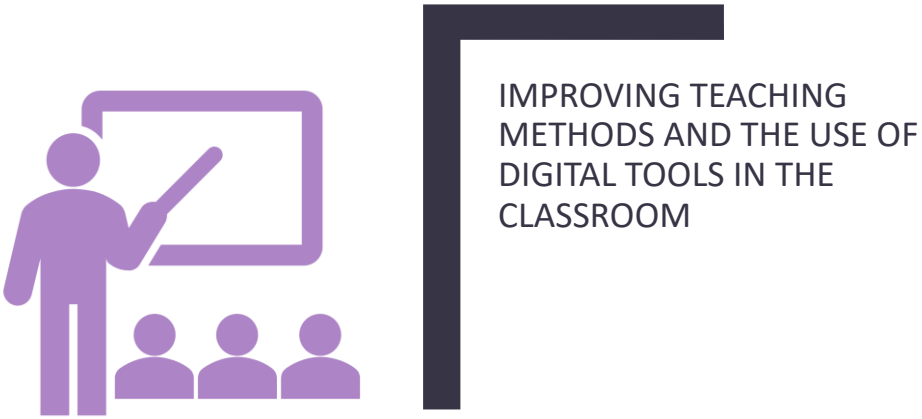
12:30-1:30	Learning Activities/Create Learning Objectives by Content Area/Collaboration
1:30-1:45	Break
1:45-2:45	Present Learning Objectives/Learning Assessments
2:45-3:00	Closing Activity

Day 2 Agenda: Pedagogy

8:00-8:30	Overview of Agenda/Day 2 Learning Objective: Teachers will be able to: • Understand and describe various types of pedagogies. • Create learning objectives to match various types of pedagogies
8:30-9:30	Traditional and Constructivist Pedagogies
9:30-9:45	Break
9:45-11:30	Traditional and Constructivist Pedagogies(continued) Collaborative and Inquiry-Based Pedagogies
11:30-12:30	Lunch
12:30-1:30	Collaborative and Inquiry-Based Pedagogies(continued)
1:30-1:40	Break
1:40-3:00	Collaborative and Inquiry-Based Pedagogies Content-specific breakout sessions

Day 3 Agenda: Content –Specific Training (Use of Technology)

8:00-9:00	Overview of Agenda/Day 3 Learning Objective: Teachers will be able to: • Create learning objectives • Choose the appropriate pedagogy • Utilize content-specific technology
9:00-10:00	Content-specific breakout sessions
10:00-10:10	Break
10:10-11:30	Content-specific breakout sessions
11:30-12:30	Lunch
12:30-3:00	Mini-Teach/Evaluation/Feedback



AGENDA: DAY 1

8:00-8:30	Introduction Overview of Agenda/ Day 1 Learning Objectives: Teachers will be able to: Understand Bloom's Revised Taxonomy Create learning objectives using the taxonomy
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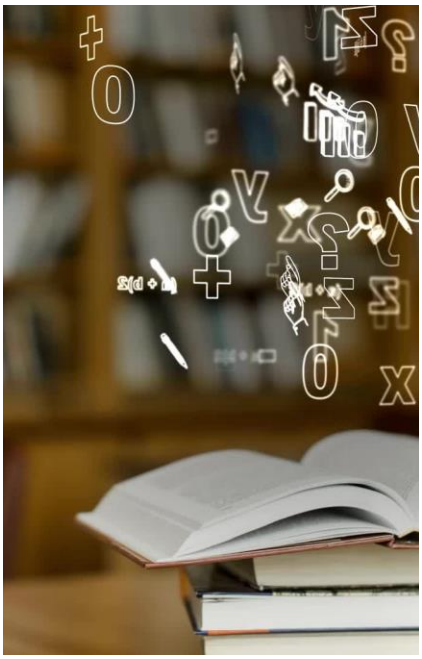
1:45-2:45	Present Learning Objectives/Learning Assessments
2:45-3:00	Closing Activity



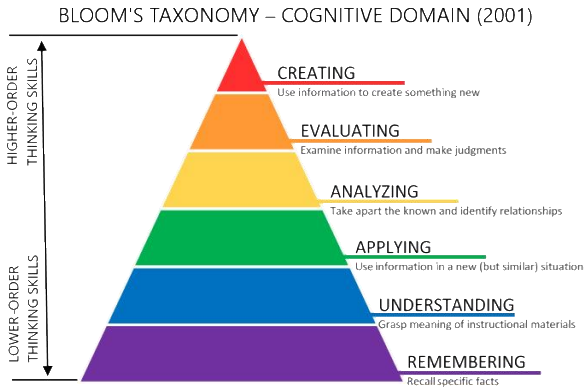
Bloom's Revised Taxonomy

Bloom's Taxonomy is one of the best-known theories in education, used to create and classify learning objectives according the level of complexity.

In principle, the taxonomy promotes higher forms of thinking and supports learning outcomes that focus on depth of learning rather than tasks.

Bloom's Taxonomy is a tool that can be used by the teachers and employee trainers to create lesson plans and assessments that lead to critical thinking.

Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman.



BLOOM'S REVISED TAXONOMY

Consists of six major categories: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating

Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman.

Remembering

Foundation for learning

Can student recall or remember?

Represented in lesson plans with words such as: define, duplicate, memorize, list

Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman.

Understanding

Can the students explain the ideas or concepts?

Represented in lesson plans with words such as: classify, describe, discuss, explain, identify

Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman.

Applying

Can the student use the information in a new way?

Represented in lesson plans with words such as: choose, demonstrate, illustrate, interpret

Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman.

Analyzing

- Can the student distinguish between different part?
- Represented in lesson plans with words such as: compare, contrast, differentiate, examine

Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman.

Evaluating

Can a student justify a stand or position?

Represented in lesson plans as: defend, argue, judge, support, evaluate

Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman.

Creating

- Can the student CREATE a new product or point of view?
- Represented in lesson plans with words such as: assemble, construct, create, design, develop, formulate, and write.

Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman.

The Higher and Lower Order Thinking Skills *in Bloom's Revised Taxonomy*

Higher-Order

Creating
Evaluating
Analyzing

*This is asking students to think at higher levels beyond simple recall, which stimulates their thinking processes

Lower-Order

- Remembering
- Understanding
- Applying

*This is asking students to recall information or state facts

Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman.

Bloom's Level	Key Verbs (keywords)	Example Learning Outcome
Create	design, formulate, build, invent, create, compose, generate, derive, modify, develop.	*By the end of this lesson, the student will be able to design an original homework problem dealing with the principle of conservation of energy.*
Evaluate	choose, support, relate, determine, defend, judge, grade, compare, contrast, argue, justify, support, convince, select, evaluate.	By the end of this lesson, the student will be able to determine whether using conservation of energy or conservation of momentum would be more appropriate for solving a dynamics problem.
Analyze	classify, break down, categorize, analyze, diagram, illustrate, criticize, simplify, associate.	*By the end of this lesson, the student will be able to* differentiate between potential and kinetic energy.
Apply	calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, perform, present.	*By the end of this lesson, the student will be able to* calculate the kinetic energy of a projectile.
Understand	describe, explain, paraphrase, restate, give original examples of, summarize, contrast, interpret, discuss.	*By the end of this lesson, the student will be able to* describe Newton's three laws of motion to in her/his own words
Remember	list, recite, outline, define, name, match, quote, recall, identify, label, recognize.	*By the end of this lesson, the student will be able to* recite Newton's three laws of motion.

Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman.

MATHEMATICS

Low-order Learning Objective

Students will be able to recognize and use absolute values

Higher-Order Learning Objective

Students will be able to evaluate polynomials

SOCIAL STUDIES

Low-order Learning Objective
Students will be able to explain the significance of the Spanish-American War

Higher-Order Learning Objective
Students will be able to analyze the importance of land ownership within the structure of colonial society

ENGLISH

Low-order Learning Objective

Students will be able to use clauses and phrases to vary sentence structure

Higher-Order Learning Objective

Students will be able to create and support a clear thesis

SCIENCE

Low-order Learning Objective

Students will be able to identify the renewable and nonrenewable resources that you use daily

Higher-Order Learning Objective

Students will be able to compare and contrast heterotrophs and autotrophs.

ACTIVITY

Create 1 lower-order learning objective and 1 higher-order learning objectives in your content area

Utilize verb chart as a resource

Each content-area will present their 2 learning objectives to the room

BLOOM'S TAXONOMY SAMPLE LESSON: FROM SPIDERMAN

Spiderman

Remembering

- The learner will LIST the main characters from the Spiderman. (Doctor Octupus, Green Goblin, Venom, etc...

Understanding

- The learner will IDENTIFY the characters in their lists as either "HEROS" or " Villians"

Spiderman

Applying:

- The learner will CHOOSE which character from their lists is the main “Hero” (Protagonist) and which character from their list is the main “Villian” (Antagonist)

Analyzing:

- The learner will DISTINGUISH what events caused the Protagonist to become a “HERO” and what events caused the Antagonist to become a “Villian”

Spiderman

Evaluating

- The learner will DEFEND either the “HERO” or “Villian” and his/her development as a character that is central

Creating

- The learner will DEVELOP a new “ HERO” and “ Villian” for the story, giving a detailed account of his/her growth into the chosen role.

Agenda: Day 2

8:00-8:30	Overview of Agenda/Day 2 Learning Objective: Teachers will be able to: Understand and describe various types of pedagogies. Create learning objectives to match various types of pedagogies
8:30-9:30	Traditional and Constructivist Pedagogies
9:30-9:45	Break
9:45-11:30	Traditional and Constructivist Pedagogies(continued) Collaborative and Inquiry-Based Pedagogies
11:30-12:30	Lunch
12:30-1:30	Collaborative and Inquiry-Based Pedagogies
1:30-1:40	Break
1:40-3:00	Collaborative and Inquiry-Based Pedagogies Content-specific breakout sessions

PEDAGOGICAL TEACHING METHODS

Types of pedagogies

- Traditional
- Constructivist
- Collaborative
- Inquiry-Based

Traditional pedagogy

- Teacher is in control of the class
- Based on lectures
- Teacher presents lesson and teach content

WHAT DOES A TRADITIONAL CLASSROOM LOOK LIKE?

- Students are in seated in rows of desks facing the front of the classroom
- Students work independently
- Face to face interaction between student and teacher
- Learns from instructor

Sample Lesson: Traditional Pedagogy

Solving multi-step equations

- Teacher models how to solve a multi-step equation
- Teacher moves into guided practice with students on solving multi-step equations
- Teacher and students work together through problems usually on board
- Students will work independently on practice worksheet
- Student will complete an exit ticket on what was learned

LEARNING OBJECTIVES AND TRADITIONAL PEDAGOGY

LO	Why it matches…
Students will be able to apply editing skills to make revisions given samples	It allows students to gain the knowledge of how to edit and what are the proper notations for editing. Students will practice on sample work.
Students will be able to factor using the FOIL Method	It allows teacher to model how to apply the foil method when factoring and allows for student practices.

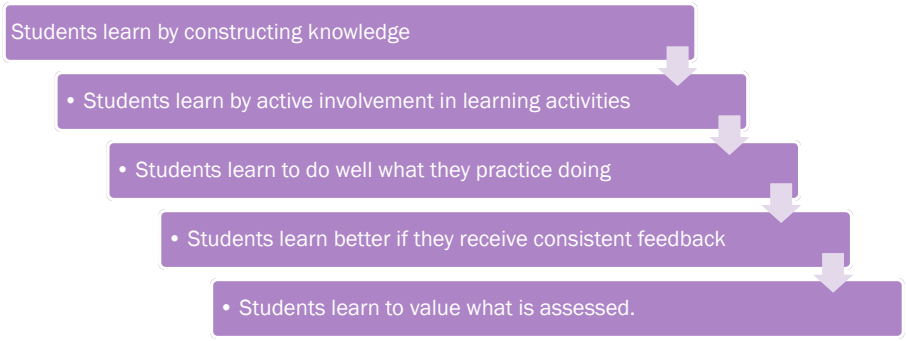
Constructivist Pedagogy

Learners create own understanding of the world based on everyday experiences

The learner must consider the information being taught and - based on past experiences, personal views, and cultural background - construct an interpretation

Tam, M. (2000). Constructivism, Instructional Design, and Technology: Implications for Transforming Distance Learning. *Educational Technology and Society, 3* (2).

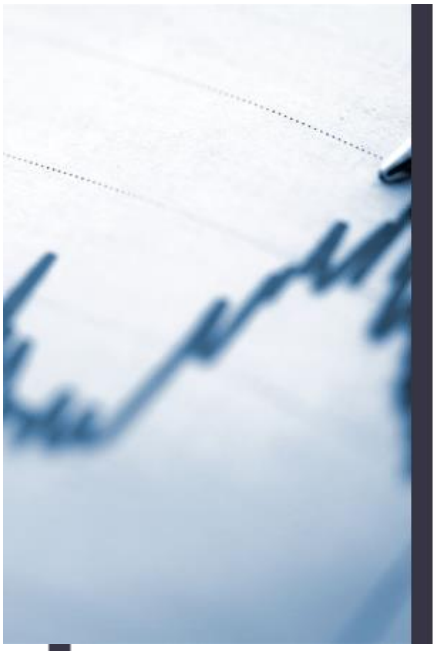
What does a constructivist classroom look like?



Tam, M. (2000). Constructivism, Instructional Design, and Technology: Implications for Transforming Distance Learning. *Educational Technology and Society, 3* (2).

Feature	Traditional Classroom	Constructivist Classroom
Objective	Provide accurate answers	Encourage discussion and ideas
Working Style	Students work independently	Students work independently, in groups, or with partners
Decision-Making	Instructors have the final say	Shared between teacher and students
Assessments	Assessments are part of the examination; they are separate from learning tasks.	Conferences, daily work, portfolios, and assignments
Study Material	Workbooks, worksheets, and basic readers.	Books, real-world scenarios, journals, and workshop methodology.

Khan, M. J. (2022). Facts And Stats That Reveal The Power Of The eLearning Sector. eLearning Industry. Retrieved from https://elearningindustry.com/facts-and-stats-that-reveal-the-power-of-the-elearning- sector
Tari, K. D., & Rosana, D. (2019). Contextual teaching and learning to develop critical thinking and practical skills. Journal of Physics Conference Series. DOI: 10.1088/1742-6596/1233/1/012102



Sample Lesson: Constructivist pedagogy
Pendulum Activity (Science)

- Investigative Question:

How does the mass of the object on the end of the pendulum effect the number of swings in 15 seconds?

• Prediction: (must include a prediction and an explanation)

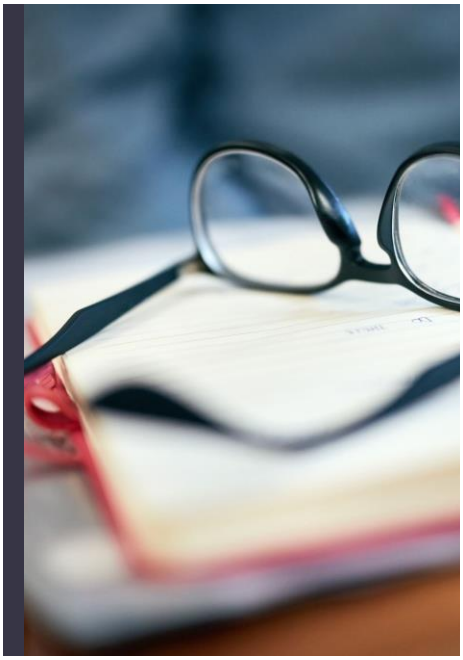
- Test your prediction
- Collect data in a data table
- Write a conclusion

LEARNING OBJECTIVES *AND* CONTRUCTIVIST PEDAGOGY

LO	Why it matches…
■ Students will be able to identify figures of speech through sensory details (English)	▪ It will allow students to listen to a poem and discuss it, then engage in direct teaching on sensory details and discussion. Students will listen again in groups and share their responses. Students are building on their knowledge
■ Students will be able to determine the total surface area of a cuboid	▪ This matches because it allow the students to define a cuboid by determining the formula from the lateral area and applying it to real-word situations.

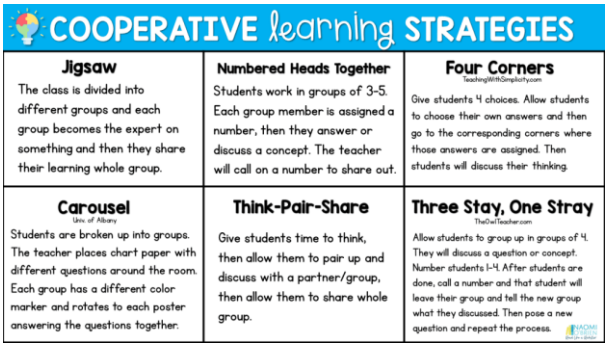
Collaborative pedagogy

- Learners work together towards greater understanding of information presented
- Shared knowledge among student and teacher
- Teachers are mediators



Woodward, V. A. (1985). Collaborative Pedagogy: Researcher And Teacher Learning Together. *Language Arts*, *62*(7), 770–776. http://www.jstor.org/stable/41405352

What does a collaborative classroom look like?



O'Brien, N. (2021). Cooperative Learning: Partner Pairings for Accountability and Differentiation. https://readlikearockstarteaching.com/cooperative-learning-partner-pairings-for-accountability-and-differentiation/

SAMPLE LESSON: COLLABORATIVE PEDAGOGY

essay plan

- **Collaborative essay plan:** Put students in pairs or small teams. Give students an essay question and have them work together to write a thesis and an essay plan, including evidence to support the thesis. Students can write collaboratively via Google Docs, and share a link to their plan in a Google Doc table shared with the whole class.

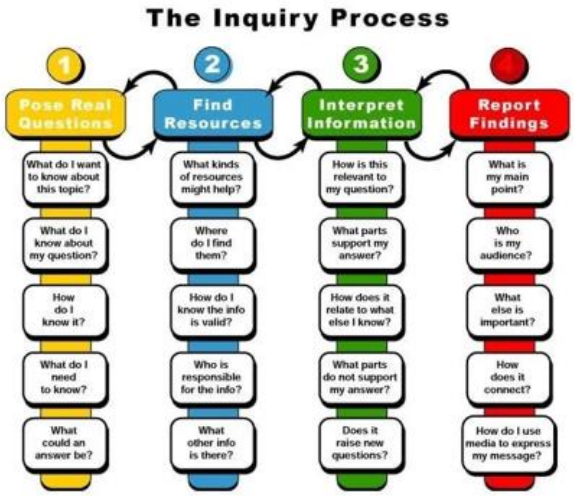
Learning objectives *and* *Collaborative Pedagogy*

LO	Why it matches...
Students will be able to identify the renewable and nonrenewable resources that you use daily (Science)	It allows student to understand a scientific investigation, communicate, and evaluate the investigation utilizing an activity that is group-based on renewable and nonrenewable resources. Students will have created their own knowledge through investigation with others.
Students will be able to explain the significance of the Spanish-American War (Social Studies)	It allows the students to collaborative in groups and discuss on the perspectives of each of the countries involved and answer questions together within a group and speaker from group can present answers.

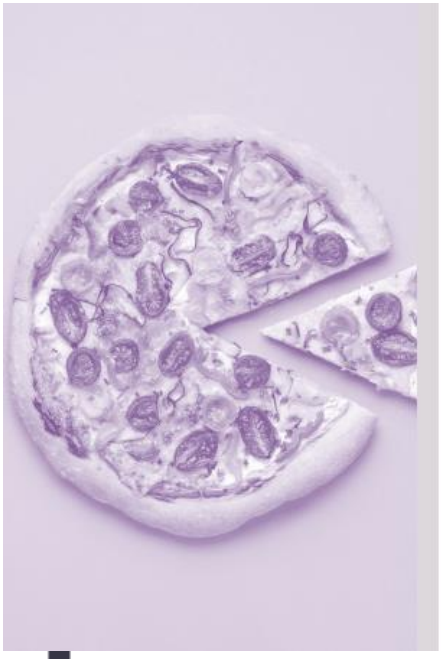
Inquiry-based pedagogy

- Process of learning that engages learners by creating real-world connections through high-level questioning and exploration. The inquiry-based learning approach encourages learners to engage in experiential learning and problem-based learning.

Ernst, D., Hodge, A., & Yoshinobu, S. (2017). What is inquiry-based learning? *Notices of the American Mathematical Society*, 64(6), 570-574.



Cross, M. (1996). *Teaching Primary Science: empowering children for their world.* Melbourne: Longman Australia.
Kuhlthau, C., Maniotes, L., & Caspari, A. (2007). *Guided Inquiry: Learning in the 21st Century.* London: Libraries Unlimited.



SAMPLE LESSON: INQUIRY-BASED PEDAGOGY

Economics of pizza

- Analyze, from a **mathematical perspective**, many students' favorite meal: pizza.
- This project-based learning assessment starts by choosing a pizza chain, researching its prices and applying linear algebra concepts to find the base cost of a pizza. These same concepts will allow students to determine how much each additional topping costs.
- Students will research individually or in small groups how much it costs to source each topping. They can then determine which type of pizza yields the greatest and smallest profit margins. Doing so acts as an introduction to basic economic concepts, encouraging students to critically think about business.

LEARNING OBJECTIVES *AND* *INQUIRY-BASED PEDAGOGY*

LO	Why it matches…
■ Students will be able to understand acceleration and how it depends on how much force is exerted (Science	➡ ■ It will allow students to experiment with various object and compare to prove this.
■ Students will be able to define and describe democracy	➡ ■ It allows the student to identify their idea of democracy, research and provide evidence

Activity

Teachers will work within their content area on 1 learning objective and which pedagogy matches with this objective and why.

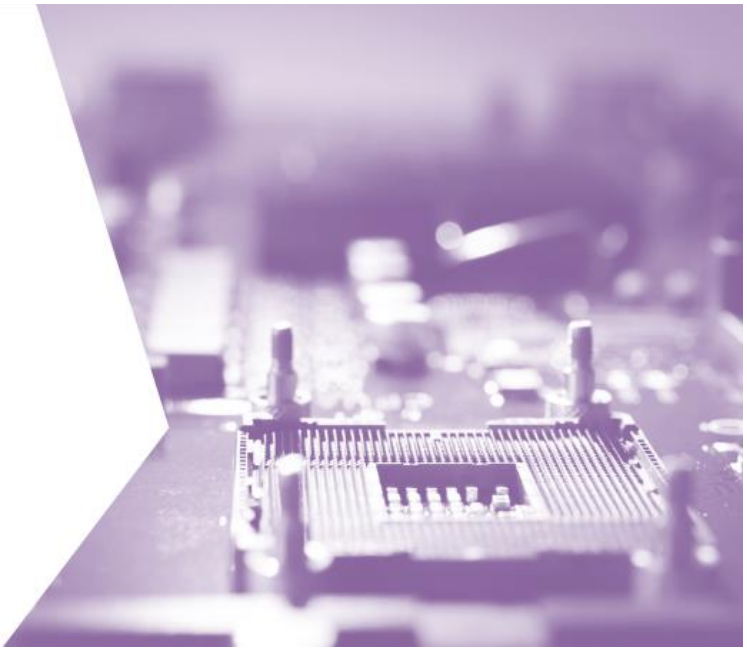
Each content area will present their findings.

Agenda: Day 3

8:00-9:00	**Overview of Agenda/Day 3 Learning Objective:** **Teachers will be able to:** **Create learning objectives** **Choose the appropriate pedagogy** **Utilize content-specific technology**
9:00-10:00	Content-specific breakout sessions
10:00-10:10	Break
10:10-11:30	Content-specific breakout sessions
11:30-12:30	Lunch
12:30-3:00	Mini-Teach/Evaluation/Feedback

Science Breakout Session

- Edpuzzle



Edpuzzle

- Edpuzzle is a web-based tool which can edits online videos and adds interactive content to achieve the learning objectives
- Edpuzzle works well with lower-order learning objectives

How does it work?

1. Either Find a video or create a video.
2. Edit the video to create your lesson(this can include voice overs and questions)
3. Assign the video to the students and monitor their progress

Let's try!

Sample Lesson with Edpuzzle

- Learning Objective: Students will be able to duplicate cell replication.
- This apart of the Analyzing in the Bloom's Revised Taxonomy.
- The pedagogy that will connect with this LO and technology is the traditional pedagogy.

- Lesson plan:
- Teacher will create a video on cell replication showing the various stages. Student will watch the video that I created on how to duplicate cell replication, Students will pause and ask questions embedded in the video to check for understanding. The students will then go through guided practice of the process of cell replication with a single cell.The students will then complete a lab on replicating cells on their own.

Google Slides

What is Google Slides

- Web-based took for creating a slide presentation that is a live documents for adding and editing when shared.

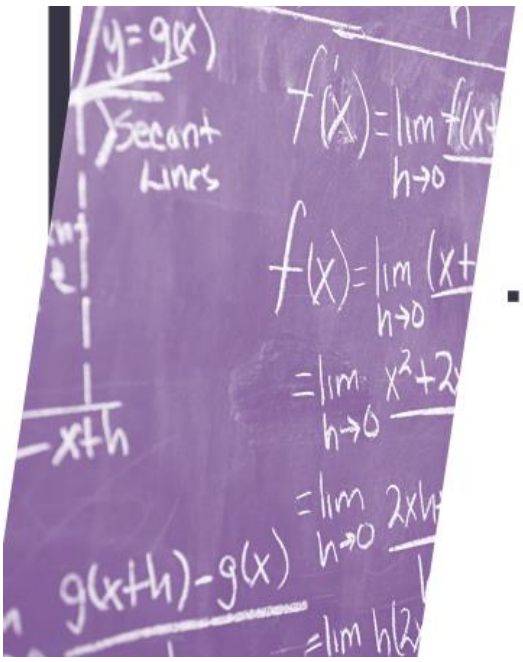
How does it work?

1. Create the presentation
2. Edit and format presentation
3. Share and work with others
4. Let's try!

Sample Lesson with Google Slides

- Learning Objective: Students will be able to DEVELOP a thesis statement and create an essay plan providing evidence
- This apart of the Creating in the Bloom's Revised Taxonomy.
- The pedagogy that will connect with this LO and technology is the Collaborative Pedagogy.

- Lesson Plan:
- Students will be put into small groups and given a topic to develop a thesis statement and create an essay plan. The students will then use google slides to create presentation of thesis and evidence. Each student will have access to the google slides to make edits and revisions on live document. Changes will be in real time and they all will have access to the document. The students will then format the document and present to the class.



Mathematics Breakout Session

- TI-Inspire Software and TI-Inspire Calculators

TI-Nspire Software for Mathematics

TI-Nspire Software

- This software allows an interactive display of a graphing calculator screen that shows keystrokes and multiple representation. It also allow for students to answer questions within the calculator and ability for teacher to see each students screen.

How does it work?

- It has many capabilities and depends on learning objective.
- Files can be uploaded to each student calculators for them to answer questions
- You have access to each student's calculator and have a display for students to see on main screen to follow teacher's steps.
- Let's try!

Sample Lesson with TI-Nspire

- Learning Objective: Students will be able to DETERMINE the slope from a table, from a graph, and in an equation.
- This apart of the Evaluate in the Bloom's Revised Taxonomy.
- The pedagogy that will connect with this LO and technology is the Collaborative Pedagogy.

- Lesson Plan:
- Teacher will model how to determine slope from a table, graph, and equation utilizing the TI-inspire software which students will watch on screen for steps. Students will be divided into groups then given equations and work collaboratively to create the multiple representations of the equation on their calculator screen and then determine the slope within their group. Students will respond as a group to questions within the calculator and results will appear on front screen. A representative from each group will explain their responses to the class. Students will then be sent a file through the calculator for independent practice problems.

Nearpod

What is Nearpod?

- A tech tool that allows teachers to create or input a slide-show, which can feature assessments, videos, and gaming activities. Teachers are able to use it as a live activity or as student-paced.

How does it work?

- Either create or upload a pre-made slide presentation
- Determine the ideas and activities nearpod offers that fits your lesson
- Let's try!

Sample Lesson with Nearpod

- Learning Objective: Students will be able to define and describe democracy
- This apart of the Remembering and Understanding in the Bloom's Revised Taxonomy.
- The pedagogy that will connect with this LO and technology is the Inquiry-Based Pedagogy

- Lesson Plan:
- Teacher will set up the nearpod as student-paced and students will start out answering open-ended question submitted into nearpod. Questions such as, What do you think democracy is? and How have you come up with this answer? Students will then complete research on the topic and then answer prompting open-ended questions if the research matches their definition why and why not? Students will then answer their constructed definition and description of democracy. Teacher will be able to grade responses and progress within nearpod.

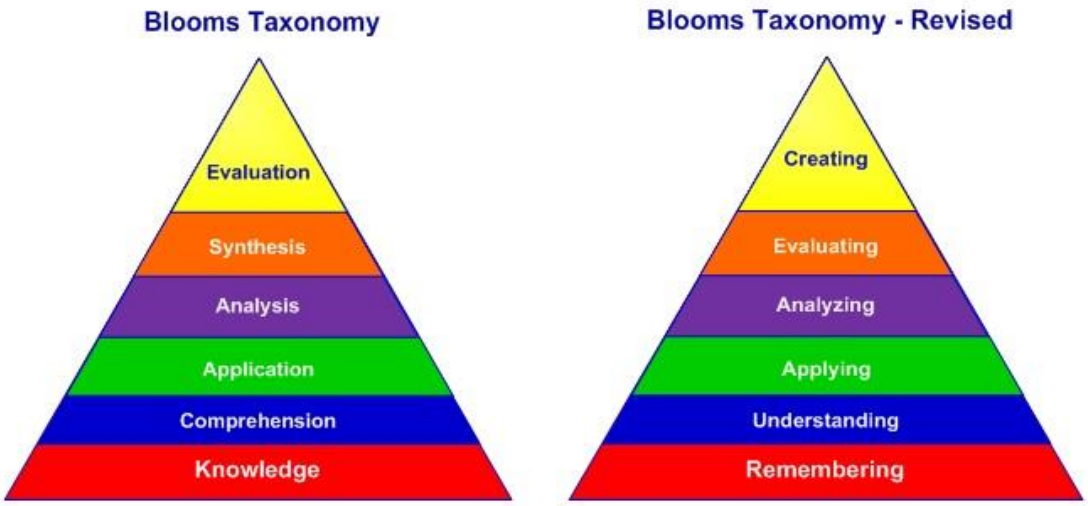
Mini-Teach

Teachers will work in collaborative groups

Each group will present a mini-teach lesson in front of peers utilizing the tech presented in training.

Teachers will include the learning objective and the pedagogy that will be used.

Appendix B: Bloom's Taxonomies



Bloom, B.S. (1956) Taxonomy of Educational Objectives, Handbook: The Cognitive Domain. David McKay, New York.

Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman.

Appendix C: Table of Software

Subject	Tutorial Software	Research Tools	Production Tools
Math	Khan Academy Bytelean.com Mathmedia.com	Desmos TI Connect Software Quizlet	Nspire Software Digital Timer EDPuzzle Smartboard
Science	Discovery Education Phet Interactive- Simulations Nova Labs PTable	Science Friday National Geographic Froguts Physics Classroom	Smartboard Pear deck Powerpoint EDPuzzle Prezi Padlet
Social Studies	History.org ICivic.org Discovery Education	Kahoot Google Docs Annenburg Classroom	Pear deck Nearpod EDPuzzle Prezi Padlet
English	Istation ReadWriteThink StudyIsland	Google Scholar Google Docs Quizlet	Pear Deck Powerpoint Popplet Live Binders Google Slides

Appendix D: Interview Questions

Interview Questions

1. What subject do you teach?
2. What do you think is important to teach in a subject?
3. How do you teach your content with major ideas or major operations?
4. Do you like your curriculum?
5. Do you follow the curriculum?
6. Gagne has 5 categories. Do you teach using any of the Gagne's learning types?
7. How do you teach? Describe a lesson.
8. Do you include technology and how?
9. How much in your teaching do you have teacher-centered or learner-centered activities?
10. Which type of activities do you give to your students?
11. Do you plan with other teachers or by yourself?
12. What professional development are you participating in and does it help?
13. Is technology use easy or difficult for you?
14. What barriers do you have with technology use in the classroom?
15. Do you feel you are knowledgeable of your subject matter?
16. Do you know about teaching techniques?
17. Can you get help with that?
18. Do you see technology as useful for instructional goals?
19. Is it something useful for teaching?
20. Have you seen models of professional development?

21. Is technology professional development helpful with technology integration?
22. What are the pros and cons of technology professional development?
23. What does successful technology professional development look like to you?
24. Are you supported to utilize technology in your lessons?
25. How do you come up with a technology-based lesson?
26. Did you have technology preparation in preservice education in one course or was it embedded in every subject area?
27. If you did not have technology preparation, was it difficult for you to integrate technology in your classroom and lessons?
28. If you did have technology preparation, how did it prepare you?
29. How did you learn to create a technology-driven lesson? Peers? Coaches?
30. Does your teaching style and technology mesh well together?
31. Describe some downfalls that technology caused?
32. Describe a good lesson with successful use of technology?
33. Are you open to use a different teaching style?
34. Is there more than one way to teach your content area?
35. Does the school provide time for planning?
36. Do you think the barriers for integration are extrinsic or intrinsic?
37. How comfortable are you with technology?
38. What is pedagogy?
39. How did you come up with your pedagogy?
40. What is technology?

41. What is content?

42. How are all three connected?

Appendix E: Email Invitation

Dear Teacher,

You are invited to take part in a research study about classroom teacher's perceptions of their knowledge of content and pedagogy in terms of a technology driven lesson**.**

This study seeks volunteers who are:

- Current core content teachers within the high school
- Five or more years of teaching experience within the district
- Participated in some type of technology professional development
- Utilizes technology within the classroom
- Integrated technology within your lessons

The study would require a 60-minute interview and a follow-up interview, either in-person or on Microsoft Teams. The study is being conducted by a researcher named Ayana Paskins, who is a doctoral student at Walden University. If you feel you would like to participate, then please read the attached consent form, and follow directions.

Thank you,

Ayana Paskins

Appendix F: Professional Development Evaluation Form

Circle one of the following for each question.

	Strongly Disagree	*Disagree*	*Agree*	*Strongly Agree*
1. I understand Bloom's revised taxonomy and how to use it when creating learning objectives.	1	2	3	4
2. I can create learning objectives based on Bloom's revised technology.	1	2	3	4
3. My knowledge of the types of pedagogies has increased.	1	2	3	4
4. I can use at least one of the pedagogies presented in my classroom.	1	2	3	4
5. I am knowledgeable of the technology provided in my content are.	1	2	3	4
6. I can apply the specific content technology presented in classroom	1	2	3	4

Answer the following.

7. What would you have liked to have learned in a PD of this nature?

8. What is the best thing you have experienced in this PD?

9. What is a strength of the PD?

10. What is a weakness of the PD?