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Perspectives of Secondary Science Teachers and Adult Secondary Science Students on Technology Integration in a Science Curriculum

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Concordia University–Portland

College of Education

Doctorate of Education Program

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Perspectives of Secondary Science Teachers and Adult Secondary Science Students on
Technology Integration in a Science Curriculum

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College of Education

Dissertation submitted to the Faculty of the College of Education
in partial Fulfillment of the requirements for the degree of
Doctor of Education in
Higher Education

Donna Graham, Ph.D., Faculty Chair Dissertation Committee

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Abstract

This qualitative intrinsic case study explored the perspectives of secondary science teachers and adult secondary science students on technology integration in a science curriculum in a high school program at a community college in North Carolina (NC). The researcher sought to answer the following research questions: How do secondary science teachers practice technology in a science curriculum in a high school program at a community college in North Carolina? How do adult secondary science students in a high school program at a community college in North Carolina experience technology in their science curriculum? Data were gathered utilizing three sources: individual face-to-face interviews, a student focus group, and a teacher focus group. Data were collected to determine how teachers and students have practiced and experienced the use of technology. This study of 14 adult secondary science students and six secondary science students revealed four themes and five subcategories that resonated throughout the data analysis. The significance of this study is that it provided insight into how the students and the teachers perceived technology use in the science classroom. The results indicated that the participants' experiences and practice with technology were overall positive and beneficial to them. The participants indicated a few hindrances with technology that they have experienced. Technology has made an impact on their learning and teaching methods.

Keywords: technology, learning, curriculum, secondary science, technology integration

Dedication

First and foremost, I would like to thank God for blessing me with this opportunity to further my education. God has given me strength when I was weak, been my comforter when I was weary, and a provider for me in my time of need. Without Him I am nothing and for His grace and mercy, I will forever be grateful. I wish to dedicate this dissertation to my father, Dr. Walter O. Whitfield who is now my guardian angel. You started this journey with me as one of my strongest supporters and although God saw fit to call you from labor to rest during this journey, I have and always will hold you close to my heart. I love you beyond words. You are one of the reasons that I didn't give up. I know that you are smiling from the heavens saying, "That's my baby girl!" To my mother, my rock, my strong tower, I say thank you! You have shown me concern, support, and most of all love. Although the journey wasn't easy you helped me through it. The prayers that only a mother can send for their child were not in vain. I love you! To my two heart beats known as my sons; DJ and Jourdan, words can't even express the sacrifices, the tears, the agony, and the determination that kept me going just for you guys during this long journey. You two are the reasons that I work so hard and aim to be the best mother that I can be. My prayer is that you will both realize that there is no goal that you can't reach, no dream that can't become a reality, and no mountain too high for you to climb when you put God first in your life. This has not been easy, but it was well worth it. My love for you both is indescribable! To my sister Kim, where do I begin? You have been my prayer warrior, my encourager, my motivator but most of all my friend. You have picked me up when I didn't feel like going on. You have reminded me so many times that God didn't bring me this far to leave me and for that I am grateful. I love you! To my niece Kyra, you have been the daughter that I never had. Your beautiful spirit has kept me uplifted and your encouraging words have made me

feel more determined than ever. I love you! To my significant other, Sytoi, I met you at one of the darkest moments of my life, but you brought light back into my world. You have shown unwavering support and have given me encouragement even when I didn't have the strength to endure. You spoke this moment into existence. Through the tears, disappointments, and wanting to give up, you never left my side. Thank you and I love you! To Randolph Williams, as my supervisor, you have been a big support for me. You have held me up and are truly the best supervisor that anyone could ask for. Thank you for your support. To my family, my New Mission Baptist Church family, my coworkers, friends, and supporters, thank you from the bottom of my heart. The prayers, words of encouragement, and motivational speeches have paid off. Thank you from the depths of my soul.

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Chapter 1: Introduction

Introduction

Modern technology is transforming in an accelerating rate in our physical, economic, cultural, and educational environments (Valanides, 2018). To enhance the academic performance of students, there is a need to turn from conventional teaching methods to modern teaching methods (Hussain & Suleman, 2017). Integrating technology into the curricula of high school students can serve as an effective and influential instrument for providing educational opportunities to the learners as well as keeping them engaged. A technology enriched learning environment should be created that enables students to manage their own learning and to assess their own progress (Tucker, 2014). Students may access technology in a variety of ways such as texting, searching the web, and social networking; therefore, integrating technology could be utilized as an educational resource. Schools are expected to ensure that all students understand how to use technologies as a tool to engage in creative, productive, lifelong learning (Herold, 2016).

The purpose of this qualitative case study was to gain an understanding of how secondary science teachers and adult secondary science students enrolled in a high school program at a local community college in North Carolina experience and practice the use of technology in the classroom. The constructivist learning theory and the Technological Pedagogical Content Knowledge model (TPACK) were used to assist in the exploration of this study. It is important that students have the opportunity to learn technological skills, therefore it is imperative that the teachers increase their use of technology in the classroom in order to prepare K–12 students referred to as “digital natives,” for the 21st century (Coyne, Lane, Nickson, Hollas, & Potter, 2017). Technology has the potential to renovate the ways of instruction, where and how learning

occurs and the roles of students and educators in the instructional process (Hussain & Suleman., 2017). In this digital age, students must learn to use tools essential to everyday life and workplace productivity (Tucker, 2014). This chapter is organized into the background of the study, statement of the problem, the purpose of the study, research question, rationale for the methodology, research design, definitions of terms, assumptions, limitations, delimitations, and summary.

Background, History, and Conceptual Framework of the Study

Smartboards, tablets, laptops, clickers, and smart phones are just a few technological resources that have enabled education to thrive and to reach greater heights. Education must not only be comprehensive, sustainable, and superb but must continuously evolve to meet the challenges of the fast-changing and unpredictable globalized world (Serdyukov, 2017). Technology may be the catalyst needed for school districts to help their students achieve at higher levels (Harris, Al-Bataineh, & Al-Bataineh, 2016). Although integrating technology in the science classroom may help support many teaching goals, some teachers have different perspectives when it pertains to integrating technology into the classroom. For the integration of technology to be effective, the teachers need confidence in using technology (Aljuzayri, Pleasants, & Horvitz, 2017). This study focused on how secondary science teachers and adult science learners experience and practice technology in a science curriculum.

Technology is changing the dynamics of education, especially the relationship between teachers and students. Among the fastest growing and irreversible trends at all levels of education: increasing use of laptops, tablets, and other mobile devices (Kim, 2018). This change is often referred to as the “digital revolution,” which is the advancement of technology from analog, electronic and mechanical tools to the digital tools available today (Delgado, Wardlow,

McKnight, & O'Malley, 2015). Technology has changed education by creating pathways for individualized learning and enabling differentiation of learning for students (Hunter, 2017). Technology affects how students acquire skill sets needed to prepare for college and a career as well as how educators integrate digital technological instructional strategies to teach (Delgado et al., 2015). Technology integration is effective when the technology supports curricular goals.

In the past, technology in education was a debatable topic amongst the society and there was a myriad of views on modernizing education while making it technology aided (Host, 2015). Innovations in education are of particular importance because education plays a crucial role in creating a sustainable future (Serdyukov, 2017). The ever-changing relationship between teachers and technology plays a very important role in the classroom (Aljuzayri et al., 2017). Many perspectives can be taken into consideration when determining the effect that technology can have on education. The teacher's perspectives can give an insight into the benefits that the integration of technology has had on their students, their teaching strategies, and if it has helped the students to increase their achievement levels. Therefore, focus groups were used to gain a better insight into the teacher's thoughts on technology use in the classrooms.

The TPACK model developed in 2006 by Mishra and Kohler, as cited by Sheffield, Dobozy, Gibson, Mullaney, & Campbell, 2015, and describes how teachers' understanding of technological knowledge (TK) along with content knowledge (CK) and pedagogical knowledge (PK) should be integrated into their teaching. Teachers have been challenged now more than ever to integrate technology into their curricula; therefore, the TPACK model has been employed to "unpack" the complexities of teaching with technology (Foulger, Buss, Wetzel, & Lindsey, 2015). TPACK is a way to understand the relationship between technology, students, and the teacher. Teachers' abilities to adapt themselves to rapidly developing technologies applicable to

learning environments are connected with technology integration (Coklar & Yurdakul, 2017). Technological innovation has the potential to serve as an important provider of sustainable development within the fields of education.

Statement of the Problem

The role that technology plays has become increasingly significant in society as well as in education. The problem this study explored is how secondary science teachers practice technology and how adult secondary science students experience technology in a high school program at a local community college located in North Carolina. Successful technology integration is prominent in preparing students to be technology savvy, retain information, and to make learning interesting for them in content areas such as science and math. The technological education system is constantly changing. Today's educators are under great pressure to provide 21st century students with a quality education based on 21st century standards (Harris, 2016). Technology should be integrated into curricula to create technology enriched learning environments that will enable students to take control of their own learning. Without this integration, the student of the future will be left without a bridge to the facilitator of learning. Technology can have the potential to accelerate progress while promoting learning skills that will not only benefit them today but in the future.

Purpose of the Study

The purpose of the study was to gain an understanding of how secondary science teachers practice technology and how adult secondary science students experience technology in a high school program at a local community college located in North Carolina. This study was important because it addressed integrating technology into the curricula of students to promote learning skills that will benefit them as learners and adults. This study was significant because it

provided knowledge to educators on what strategies may be useful to utilize technology as a tool to increase student engagement, create student-centered learning environments, and motivation in the science classrooms.

Research Questions

This study focused on how secondary teachers and adult secondary science students enrolled in a high school program at a local community college experience and practice the use of technology in a science curriculum. Based on the needs expressed in the literature, the following questions were generated to guide this research. This study strived to answer the research questions throughout this qualitative case study. The research questions that guided the study were:

- RQ1. How do secondary science teachers practice technology in a science curriculum in a high school program at a community college in NC?
- RQ2. How do adult secondary science students in a high school program at a community college in NC experience technology in their science curriculum?

Rationale for the Study

This study used a qualitative research method to understand how secondary teachers practice technology and how adult secondary science students' experience technology in a science curriculum. As opposed to quantitative research, which is focused on numbers and figures to quantify opinions, attitudes, behaviors, and other defined variables with the goal to confirm casual hypotheses about a specific phenomenon, the qualitative research method is more appropriate for this study (Farnsworth, 2016). Conducting research in a natural setting, using multiple methods that are interactive and humanistic, emerging data rather than prefigured data are some of the characteristics of qualitative research (Campbell, 2014). The participants

answered questions about their experiences and practice with technology to gather information on the perceptions, practices, and experiences of teachers and students regarding the implementation of technology vital in conducting research on the effectiveness of technology.

Research design. A qualitative case study design was used in this study to address the research questions. Qualitative research is used to gain insights into people's feelings and thoughts, which may provide the basis for a future standalone qualitative study or may help researchers to map out survey instruments for use in a quantitative study (Sutton & Austin, 2015). A case study provides context-dependent knowledge and accounts of practice that are drawn together from the voices, actions, interactions, and creations of the carriers or practice in a site (Miles, 2015). A qualitative case study design explores the experiences of individuals through explanations that the people involved present (Van Manen, 2014); therefore, this design will be employed for this study.

Case study research is one of several forms of social science research. Doing case study research would be the preferred method in situations when (a) the main research questions are "how" or "why" questions; (b) a researcher has little or no control over behavioral events; and (c) the focus of study is a contemporary, as opposed to entirely historical, phenomenon (Yin, 2014). This case study involved collecting data through interviews of secondary science students, student focus group, and a faculty focus group. The teachers and students that participated in the focus group and interviews had the opportunity to discuss, and openly share their lived experiences and practices with technology within a classroom setting.

Definition of terms. Numerous terms were used throughout this qualitative study that may need to be clarified to get a better understanding of what the researcher was saying. The terms are defined below.

Constructivist learning: Learners make sense of the world around them, as well as new information by working to construct knowledge through interaction with others, texts, social media, etc. (Bryant & Bates, 2015).

Curriculum: The lessons and academic content taught in a school or in a specific course or program (Curriculum, 2015).

Digital native: An individual who was born after the widespread adoption of digital technology (Digital native, 2018).

Technology integration: The routine and transparent in learning, teaching, and assessment of computers, smartphones, and tablets, digital cameras, social media platforms, networks, software applications, and the Internet aimed at helping students reach the district's and teacher's curricular and instructional goals (Cuban, 2016).

Assumptions, Limitations, and Delimitations

Numerous assumptions, delimitations, and limitations were associated with this study. Assumptions are necessary elements in research because they are required to conduct the study, for example often there are beliefs in the research that are necessary to conduct the research but cannot be proven (Simon & Goes, 2013). Limitations are constraints that are largely beyond your control but could affect the study outcome and unlike limitations, delimitations result from specific choices made by the researcher (Simon & Goes, 2013). Within this study, a number of limitations existed based on the sample size.

Assumptions.

1. The students were selected based on specific criteria; therefore, the researcher believed that all the participants in the study would answer the interview questions honestly and factually.

2. It was assumed that the participants would keep the confidences of others from their focus group meetings.
3. An assumption that pertained to the phenomenon within the study population was that the practice and experiences that adult learners and secondary teachers have had with technology integration within the curriculum could improve teaching strategies in the education system.

Limitations. Limitations can limit the extensity to which a study can go, and sometimes affect the result and conclusions that can be drawn (Simon & Goes, 2013). It is imperative to understand that research designs and collecting data are a complex process and that circumstances may arise that may possibly affect the research of this study. Limitations that affected the study were sample size and the criteria required to participate in this study.

1. The limited number of participants due to small school enrollment, time constraints due to teacher schedules, and the possibility of students having limited experience with technology in science could be limitations of this study.
2. This study will take place at one location
3. This study was limited to adult secondary science students and secondary science teachers.

This study consisted of 20 participants which included 14 adult secondary science students and six secondary science teachers from a local community college in North Carolina. Recognition of these potential limitations helped the researcher to make every effort to minimize the chances of the limitations becoming a major concern.

Delimitations. Delimitations are characteristics that arise from limitations in the scope of the study and by the conscious exclusionary and inclusionary decisions made during the

development of the study plan (Simon & Goes, 2013). Delimitations that arose from this study were:

1. The start and end date for the collection of data. The data were collected in the Spring Term of 2018–2019.
2. The area of study which focused only on secondary science teacher and adult science students who were enrolled in the high school program at the particular education center may be a possible delimitation factor for the study.
3. The research questions that were chosen for this study were also a delimiting factor because the questions were designed to be answered within a meeting time of an hour.

Chapter 1 Summary

This chapter provides an outlined background in which the nature of this qualitative study is based on. The purpose of this qualitative case study was to explore how secondary teachers practice technology and how adult secondary science students experience technology in a science curriculum. An explanation of definitions, limitations, delimitations, and assumptions is provided within this case study.

The research questions that guided this study were included to provide a deeper understanding of what prompted this study. The motivation for this study was inspired by the importance that technology has had on education as well as the students involved. To gain an insight into the benefits that technology has had on education a qualitative case study was chosen as the most suitable method for this study.

A qualitative case study is the method used when researchers want to explore and understand the meaning of individuals attached to a social or individual dilemma (Yin, 2014).

Chapter 2 will provide a background to the qualitative study as well as give insight into the theoretical framework that the study was drawn from. The literature review will be included in Chapter 2 as it was the foundation in which prompted the researcher to conduct this qualitative study.

Chapter 2: Literature Review

Introduction

Technology has become an important element in today's world. The emergence of technology has not only become relevant in health, the working environment, and society but in education as well. Technology should be an important modern aspect of science teaching and learning, especially when consideration is given to ways in which technology is shaping or reshaping lives and society (Campbell, Longhurst, Wang, Hsu, & Coster, 2015). Social networking, online gaming, iPods, and mobile devices are just a few technological resources that have transformed the lives of students with the help of technology. The past decade has seen a strong focus in the United States on increasing the use of technology in the nation's schools, to spur innovation and foster global economic competitiveness (McKnight et al., 2016).

Integrating technology into the curricula of high school students can imprint a lasting positive effect on a student's learning experience. The implementation of technology has created a dramatic shift in the world of education. Many see technology as a potentially powerful resource that is reshaping society and has the potential to do the same in the science classrooms (Campbell et al., 2015). The integration of technology into the classroom, in both K–12 and secondary education, is no longer simply rising—parents, students, educators, administrators, and policy makers expect it (Meehan & Salmun, 2016).

Technology has impacted the way that people study and has changed throughout history (Markova, 2014). While engaging in research on whether technology can help to improve achievement levels in science for high school students, studies were found that supported the idea of technology being utilized as a resource that can aid in increasing achievement levels of students. Demand is increasing for students to be competent in their ability to access, interpret,

compare and contrast, synthesize, and communicate ideas electronically using laptops and additional technologies (Robinson, 2016). It is imperative that teachers increase their use of technology in the classroom to prepare our K–12 students referred to as “digital natives,” for the 21st century (Coyne et al., 2017).

Technology is not only an integral part of our daily lives but in the educational system as well. Technology enables students to gain access to information, communicate, and to enhance their knowledge in content areas such as science, math, and history. Students access technology in a variety of ways such as texting, web surfing, and social networking. Use of technology as an educational resource is a new approach to learning that will encourage students to be self-directed learners (Barter, 2013). Students of all ages are finding ways to utilize technology whether it is through cell phones, iPads, iPods, laptops, or computers. Research has suggested that technology-enabled project learning has the greatest benefits as this allows students to be challenged intellectually while providing them with a realistic snapshot of what real-world problems look like (Host, 2015).

Students must be equipped to live in a multifaceted, multitasking, technology-driven world. It is important to ensure that all students have equal access to the new technological world (Tucker, 2014). Technology tools such as iPads, smartboards, and educational websites can encourage students to stay engaged and on task, as a result, instructional technologies such as interactive simulations and mobile devices have become more common in education (Vickrey, Golick, & Stains, 2018). In this chapter, an explanation of the background to the problem, theoretical framework, a review of research literature, and a summary will be addressed.

Background to the problem. The 21st century requires students to comprehensively have a “science and technology skill” (Zahara & Atun, 2018). Teachers have different

perspectives when it pertains to integrating technology into the classroom. Some teachers may feel that they have not received adequate or proper training to successfully integrate technology into their classrooms (Hsu, Wang, & Runco, 2013). Technologies such as Smartboards, tablets, laptops, and Elmo's are a few resources that have taken education to a greater height, but these resources may not always be readily available. Integrating technology in the science classroom can help support many teaching goals. However, research indicates that teachers need confidence in using technology to effectively integrate it into classrooms (Aljuzayri et al., 2017).

The concept of integrating technology into the classrooms has encouraged many teachers to find ways to teach using technology in a manner that will affect students and their learning. The integration of learning technologies into courses offers potential affordances such as individualized learning, flexibility over both time and space, enhanced access to learning resources, improved support of course content and improved efficiency (Aljuzayri et al., 2017). A close relationship exists between technology and constructivism, the implementation of each one benefiting the other (Gilakjani, Leong, & Ismail, 2013).

Computer self-efficacy, personal technology use, positive teacher attitudes, beliefs towards technology and access to professional development in the computer technology area are significant in motivating teachers to use technology. Integrating technology into instruction can be beneficial to the teachers as well as the students if utilized properly (Gilakjani et al., 2013). Technology paves multiple pathways for individualized learning by boosting learning technology, creating opportunities for production, and enabling differentiation of learning (Hunter, 2017).

Access to technology is an important first step in the digital conversion of school systems; however, for the conversion to be successful, it is critical to move the focus beyond

technology itself, to how technology enables teaching as well as learning (McKnight et al., 2016). Successful technology integration is the key to prepare students to be technology savvy, retain information, and to make learning interesting for them in content areas to include science and math. The technological education system is constantly changing; therefore, a technology enriched learning environment should be created that enables students to manage their own learning (Tucker, 2014). Technology can accelerate progress and deliver the breadth of skills that all young people need to be successful today as well as in the future (Winthrop, Williams, & McGivney, 2016). Biju (2017) stated that technology has evolved from mere internet to wearable technology, which can bring tremendous modifications in the teaching-learning.

The effect that technology has had on education can be viewed from many perspectives. Teachers' experiences with technology can significantly influence how frequently they integrate technology into their classroom. Many factors appeal to teachers to use computer technology in their classrooms (Gilakjani et al., 2013). Research showed that factors such as computer self-efficacy, personal technology use, positive teacher attitudes and beliefs towards technology appeal to teachers to use computer technology (Gilakjani et al., 2013). The teacher's perspectives can give insight into the positive effects that integrating technology has had on their students in helping them to increase their achievement levels. Technology integration in science classrooms can be utilized as a resource to support a variety of instructional methods. Students can give an insight into how implementing technology has sparked increased interests in disciplines such as science. There is a common focus on raising student achievement while integrating technology as a tool (Costley, 2014). The innovative use of educational technologies can lead to significantly better results on examinations, indicating improved learning outcomes, in addition to improvements in problem solving skills (Markova, 2014).

Conceptual Framework

For this study, the conceptual framework was drawn from the TPACK model that was developed by Mishra and Koehler (2006) as a way for teachers to integrate technology into their classroom. The TPACK model is a way to understand the relationship between technology, students, and the teacher. Additionally, the constructivist learning theory was used in this study as the theoretical framework. The focus of this study was to gain an understanding of how secondary science teachers and adult secondary science students enrolled in a high school program at a local community college located in North Carolina perceive the use of technology in a science curriculum to influence achievement levels.

TPACK model. Teachers have been challenged, now more than ever, to integrate technology into their teaching. They face considerations of what technology to use, how to use it and how to fit it within contextual constraints such as school policies and curriculum (Walsh, 2017). The Technological Pedagogical Content Knowledge (TPACK) framework is a conceptual tool that has been used in studies that consider integrating technology into the classroom. The TPACK framework developed by Mishra and Koehler (2006) describes how teachers' understanding of technological knowledge (TK) along with content knowledge (CK) and pedagogical knowledge (PK) are integrated into their teaching (Sheffield et al., 2015). It is a better way to integrate technology into the classroom and into teaching to provide students with a more meaningful learning experience. The relationship between the individual components of the TPACK framework—the interactions, connections, and affordances—is crucial for the effective integration of technology into the teaching and learning environment (Sheffield et al., 2015).

The TPACK framework identifies categories of knowledge that teachers need to teach their students a subject, teach effectively, and use technology within the classroom. The TPACK model has been employed to “unpack” the complexities of teaching with technology (Foulger et al., 2015); therefore, it plays an important role in integrating technology in secondary science to increase student achievement levels. Understanding the components that contribute to designing the TPACK model can help teachers develop instructional strategies and skills that will be appropriate for learners. The TPACK model reemphasizes the importance of integration for a meaningful teaching-learning process (Biju, 2017).

The TPACK framework has significantly influenced theory, research, and practice in teacher education and teacher professional development and the TPACK model emphasizes how the connections among teachers' understanding of content, pedagogy, and technology interact with one another to produce effective teaching (Koehler, Mishra, Kereluik, Shin, & Graham, 2014). The TPACK model has had a tremendous influence on research and practice within the education system by focusing on the content and how teachers teach the content by means of technology. The TPACK model is an essential element in the education system because it incorporates the growing demand for the use of technology and fosters the need for students to be innovative and connected to their learning process.

TPACK is an influential model that has the potential to encourage teachers to think beyond technology as an add-on and consider how technology supports the contents being taught, and how pedagogy might change when teaching with technology (Walsh, 2017).

Technology integration not only involves technology but utilizing technology for the benefits of students' learning in ways that can enhance instruction while improving student learning at the same time. There is a necessity to frame teaching in a more integrated and meaningful way. The

TPACK model is a framework that accomplishes that by integrating teaching and technology in a critical way (Maor, 2013). In K–12 education, the TPACK framework has been used widely to understand, assess, and support teachers' knowledge of and proficiency in integrating technology with pedagogy and subject matter (Vickrey et al., 2018).

Constructivist learning theory. Integrating technology is a strategy that enables students to innovative in their learning process. The central premise of constructivism is the idea that learners can create new understanding by actively building upon prior knowledge and experiences (Yoders, 2014). Yoders (2014) also mentioned that Vygotsky had many themes associated with his work with one key theme being the Zone of Proximal Development (ZPD). Vygotsky described the ZPD as the difference between what the learner can do either with or without assistance or guidance (Yoders, 2014). Students placed in a learning environment in which technology is integrated is a way to enable them to be innovative and to be a part of cooperative learning, which is a foundation of constructivism.

The constructivist learning theory, which refers to the idea that learners construct knowledge for themselves, can have a positive impact on online-learning environments (Miller & Ballard, 2017). Learners create meaning as internal representations based upon their experiences, rather than acquiring meaning directly from external sources (Yoders, 2014). Implementing the constructivist learning theory provides students with the opportunity to be responsible for their learning as well as to be engaged in their learning. The constructivist learning theory is a means of motivation for students to be more involved with their overall learning process, which in turn could help the students to acknowledge their individual skills. Constructivist learning environments have the potential to create a positive learning place that students can utilize a variety of learning tools and information resources. The collaborative

classroom environment fosters the degree of student participation, which is at the center of constructivist theory (Aly, 2014).

Constructing knowledge is the start of cognitive development. Two key constructivist concepts that are an extension to Vygotsky's Zone of Proximal Development are scaffolding and cognitive apprenticeship. Scaffolding is an educational technique that helps the learner close the gap in cognitive ability found in the Zone of Proximal Development (Schunk, 2012).

Scaffolding is a technique in which the learner receives high levels of support that decrease as they accomplish difficult learning goals. As technology is integrated into the science curriculum students may require a high level of support until they grasp the concept of learning context through technology. Scaffolding enables the learner to learn difficult concepts or tasks that might otherwise not be obtained by the learner alone. Integrating technology in the classroom may require support or guidance when first introduced but as time goes on the level of support may decrease as the students grasp the concept of the contexts.

Yoders (2014) described cognitive apprenticeship as the transmission of expert knowledge to a novice in a gradual manner by way of specific processes such as task or problem modeling and provision of performance feedback. As technology is integrated into, the classroom is important to get feedback from not only from the students but from the teachers as well. Scaffolding and constructive apprenticeship may be useful in helping students to learn complex science concepts. Scaffolding techniques in computer-based learning environments and other technologies such as simulations and Web-based learning systems support self-regulated learning and metacognition (Yoders, 2014).

Review of Research Literature and Methodological Literature

Technology has changed the way that educators teach as well as the way that students learn. Many learning theories can be used to apply and integrate this technology more effectively (Gilakjani et al., 2013). New approaches for teaching and assessing scientific inquiry and practices are essential for guiding students to make the informed decisions required of an increasingly complex and global society (Stone, 2014). The integration of technology in a high school science classroom may improve achievement levels of students in science because it will give them an alternative resource to gain knowledge of the content material. There is a sense of urgency to improve achievement in American Science, Technology, Engineering, and Mathematics education, which is evident by the massive educational reforms that have occurred in the last two decades within STEM education disciplines (Kelley & Knowles, 2016).

Many STEM-based curricula use interdisciplinary projects with the goal of helping students see connections across disciplines through long-term engagement in tasks that require authentic problem solving and application (Lesseig, Slavit, & Nelson, 2017). Therefore, science educators can benefit from a STEM education conceptual framework to effectively integrate technology into their classrooms. Teachers have the responsibility for other tasks of ensuring that their students are properly equipped with the knowledge that they need to be prepared for a technology savvy society. Lesseig et al. (2017) found that to meet the demands of our increasingly technological society, students need to develop the ability to think critically; to analyze and solve complex, real-world problems; and to find, evaluate, and use appropriate learning resources. Technology allows students to find information easily but well-trained teachers using technology effectively as a tool supports students to think critically (Vrvilo, 2018).

This present study explored how high school science students and secondary science teachers experienced and practiced technology. The effectiveness that technology has had and will have on high school students is an important step in discovering which strategies and methods have been successful, therefore effective instruction in STEM concepts relies on the use of effective instructional methods (Smith, Rayfield, & McKim, 2015). The researcher synthesized the literature for this study by exploring themes that were significant to the research topic. The following themes emerged from the literature: perceptions of technology use, science technology integration in high school, achievement levels with technology, benefits of technology integration in science, and challenges.

Perceptions of technology use. Literature was reviewed pertaining to the topic of perceptions of technology use in science. However, Chen (2012), Mundy, Kupczynski, and Kee (2012), and Kim, Kim, Lee, Spector, and DeMeester (2013) showed that students and teachers had positive perceptions when technology was used as a learning tool to integrate technology into the high school science curriculum. Technologies such as PowerPoint are used with regularity, online and hybrid courses are becoming commonplace, and additional devices such as personal response units (PRUs) or “clickers” are being implemented in classrooms nationwide (Meehan & Salmun, 2016). The developments and utilization of these technologies have prompted educators to discuss the pros and cons of using technology in the classroom. Teachers and students may perceive the idea of integrating technology into the curricula differently. Hervey, cited by Jones (2017), found that teachers’ attitudes about technology as an instructional tool greatly influenced the ways they used technology in their classes. The teachers' perspectives were taken into consideration because their beliefs about technology tend to influence how they utilize technology in their classrooms.

A study was conducted to analyze teachers' perceptions of technology use in the classroom by surveying those who participated in a program called TeachUp! (Mundy et al., 2012). Digital Opportunity Trust USA Inc. (DOT USA) developed the program. The results showed that teachers who were part of DOT USA's TeachUp! Program perceived a significant increase in the areas of student engagement, student excitement, and student acceleration of learning and student proficiency in computer technology (Mundy et al., 2012). Receiving technology skill training is a key component to fully experience the possible effects that technology can bring to the classroom.

Gaining an insight into teachers' perceptions about integrating technology into the classroom was important in this study because teachers are the facilitators of instruction for the students. Technology continues to enable teachers to engage their students in ever-increasing ways (Smith, 2013). Online tools for learning can make education more democratic, allowing a wider variety of students to have a voice. With more technology exposure for students and more professional development for teachers to hone their acquired teaching methods, technology may be the catalyst needed for school districts to help their students achieve at higher levels (Harris et al., 2016).

Science technology integration in high school. Technology integration can be a useful tool in education to expand students' critical thinking process, problem-solving skills, and increase their performance in various subject areas. Educational technology refers to a variety of technology-based programs or applications that help deliver learning materials and support the learning process in K–12 classrooms to improve academic learning goals (Cheung & Slavin, 2013). Science, technology, engineering, and mathematics is also known as (STEM) education

is a vital issue in education. Becker and Park (2011) noted that research shows that integrative approaches improve students' interest and learning in the STEM.

It is important for students to be knowledgeable of the STEM to better prepare them for the global economy. Ever-advancing technology has transformed our educational system; education and technology are a great combination if used together with the right reason and vision (Host, 2015). With the importance of technology in education, teacher training and professional development have greatly emphasized technology integration (Kim et al., 2013). Technology has a way of sparking students' interest whether it is an electronic game, video, or even websites. Creating projects that will encourage students to collaborate will be an effective measure of learning.

Internet research, virtual manipulatives, and multimedia resources allow students to explore unanswered questions. Creation activities enable the students to be active partners in constructing learning experiences in the classroom and beyond (Blair, 2012). The use of technology has created new opportunities within the traditional classroom but has also served to expand learning experiences. Applying technology applications has the capability to encourage and motivate students to take their learning experiences to higher levels.

Technology has transformed education, affecting how students acquire the skill sets needed to prepare for college and a career and how educators integrate digital technological instructional strategies to teach (Delgado et al., 2015). A review was done to examine research on the effects of educational technology applications on mathematics achievement in K–12 classrooms (Cheung & Slavin, 2013). In comparison to previous reviews, the review on the effects of educational technology applications on mathematics achievement in K–12 classrooms

applied consistent inclusion standards that focused on studies that met high methodological standards (Cheung & Slavin, 2013).

Achievement levels with technology. Technology can open windows to a broad range of information and knowledge for students of all ages. Research on the effectiveness of technology in education on student outcomes have been monitored for more than 20 years; the integration of technology into instruction has positive effects on student achievement (International Society for Technology in Education (ISTE), 2008). Host (2015) stated that technology used properly can assist students to acquire the skills they need to thrive in the complex, highly technological knowledge-based economy. For technology to help increase student achievement levels it must support four key components of learning: active engagement, participation in groups, frequent interaction, and feedback and connection to real-world experts (Host, 2015).

Students should be intellectually challenged in order to reap the benefits that the integration of technology can bring to the curricula; therefore, technology integration can be a useful tool in education to expand students' critical thinking process, problem-solving skills, and increase their performance in various subject areas. Liao, Liao, Chen, and Liao (2016) investigated the effects of integrating technology into electronics curriculum teaching. Two subject groups were divided into a control group and an experimental group. The control group was taught by a traditional teaching approach and the experimental group was taught with the integration of technology. The experimental group demonstrated a significantly higher effect than the control group regarding their cognitive skills and enhanced their learning effects (Liao et al., 2016). For student performance to approximate student potential, students need access to a

constantly evolving array of technological tools and activities that demand problem-solving, decision-making, teamwork, and innovation (Blair, 2012).

Technology has created a pathway for educators to teach and for learners to learn. Technology provides students with an alternative method to acquire knowledge of their content material. The urgency to improve student achievement has prompted a massive educational reform in science, technology, engineering, and mathematics (Kelley & Knowles, 2016). The innovative use of educational technologies can lead to significantly better results on examinations, indicating improved learning outcomes, in addition to improvements in problem solving skills (Markova, 2014).

Benefits of technology integration in science. A generation of students has been given the name "digital native," meaning that they are knowledgeable about technology and are familiar as to how the technology works. The term "digital native" became significant in education in 2001 when Prensky claimed that educational systems were no longer meeting the needs of its digital native students. Technology occupies considerable time in a student's life.

Integrating technology can encourage students to be critical thinkers and possibly drive students to want to learn more about content areas such as science and math. Providing multiple channels for students to access knowledge could be a gateway to student success. Use of technology in educational settings effectively requires change in pedagogical beliefs, attitudes, and practices (Vatanartiran & Karadeniz, 2015). With the world literally at their fingertips, today's students need teachers and administrators to re-envision the role of technology in the classroom (Blair, 2012). A successful digital conversion for classrooms is not determined by technology, but by how technology enables teaching and learning (McKnight et al., 2016).

Constantly providing students with a variety of technological tools as resources for learning can increase student performance.

Technology may increase a student's motivation to retain and learn new information by allowing them to be engaged on a completely different level than they have ever before as Harris et al. (2016) found. Motivation is an essential element in education because it can be used as a driving force that pushes students to want-to-want to learn more. Motivation can inspire students to achieve goals and to be confident in themselves. Information technology integrated into teaching provides multiple channels of stimulation and allows students to use various senses in learning, creating a multi-intelligence learning (Liao et al., 2016). Gilakjani et al. (2013) noted that technology provides many new opportunities for issues like learning styles, student-centered instruction, and promotion of higher-level thinking not to mention that it provides the students with an innovative approach to learning.

Students can learn according to their abilities and needs; it allows them to work at their own pace (Cox, 2017). The use of technology allows teachers to truly differentiate and tailor instruction to meet the needs of their students (Harris et al., 2016). As school districts around the country consider investments in technology in an effort to improve student outcomes, a report from the Alliance for Excellent Education and the Stanford Center for Opportunity in Education (SCOPE) finds that technology- when integrated properly can produce significant gains in student achievement and boost engagement (Hammond, Goldman, & Zieleszinski, 2014). Integrating technology into the classroom will offer students an effective way for them to be engaged and exposed to a variety of learning tools.

Technology can be viewed as a pathway for teachers to connect with their students. Subjects that students find difficult or challenging can be delivered through technology in a way

that they can grasp a better understanding of it. Science educators can take advantage of the inquiry-based curriculum through technology to improve the achievement levels for their students. IT Trade Association CompTIA, as cited by Cox (2017), reported about 75% of educators think that technology has a positive impact on the education process.

Implementing technology gives teachers time to work with students individually by being able to focus on their strengths. Technology can benefit teachers by enabling them to reach their students through interactive learning and to explore and create content as well as learning the material. Teachers will be able to enhance their instruction by explaining concepts, coordinate student discussions and promote higher-level thinking through technology. Technology can extend the boundaries of traditional pedagogies within the classroom.

Challenges. Teachers may feel that they do not have an adequate amount of technological resources in the classroom to properly implement it into their lessons. Lack of technology leadership and technology integration plans are important obstacles to using technology effectively in schools (Vatanartiran & Karadeniz, 2015). The number of technological resources that are available can depend on things such as the budget. The integration of technology in teaching is still challenging for most teachers, even though there has been a historical growth of Internet access and available educational technology tools in schools (Guzey & Roehrig, 2016). A major challenge faced by teachers in general, and particularly science teachers, is that of constructive integration of technology tools to improve the process of learning and its assessment (Biju, 2017).

Integrating technology into the curriculum may be a challenge for some schools due to lack of resources, budget cuts, and lack of proper technological training for the teachers. Traditional school cultures are challenged with the invasion of technology into school settings,

sometimes mandatorily from top to bottom (Vatanartiran & Karadeniz, 2015). Teachers who do not feel as if they are knowledgeable in effectively using technology may be hesitant about introducing technology as a method to deliver instruction. Research shows that financial constraints and the need to change teaching styles can all function as hurdles for educators attempting to incorporate technologies into learning and teaching (Crompton, 2013). The cost, infrastructure, and technology development in schools across the country are not the same; therefore, the financial constraints that school districts and states are under can make immersing technology even more difficult (Harris et al., 2016).

Adapting to change may be an issue that people, in general, find difficult to deal with. Teachers who have not had a lot of experience in utilizing technology for reasons other than personal reasons may find it hard to incorporate technology into teaching strategies that they previously did without digital technology. Issues such as access, time, and lack of professional development can also pose a challenge to properly integrate technology into the classroom (Crompton, 2013).

Having access to technology may be a problem that schools may face especially if there are limited amounts such as having smartboards or laptops that the classrooms must share. Learning how to properly utilize technology takes time to learn especially if a teacher is not familiar with it. Lack of vision can also be a challenge if there is not a strong administrative vision supporting the use of technology. Professional development can have a negative effect if the training lacks a connection to actual classroom practice (Crompton, 2013).

Review of Methodological Issues

Numerous methodological issues and strategies were explored to ensure that quality and relevant literature was reviewed on the experiences and practices of teachers and students with

technology in the science curricula. Peer reviewed journal articles and books were among the resources that were reviewed to gain insight into previous studies that focused on technology integration in the classrooms. Through the search process, numerous peer reviewed journal articles or books published between the years of 2012–2019 were discovered to be relevant for the study.

Methods for conducting educational research were reviewed and discussed in the literature. There were three methodological approaches reviewed in the literature to gain an understanding of the experiences and practice that secondary science students and secondary teachers have had with technology integration in science classrooms. The three methodological research methods that were reviewed were quantitative research, mixed method research, and qualitative research.

The quantitative research method uses numerical data to quantify a problem. In a quantitative research method, measurable data is used to formulate facts and can be used to uncover patterns in research. A few studies relevant to this research used the quantitative research method. Aljuzayri et al. (2017) conducted a quantitative descriptive study with a four-point Likert scale survey design. The Likert scale survey was used to collect self-reported confidence data from 40 practicing high school science teachers in the Midwest region of the United States (Aljuzayri et al., 2017). This study used a survey to collect data for the computation of basic descriptive statistics expressed as percentages. An online anonymous Qualtrics Survey was used as the research method to gather four-point Likert scale data on science teacher confidence with the use of various forms of hardware and software technologies in their classrooms (Aljuzayri et al., 2017).

Another methodological approach reviewed was the mixed method research method. This method of inquiry was a combination of quantitative and qualitative research methods (Creswell, 2014). Coyne et al. (2017) conducted a mixed method research study that was designed to answer the following research questions:

1. Is technology important to pre-service teachers?
2. How much technology did pre-service teachers observe during their field experience observations in the K–12 classrooms?
3. How prepared do pre-service teachers feel in utilizing technology in the K–12 classroom?

This research used an online survey, in which the responses included a 4- and 6-point Likert scale and seven open-ended questions. Descriptive statistics were used to analyze the data to include mean scores, standard deviations, and percentages (Coyne et al., 2017). Themes and patterns were identified by coding the open-ended questions.

The qualitative research method was another methodological research approach reviewed in the literature. Qualitative research studies are a correlation between data collection and data analyses. Numerous studies were examined during the review of literature that used the qualitative research method. Pringle, Dawson, and Ritzhaupt (2015) conducted a qualitative study to examine how teachers involved in a yearlong technology integration initiative planned to enact technological, pedagogical, and content practices in science lessons. This study used observations and lesson plans as proxies for teacher practice (Pringle et al., 2015). Teachers in this study were engaged in a professional development program that enabled the teachers to collaborate and engage in learning experiences.

Methods from a variety of reviewed literature were examined to determine the best methodology for this present research study. Reviewing the literature allowed the researcher to discover the strengths and weaknesses of the methods as well as limitations. The qualitative research method deemed to be the most appropriate for the study. The qualitative research method was a method for investigating and comprehending the meaning people or groups attribute to a social or individual problem (Creswell, 2014). Interviews, student focus group, and a faculty group were used to inquire about the experiences and practices that the student participants and teacher participants have experienced with technology.

Synthesis of Research Findings

The advancement of technology has changed the way people live, interact, communicate, and conduct business. Technology will continue to play a significant role in education by producing innovative and student-centered learning environments therefore, further research on how secondary science teachers and students practice and experience technology is necessary. Martin and Carr (2015) proposed that classroom integration of technology refers to the actual use of several types of technology resources. Teachers who frequently integrate technology understand the value of technology to students' academic careers (Harris, 2016).

Classrooms with technologically confident teachers had higher student engagement and higher self-efficacy in using technology (Aljuzayri et al., 2017). Technology has not only affected the amount of information available to students, but it has also transitioned the types of skills students need to identify quality information and where learning takes place (Delgado et al., 2015). To develop engaged citizens and to continue to be globally competitive, schools must integrate 21st century competencies throughout the curriculum including the development of critical thinking, complex problem-solving, collaboration, and multimedia communication (U.S.

Department of Education, 2015). A plethora of literature that was relevant to the topic of how teachers and students experience and practice technology in the classrooms was reviewed. The literature was synthesized around themes explored significant to the research topic that examined the perceptions of technology use, science technology integration in high school, achievement levels with technology, benefits of technology integration in science, and challenges of using technology.

Critique of Previous Research

A plethora of previous literature was reviewed and critiqued to help support this study. Delgado et al. (2015), Vickrey et al. (2018), Harris (2016), Coyne et al. (2017), Aljuzayri et al. (2017), and Gilakjani et al. (2013) are a few studies that impacted and supported the present study. However, none of the studies solely focused on how secondary science students and secondary science teachers in a high school program at a community college in NC experienced and practiced technology.

Delgado et al. (2015) focused on the integration, resources, and effectiveness of technology in K–12 classrooms. The profound and rapid change that technology is having on education is a key factor in how students acquire their knowledge and how teachers integrate technology. This study was important to this present study because the experiences and practices that the students and teachers have had with technology was the focus of the study. Delgado et al. (2015) presented a critical review of the transitions that technology integration has made over the years; the number of resources and the amount of funding that has been allocated to immerse school with technology; and the conflicting results presented on the effectiveness of using technology in education.

Through a synthesis of selected themes, Delgado et al. (2015) addressed how the digital revolution has changed the way that people obtain information and that more information than any one person could acquire is available via the Internet. The researchers acknowledged that there are still disparities in the availability of technology. One of the biggest changes occurring in the digital age is the movement to increase access (Delgado et al., 2015). The authors researched the plethora of technological instructional strategies that were being used to integrate technology into K–12 classrooms.

Vickrey et al. (2018) concentrated on the instructional technologies that have become more common in higher education. This study explained how the instructional technologies addressed the components of a broader Technology Pedagogical Content Knowledge (TPACK) framework that targeted the meaningful integration of technology in instructional practices (Vickrey et al., 2018). The authors identified important constructs such as students' perceptions of technology that are addressed in agricultural sciences literature but not currently represented within the TPACK framework (Vickrey et al., 2018).

The authors' objective was to use the components of the TPACK framework to characterize previous research on the integration of technology, pedagogy, and content in agricultural sciences. Specifically, Vickrey et al. (2018) were interested in understanding the ways technology assists in students' learning and students' perceptions of technology. These authors provided insight into the correlation technology and content.

Harris (2016) focused on the effective integration of technology in schools' curriculum. Harris (2016) recognized that technology has become a fundamental part of society's daily lives to include education. This research addressed how students need technological and informational skills to compete in the 21st century.

Coyne et al. (2017) were concerned with the barriers that that teachers face while trying to integrate technology in the classrooms but did not view the barriers that students may face with technology. The authors agreed that technology plays a crucial role in our society; therefore, this study was relevant to this present study. Coyne et al. (2017) discovered themes that emerged from their study; technology is important to incorporate in the K–12 classroom and that teachers have a relatively high level of preparedness in using technology in the classroom but have limited pedagogy knowledge warranting the need for teacher education programs to increase effective instruction in technological pedagogical content knowledge.

Coyne et al. (2017) addressed how a gap exists between learners who are using technology in active, creative ways to support their learning and those who predominantly use technology for passive content consumption. Conducting education classes on integrating technology can help teachers to gain knowledge and skills that they can utilize in their classes and assist them with learning how to integrate technology into their lesson plans and teaching. Coyne et al. (2017) focused on how vital it is to implement teacher preparation programs that prepare teachers to effectively integrate technology into their classrooms.

Although Aljuzayri et al. (2017) examined high school teachers' confidence with classroom technology integration, they did not view the confidence of the students with classroom technology integration. The confidence of the student with technology being integrated into the classroom is important to the success of the student. Aljuzayri et al. (2017) indicated that teachers need confidence in using technology to effectively integrate it into classrooms.

Aljuzayri et al. (2017) used a quantitative descriptive study. A four-point Likert scale survey was used in the study to collect self-reported confidence data from 40 practicing high

school science teachers in the Midwest region of the United States. Aljuzayri et al. (2017) revealed that 100% of the science teachers reported confidence in using the internet, and 90% or more reported confidence with computers, email, and power point. The authors' study provided information for professional development opportunities that focus on improving confidence in classroom technology use by addressing skills and motivation for science teachers.

Gilakjani et al. (2013) focused on teachers' use of technology and constructivism. The authors discussed learning theories that can be used to apply and integrate technology more effectively. Although Gilakjani et al. (2013) explained whether technology by itself can make the education process more effective or if technology needs an appropriate instructional theory to indicate its positive effect on the learner, it did not focus on a particular age of students.

Gilakjani et al. (2013) concluded that there is a close relationship between technologies and constructivism.

Chapter 2 Summary

Chapter 2 provides the conceptual frameworks for this study. Integrating technology to increase student centered learning environments in secondary science is an important topic as technology-enhanced academic environments are steadily on the rise in the education system. Access to computers and their corresponding technologies such as the internet and popular software programs have allowed these tools to enter the 21st century classroom to further the efficiency and effectiveness of education (Meehan & Salmun, 2016).

The significance of this study will be to suggest strategies and methods that teachers can integrate into their lessons through technology to encourage and support student success.

Challenging the 21st century requires students to comprehensively have a science and technology skill (Zahara & Atun, 2018). Technology has been a phenomenon to help motivate,

differentiate, and allow students to achieve and excel in ways that they have never been able to do before (Harris et al., 2016). Interrelated components have been explored to gain a better understanding of how the integration of technology can have the potential to increase high school students' achievement levels in science. Components such as the perceptions of technology use, science technology integration in high school, achievement levels with technology, benefits of technology integration, and challenges have been researched and explored to gain a better insight on technology integration.

Many studies of TPACK, such as Graham (2011), Harris and Hofer (2014), Koh, Chai, and Lee (2015), have led teachers, school leaders, education systems and policymakers to explore and rethink ways to enact technology integration in education settings. Science educators can benefit from a TPACK framework and it can serve as a guide that shows them how to effectively integrate technology. Within the framework, teachers' professional development of technology integration should go beyond just technology; the integration of technology, pedagogy, and content is emphasized (Lee & Kim, 2014). TPACK explains the set of knowledge that teachers need to teach their students content; therefore, it is important to utilize this theory in this study. Another theory that is beneficial to this present study is constructivist-learning theory. Constructivism states that learning happens in contexts and that learners form much of what they learn and understand as a function of their experiences in the situation (Gilakjani et al., 2013).

Technology has created a pathway for educators to teach and for learners to learn. The urgency to improve student achievement has prompted a massive educational reform in science, technology, engineering, and mathematics (Kelley & Knowles, 2016). Reviews of literature enabled the researcher to explore the importance of discovering research that supports the idea of

technology being able to effectively increase achievement levels for high school science students. Chapter 3 will provide an overview of the research questions, the purpose and methodological design, and the ethical procedure for the qualitative research study.

Chapter 3: Methodology

Introduction

There is a growing expectation that the education system should be equipping students for life in what has been termed the knowledge society (Barter, 2013). The aim of the qualitative case study was to gain an understanding of how secondary science teachers practice technology and how adult secondary science students experience technology in a high school program at a local community college located in North Carolina. The researcher will use the constructivist learning theory and the TPACK model to build the framework for the study.

For secondary education, it was important to understand the technological tools, strategies, and methods that science students and science teachers have used in the science curriculum. Interviews, student focus group, and a faculty focus group were used in this study to explore the experiences and practices with technology that science students and science teachers in a high school program have had. The researcher's use of focus groups was a deliberate attempt to surface each student's perspective in the sample group (Yin, 2018).

Chapter 3 will provide an overview of the research questions, the purpose and methodological design of this study. This section provides the validation of the study as well as the methodological sections, which are subdivided into the research population, sampling method, and participants. This chapter provides an explanation of the data collection and process of coding, which includes the instrumentation and data analysis procedures. Ethical procedures will be discussed as a subsection under the validation of this study.

Research Questions

The study focused on how secondary teachers and adult secondary science students enrolled in a high school program at a local community college experienced and practiced the use of technology in science classes. The following research questions guided the study:

1. How do secondary science teachers practice technology in a science curriculum in a high school program at a community college in NC?
2. How do adult secondary science students in a high school program at a community college in NC experience technology in their science curriculum?

The research questions were addressed using a triangulation of individual face to face interviews and focus groups.

Purpose and Design of the Study

The purpose of this qualitative case study was to explore how secondary teachers practiced technology and how adult secondary science students' experience technology in a science curriculum. Faculty and student access to technology is almost ubiquitous in education with nearly all institutions providing email accounts; employing learning management systems; and providing some level of wireless access in classrooms, and research areas (Dahlstrom, Brooks, & Bichsel, 2014). A growing number of studies have been conducted to understand learning and teaching activities in online learning environments (OLEs) and to design effective OLEs for meaningful learning in higher education (Cho et al., 2015). Understanding the firsthand experiences that secondary teachers and adult secondary science students have had with technology within the classroom will help the researcher to gain better insight into this study.

This case study design was used for the study to address the research questions. A case study provides context-dependent knowledge and accounts of practice that are drawn together

from the voices, actions, interactions, and creations of the carriers of practice in a site (Miles, 2015). A qualitative case study design investigates the experiences of individuals through explanations that are presented by the people involved (Van Manen, 2014). This case study involved collecting data through interviews of secondary science students, student focus group, and a faculty focus group. A qualitative research study approach was chosen to conduct the study in the form of focus groups and interviews to gather data on the impact of technology integration within the classroom.

Some of the characteristics of qualitative research include taking place in a natural setting, using multiple methods that are interactive and humanistic, emerging data rather than prefigured data, and being fundamentally interpretive (Campbell, 2014). Qualitative research involves asking participants about their experiences of things that happen in their lives (Austin & Sutton, 2014); therefore, gathering information on the perceptions, practice, and experience of teachers and students in regards to the implementation of technology is vital in conducting research on the effectiveness of technology. Murphy (2016) noted that the use of technology in the high school classroom can have a positive effect on the engagement of the student and thus improving mathematics understanding and test scores. The complexity situated in analyzing and re-presenting practice through case study research, along with the connections that the reader makes between the case and their experiences, is powerful in working to inform everyday educational practice (Miles, 2015). The information gathered in this study may assist teachers in exploring ways that technological tools can be used to improve students' success in the classroom.

Population and Sampling Method

The sample in this qualitative case study was composed of six secondary science teachers and 14 secondary science students enrolled in a high school program at a local community college located in North Carolina. Six of the 14 adult secondary science students were randomly selected to participate in a focus group. The community college serves approximately 37,000 students with 240 of them being high school students annually through its various Curriculum and Corporate & Continuing Education opportunities. The college has a College and Career Readiness Program that includes Adult Basic Education (ABE), Adult High School (AHS), Compensatory Education Development (HRD), Workforce Preparedness, and College and Career Readiness Student Services. The samples for this study consisted of six secondary science teachers and 14 adult secondary science students aged 18 to 60 years old.

Sampling Method. The selection of this study was based on a technique called purposeful sampling. Purposeful sampling is the deliberate choice of a participant due to the qualities the participant possesses (Etikan, Musa, & Alkassim, 2016). Purposeful sampling is widely used in qualitative research for the identification and selection of information-rich cases related to the phenomenon of interest (Palinkas et al., 2015). The six teachers were secondary science teachers that have had experience in implementing technology in their classrooms. The 14 adult students were between the ages of 18 to 60 who have had experience in using technology as an educational learning tool in their science classes. The purposeful sampling method was used to invite the participants to participate in the study who meet the specific characteristics that the research population will be comprised of. In purposeful sampling the researcher decides what needs to be known and sets out to find people who can and are willing to

provide the information by virtue of knowledge or experience (Etikan et al., 2016); therefore, this strategy was used for this study.

Participants. The participants for this study were a diverse group comprised of six secondary science teachers and 14 secondary adult science students between the ages of 18 to 60 years old. The teachers were faculty members at a local community college that has a College and Career Readiness Program for students to obtain their high school diploma. The teachers and students were from the same academic environment. The role of the researcher in qualitative research is to attempt to access the thoughts and feelings of study participants (Sutton & Austin, 2015). The participants were informed that their participation in the study is voluntary and that their responses to the individual face to face interviews would be kept confidential.

Sources of Data

Researchers use several types of instruments to collect and measure qualitative data (Creswell, 2014). The researcher used interviews, a student focus group, and a faculty focus group to understand the experiences and practices of secondary science students and secondary science teachers with technology in this study. The interviews and focus group protocols provided the researcher with an opportunity to explore the phenomenon being investigated from the perspectives of the students and the teachers in this study.

The researcher gathered data using three distinct methods. The sources of data in qualitative research are comprised of the entire process involved in collecting data in a study, which provides the types of instruments used as well as the dependability, trustworthiness, and rigor of the study (Creswell, 2014). Interviews, faculty focus group, and student focus group served as the sources of data for this study. Qualitative interviewing techniques help researchers to observe and record a subject's unique perspective or experience as it relates to a particular

issue. Interviews with the students and teachers enabled the researcher to obtain complex and in-depth data that questionnaires may not (Meier, 2018).

Data gathering is crucial in research, as the data is meant to contribute to a better understanding of a theoretical framework (Etikan et al., 2016). A purposeful sampling approach was used in this study. Purposeful sampling is widely used to identify and select information that relates directly to the interest of the study in qualitative research. The purposive sampling technique, also called judgement sampling, is the deliberate choice of a participant due to the qualities the participant possesses (Etikan et al., 2016). Purposeful sampling allowed the researcher to gain a broader insight into the teachers' and students' views on technology use in the science curriculum. The notion of purposive sampling was used to indicate that interviewees or participants were selected based on their knowledge and verbal eloquence to describe a group or (sub)culture to which they belong (Gentles, Charles, Ploeg, & McKibbin, 2015).

Approval for this study was sought from the local college and administrators prior to conducting the research study through an email. Once the approval was granted, the community college's database system automatically selected the potential students for the research based on the criteria that were set forth for this study. The criteria were to be between the ages of 18 and 60, and to be a science student enrolled in the Adult High School program at the local community college. The 14 adult secondary science students were randomly selected using purposeful sampling. The 14 adult secondary science students were recruited, and their emails were obtained by using the student Datatel database system. An email was sent to the 14 adult secondary science students and they all agreed to participate in the study. A consent form was signed by each student as they agreed to participate. The consent form included confirmation of

researcher/participant confidentiality. The 14 adult secondary science students were contacted by email to set up a time and date for the interviews.

The individual face-to-face interviews with the adult secondary science students were scheduled after school and held in an office on campus. The researcher scheduled three interviews per day over a two-week period. The interviews (see Appendix B) were recorded using a digital audio recorder and consisted of 13 questions; two open-ended questions, two general questions, and nine questions that were designed by the researcher that enabled a broader insight on the participants' personal experiences with technology.

Included in the interview were two questions that disclosed the participant's demographic data (see Table 1 and Table 2). The interviews lasted 45 minutes-to an hour in duration. As each scheduled interview was completed during the day, the transcripts were transcribed by hand by listening to the recordings. The transcripts were emailed to the participants for member checking. Once the individual face-to-face interviews were finished, six of the 14 participants were randomly chosen to participate in the adult secondary science student focus group. A convenient time and date were set up for both the adult secondary science student focus group and the faculty focus group separately.

The secondary student science focus group was comprised of six students and the participants met with the researcher in the same office as the interviews. The participants were reminded that the focus session would be recorded and then given an overview of the purpose of the study. Each participant was asked to introduce themselves by telling their name and sharing something about themselves. The participants had seven questions (see Appendix C) to discuss with the researcher to gain an insight into their experiences with the use of technology. The

focus session was conducted within a 45-minute period. The transcripts were transcribed by hand and emailed to the participants for member checking.

The school website was accessed to retrieve the six science teachers' email addresses. An initial email was sent to the six secondary science teachers explaining the study and inviting them to participate in the study. The email stated that the participants' participation would remain confidential throughout the study and its publication. The six teachers agreed to participate. A consent form was signed by each teacher once they agreed to participate. The participants were then contacted by a second email to set up a date and time to conduct the focus group interview.

The faculty focus group met on a separate day from the adult secondary science student focus group. The participants were reminded that the session would be recorded and then given a brief overview of the study. Each participant was asked to introduce themselves and to share how many years they had been teaching. Once the introductions were complete the session began. The faculty focus group was asked questions different from the science students focus group that aimed to get an idea of the types of technological resources that have been implemented in their classrooms (see Appendix D). Each population received a series of questions that gave the researcher an idea of their perceptions on technology. The questions were designed so that the answers can be analyzed accurately. Transcripts were completed by hand and emailed to the participants for member checking.

Data Collection

The purpose of this qualitative case study was to explore how secondary teachers practice technology and how adult secondary science students experience technology in a science curriculum. Elo et al. (2014) concluded that it was important to scrutinize the trustworthiness of

every phase of the analysis process, including the preparation, organization, and reporting of results.

The researcher sought approval from the local college and administrators prior to conducting the research study. The school website enabled the researcher to access the six science teachers' email addresses to get their approval to participate in the study. The researcher sent an email to the teachers explaining the study that was being done. The 14 adult secondary science students were randomly selected using purposeful sampling. The students were recruited, and their emails obtained by using the college's Datatel database system. The Associate Vice President of Student Affairs accessed the database system, which automatically selected the potential students for the research based on the criteria set forth for this study. Out of the 14 adult secondary science students, six were randomly selected to participate in a student focus group. There were a variety of ways that the researcher could make a record of what was said during the interview and focus groups. Taking handwritten notes, video recording, or audio recording is a way to record data, but the recordings must be transcribed verbatim before data analysis can begin (Sutton & Austin, 2015). A record was made of the responses from the participants by the researcher taking notes and using a Phillips digital audio recorder. The recordings were transcribed prior to being analyzed.

Interviews. Interviews are the most common format of data collection in qualitative research (Jamshed, 2014). Interviews were set up with the 14 adult secondary science participants as well as with the teachers. The strength of qualitative research lies in the use of interviews which allow qualitative researchers to conduct an in-depth investigation into their subject inquiry, questions were asked that enabled the researcher to have a better understanding of how the teachers and students perceive the use of technology in the classroom. Interviews

with the focus groups provided the researcher with a deeper understanding of how technology is practiced and experienced among the groups. The answers to the questions were evaluated and coded to analyze the data.

In qualitative data analysis, coding is a researcher-generated construct that symbolizes or “translates” data (Vogt, Gardner, Haeffele, & Vogt, 2014). The interviews lasted approximately 45 minutes to an hour long. The interviews were audio recorded which made it easier for the researcher to focus on the interview content and the verbal prompt (Jamshed, 2014). After the individual face to face interviews with the 14 adult learners and the secondary teachers, a designated time was set aside to meet with the faculty focus group that was comprised of six secondary science teachers as well as the student focus group in the conference room at the local community college.

Focus groups. The qualitative case study used two focus groups as a strategy to collect data. Focus groups were conducted as part of a series in which the participants vary but the area of interest was constant (Devault, 2018). A focus group consists of a small group of people, usually between six and nine in number, who are brought together by a trained moderator (the researcher) to explore attitudes and perceptions, feelings, and ideas about a topic (Dilshad & Latif, 2013). One focus group was comprised of six secondary science teachers from the local college and the other focus group was comprised of six adult secondary science students also from the local college.

The first focus group consisted of six secondary science teachers that were employed at the local college in the high school program. The focus group interview provided a natural setting for a relatively homogenous group to reflect on the six questions that will be asked by the researcher pertaining to the participants’ perceptions on the implementation of technology in the

classroom and its effect on achievement levels. The second focus group consisted of six adult secondary science students that are enrolled in the adult high school program at the local college. These focus group participants were asked six different questions from the first focus group that pertained to and were relevant to the study.

The purpose of the focus groups was to collect pertinent information on the experiences and practices of the participants regarding the use of technology in the classroom. A focus group interview aims at collecting high-quality data in a social context which primarily helps to understand a specific problem from the viewpoint of the participants of research (Dilshad & Latif, 2013). Research techniques have their own merits and demerits, but group discussions have some intrinsic worth of expressing the opinions of participants openly (Jamshed, 2014).

Identification of Attributes

The attributes that defined this intrinsic qualitative case study were constructivist learning, curriculum, digital native, modern technology, and technology integration. Students have had different experiences with using technology. Teachers have practiced and utilized a variety of strategies to integrate technology into the classroom. The goal was to gain an insight into the varied experiences that science students have had with technology. The researcher also sought to explore the scope of strategies and methods that science teachers have used with technology in their curriculum.

Data Analysis and Procedures

Qualitative data consisted primarily of words rather than numbers, so, therefore, the results were in textual form. Making sense of the information that was collected through the individual face to face interviews and focus groups was a step towards analyzing the data to answer the research question. The interviews were analyzed by transcribing the responses that

the participants provided. Categorizing or coding data is the crux of qualitative analysis (Morrison, 2014). Sutton and Austin (2015) stated that the researcher must interpret the phenomenon to grasp an understanding of the relationships between the information to glean from the dissimilar sources of data once the analysis of qualitative data has been collected. Coding enabled the researcher to identify themes that correlated and supported the study. Recognizing the correlated themes assisted the researcher in making a connection between technology and science achievement levels.

The coding process consisted of two cycles that assisted the researcher in interpreting the information that was collected from this study. Saldaña (2015) stated that in the first cycle coding, the researcher initially analyzes the information collected and assigns codes to the data. The information that was collected consisted of the answers to the open-ended questions and interview responses that the researcher will conduct with the secondary science teachers and students. The second cycle of the coding process is more complex and requires the researcher to pose more analytical skills to classify, prioritize, integrate, synthesize, abstract, and conceptualize the data while building theory (Saldaña, 2015). The second cycle of the coding process enabled the researcher to classify the experience that the teachers and students have had with technology in the science field. Knowing their experiences positive and negative helped the researcher to establish a common ground among the teachers and students.

Interviews were conducted with the 14 adult secondary science students. The interviews provided the researcher with a deeper insight into how technology is experienced and practiced by the participants. The participants were able to provide the researcher with detailed and firsthand experiences concerning technology and science achievement levels relative to this

study. The questionnaires and interview responses were analyzed to develop a foundation that supported the study.

Limitations of the Research Design

It was imperative that the researcher understood that research designs and collecting data were complex processes and that one may run into circumstances that could affect their research. The following section identified the possible limitations of the study design and qualitative research. Every study, no matter how well it is conducted and constructed, has limitations that relate to the specifics of each methodology and design (Simon & Goes, 2013). This study consisted of 20 participants, which included 14 adult secondary science students and six secondary science teachers from a local community college in North Carolina. This study took place at one location and was delimited primarily to secondary teachers who are employed in the high school program at the local community college and for adult secondary science students that are enrolled in the high school program at the local community college.

This study, which utilized a purposeful sampling method, was useful for the criteria that were required to participate in this study. Purposive sampling is characterized by the incorporation of specific criteria met by the participants at the moment of selection (Padilla-Diaz, 2015). There were a few limitations in this study. Limitations that may have affected this study were the limited number of participants due to the small school enrollment. Another limitation to this study was the time constraints due to the differences in the teachers' schedules. The students also had limited experience with technology regarding achievement scores in science.

The delimitations may have derived from the limitations of this study; for example, the researcher was aiming to focus on the perceptions of technology to increase science achievement levels for secondary students. Focusing on this area of study with only the teachers and students

who were enrolled in the high school education program at the particular education center may have been a possible delimitation factor for this study.

Validation

Qualitative research is primarily exploratory research and it is used to gain an understanding of underlying reasons, opinions, and motivations (Wyse, 2011). The methods that are used to conduct qualitative research vary in their techniques for obtaining information. A solid foundation is necessary for a case study to be valid (Yin, 2014). Validation measurements were used by the researcher that were in line with the qualitative research paradigm. The data and the instruments that were used for the research was checked for accuracy to validate this qualitative research. The methodology chosen for this study was appropriate and answered the research questions. Validity is a key concept in qualitative educational research (Green, 2015). The researcher crosschecked

Credibility. A thorough examination of the information presented in this study ensures the reliability of this study. It is important to take precautions while researching, analyzing, and collecting data for this study to protect the credibility of the information that is discovered and identified during this study. To ensure the validity, reliability, and credibility of this study, a triangulation of different data sources of information was used. Credibility was addressed in this study by providing details of the research process, triangulating multiple data sources, and conducting member checking. Triangulation strengthens the qualitative study by combining various evaluation methods to validate the research (Zohrabi, 2013).

Dependability. A qualitative analysis enabled one to examine the validity and strength of integrating technology in the classroom. Member checking was a method used in this study to ensure the stability and dependability of the data provided. Preserving the reliability and

accuracy of this study is important. The researcher provided the participants with questions that are pertinent to this study and ensure that the participants in this study are qualified participants. The researcher notated the perceptions of both the teachers and the students regarding their perceptions of technology utilization in increasing science achievement levels. The researcher seeks to find ways to bridge the gap of technology integration in high schools and to make suggestions for future research on this topic.

Expected Findings

The expected findings in this intrinsic qualitative study revealed the experiences and practices that science students and science teachers in a high school program have used in the classrooms. The researcher expects to find ways to assist future studies in understanding the perceptions of science students and science teachers towards technology integration in the science curriculum. The researcher also seeks to discover methods and strategies that enhanced student learning, student motivation, student technology skills, boost teacher confidence, and increase the accessibility of technology in the high school program.

Ethical Issues

The participants were required to sign a written voluntary consent form that served as evidence to participate in the study. The participants in this study were comprised of adult secondary science students 18 years of age or older and secondary science teachers. There was not a conflict of interest in the study because the students were not students of the researcher. The researcher considered all the necessary procedures while conducting this study to attempt to avoid any ethical issues that may arise. The participants were comprised of secondary science teachers and students that are enrolled in high school science classes in a local college in North Carolina. Possible risks were considered prior to beginning this study.

No risks, such as physical or mental, were foreseen that could have occurred as a result of the study. Ethical measures were implemented by the researcher which included securing documents in a double locked file cabinet. The participants' confidentiality were always protected throughout the study. Prior approval from the appropriate community college board members, organizational leaders, and chairpersons was secured before the researcher began the study. Pseudonyms were assigned to each of the participants as an extra measure to protect their identity. The ethical guidelines set forth by the Concordia University–Portland Institutional Review Board (IRB) were followed by the researcher.

Chapter 3 Summary

This chapter has provided the researcher with an opportunity to describe the method of organization for this qualitative case study. A qualitative research study deemed to be the most appropriate study because qualitative research is utilized when there is a need for researchers to work with words and images (Aborisade, 2013). The perceptions of secondary science teachers and students are a part of the foundation of this study. Additionally, the use of technology as a resource to increase science achievement levels is the focus of this study. Interviews, a faculty focus group, and a student focus group were used to provide the researcher with an in-depth analysis of how technology is perceived by not only secondary science teachers but by adult secondary science students as well. Examples of the interview and focus group questions as well as the findings from this study will be in Chapter 4. The researcher was able to analyze, organize, and present the findings as groundwork for future studies.

Chapter 4: Data Analysis and Results

Introduction

The purpose of this qualitative study was to explore how secondary science teachers and adult secondary science students enrolled in a high school program at a local community college located in North Carolina experience and practice the use of technology in a science curriculum. The sources of data used in this study included interviews, and faculty and student focus groups. The study was conducted at a local community college in North Carolina. This was delimited primarily to secondary teachers who were employed in the high school program at the local community college. This study was also for adult secondary science students who were enrolled in the high school program at the local community college.

The community college serves approximately 37,000 students with 240 of them being high school students annually through its various Curriculum and Corporate & Continuing Education opportunities. The college has a College and Career Readiness Program that includes Adult Basic Education (ABE), Adult High School (AHS), Compensatory Education Development (HRD), Workforce Preparedness, and College and Career Readiness Student Services. For this study, the sample consisted of six secondary science teachers and 14 adult secondary science students ranging from 18 to 60 years of age. There were a total number of 20 participants that participated in this study.

This study used a qualitative case study research design to answer the following research questions:

RQ 1: How do secondary science teachers practice technology in a science curriculum in a high school program at a community college in NC?

RQ 2: How do adult secondary science students in a high school program at a community college in NC experience technology in their science curriculum?

The research questions were addressed using a triangulation of individual face to face interviews and focus groups.

Chapter 4 is divided into five sections that include a description of the sample, research methodology and analysis, summary of the findings, presentation of data and results, and the chapter summary. The Description of the Sample section presents a description of the research population and participant samples used for the study. The Research Methodology and Analysis Section of this chapter provides a detailed synopsis of the methodology selected for this study.

This section also provides an explanation of how the selected methodology led to the analysis that was used to examine the data collected through the study. The Summary of the Findings Section gives an overview of the themes that were gleaned from the coding of the information that was derived from the responses to the interview and focus group questions. The Chapter Summary serves as the highlights that resulted from the study findings.

Description of the Sample

This single case study was conducted at a local community college in North Carolina. A purposeful sampling approach was used to select the participants for this study. The participant selection was purposefully selected to provide information from the individual interviews, student focus group, and faculty focus group. The recruited sample in this qualitative case study was a diverse group comprised of 14 adult secondary science students ranging from 18 to 60 years of age who were enrolled in the Adult High School Program at the local community college and six secondary science teachers that worked in the Adult High School Program. The

community college's student database system was used to recruit adult student learners who met the criteria.

An initial email was sent to the students who met the inclusion criteria which were: science students who were between the ages of 18 to 60 and enrolled in the Adult High School Program at the local community college to invite them to participate in this study. The student database identified 30 adult learners who were between the ages of 18 and 60 and were science students enrolled in the Adult High School program at the local community college. Fourteen adult learners responded to the email stating their interest to voluntarily participate in this study. The science teachers' emails were accessed through the college's faculty Web Advisor system. An initial email was sent inviting the science faculty to participate in this study. The six science teachers agreed to participate in this study. A second email was sent to the 14 students and the six science teachers that included a consent form. Once the consent forms were returned the interviews were scheduled during March and April 2019. The focus group sessions occurred in April 2019.

The 14 adult secondary science students had some experience with using technology as an educational learning tool in their science classes. Six of the 14 adult secondary science students were randomly selected to participate in the focus group. The sample included seven females and seven males. Thirteen of the participants were in the Millennials age group, who are individuals between the ages of 18 and 35, and one participant was in the Generation X age group, individuals between the ages of 36 and 47.

The six secondary science teachers had some experience in implementing technology into their classrooms. The sample included two males and four females. The years of experience in

teaching varied between each participant. Only one teacher had less than 10 years of experience in teaching. Table 1 and Table 2 indicate the demographics for each teacher participant.

Table 1

Gender Distribution of Secondary Science Teacher Participants

Gender Group	Number of Participants
Male	2
Female	4
Total Participants	6

Table 2

Experience Distribution of Secondary Science Teacher Participants

Years of Teaching Experience	Number of Participants
0–10 Years	2
11–20 Years	3
21–30 Years	0
31 Plus Years	1
Total Participants	6

Research Methodology and Analysis

Yin’s (2014) model was applied by the researcher for analyzing data to this study. Data was analyzed which enabled the researcher to provide an explanation for the study. The goal was to explore the adult secondary science students’ and secondary science teachers’ perceptions of technology and their experiences with technology in the science curricula. The researcher had an intrinsic interest in understanding the experiences and practices that the students and teachers had experienced with technology therefore, the primary focus was to explore and understand this phenomenon.

Analyzing the data from this present study included transcription, coding, and evaluating the data that resulted from the interviews and focus groups. Once the 14 individual student

interviews and focus groups were complete, the researcher transcribed, evaluated, and coded the data. The interviews and focus groups were recorded using a digital recording device.

Following the completion of transcribing the transcripts from the interviews and focus groups, the data analysis process began.

Case study design. A case study design was used for this study to address the research questions. A qualitative case study design approach enabled the experiences of the participants to be investigated through collective data. The data was collected through interviews of adult secondary science students, secondary science teachers, and focus groups. The interviews and focus groups combined the voices, actions, and perceptions of the participants and provided the researcher with information beneficial to this study.

Interviews. The interview protocol guide (see Appendix B) consisted of 13 questions; two open-ended questions, two general questions, and nine questions that were designed by the researcher that enabled a broader insight on the participants' firsthand experiences with technology. To collect data and answer the research questions that guided this study, individual face-to-face interviews were held in the researcher's private office on the main campus of the local community college and conducted with each of the 14 adult secondary science students. The adult secondary science students were asked the questions on the interview protocol guide and their replies were recorded with an audio recorder. Notes were taken as they answered the questions. Included in the interview were two questions that disclosed the participant's demographic data (see Table 3 and Table 4).

Table 3

Generation Distribution for the Adult Secondary Science Participants

Age Groups	Number of Participants
Millennials (ages 18-35)	13
Generation X (ages 36-47)	1
Baby Boomers (ages 48-66)	0
Total Participants	14

Table 4

Gender Distribution for the Adult Secondary Science Participants

Gender	Number of Participants
Male	7
Female	7
Total Participants	14

The average time of each interview was approximately 40 minutes. The interviews were conducted for a total of 9.33 hours. As each scheduled interview was completed, data was collected and transformed into transcripts. The transcripts were transcribed by hand using Microsoft Word and produced 39 double-spaced transcript pages. All the data that were collected were kept securely in a double locked file cabinet located in the researcher's office. This was done to ensure the confidentiality of the participants and was only accessible for the researcher. To protect the identity of the student participants, pseudonyms were assigned; P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, and P14 were used to distinguish the participants.

The transcripts were emailed to the participants for member checking. No changes had to be made to the transcripts. Once the individual face-to-face interviews were finished, six of the 14 participants were randomly chosen to participate in the student focus group. A convenient

time and date were set up for both the adult secondary science student focus group and the secondary science teacher focus group separately.

Student focus group. The student focus group (focus group 1) was comprised of student participants P1, P6, P7, P8, and P12 from the 14 interview participants. To protect the identity of the participants, pseudonyms F1, F2, F3, F4, F5, and F6 were assigned to distinguish them. The participants met with the researcher in a conference room located on the local community college's campus. The participants were reminded that the focus session would be audio recorded and given an overview of the purpose of the study.

The participants were seated at a table so that each participant could respond to the questions in a roundtable format. Each participant was asked to introduce themselves by telling their name and sharing something about themselves. The participants were then asked questions from the student focus group protocol guide (see Appendix C) that helped guide the study pertaining to technology. The researcher was the moderator for the focus group session. The focus session was conducted within a 45-minute period. Data were collected and transformed into transcripts. The transcripts were transcribed by hand using Microsoft Word and produced 12 double-spaced transcript pages. The transcripts were then emailed to the participants for member checking. The transcripts needed no changes.

Faculty focus group. The faculty focus group (focus group 2) met on a separate day from the student focus group in a conference room located on the community college's campus. To protect the identity of the participants, pseudonyms T1, T2, T3, T4, T5, and T6 were assigned to them to distinguish them. The participants were reminded that the session would be recorded and then given a brief overview of the study. Each participant was asked to introduce themselves and to share how many years they had been teaching. Once the introductions were

complete the session began. The focus group discussion was conducted with the use of an interview guide consisting of six questions that were geared towards understanding how secondary teachers practice technology and how they perceive the use of technology use in their classrooms (see Appendix D). Transcripts were completed by hand and emailed to the participants for member checking. The data were transcribed in preparation for the coding process.

Data analysis procedures. Three distinct methods were used to gather data for the study. The data were obtained through individual interviews, a student focus group, and a faculty focus group. The researcher identified the 14 student participants by using P1 through P14 to protect their identity. The adult secondary science student focus group were identified by using F1 through F6 and the secondary science teachers were identified using T1 through T6 for the sake of confidentiality. The transcriptions from the interviews and focus groups were by using Microsoft Word.

The analysis was ongoing and simultaneous to data collection. The data analysis process began after the transcriptions of the interviews and focus group sessions. The researcher read over the transcripts and highlighted, underlined, and grouped information together that was relevant for the study.

Once the data analysis was complete the researcher assigned codes to the data. A code in qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and evocative attribute for a portion of language-based or visual data (Saldaña, 2015). The coding process consisted of two cycles to assist in interpreting the data that was collected from the study. Two of Saldaña's coding techniques; In Vivo and pattern coding,

were used to enable the researcher to become familiar with themes and perceptions of technology derived from the transcripts.

In Vivo coding enabled the researcher to apply the words of the participants verbatim to discover the dimensions of the various codes that the data could be broken down into. A variety of codes were identified which were sorted and then categorized into potential themes. Theming refers to the drawing together of codes from one or more transcripts to present the findings of qualitative research in a coherent and meaningful way (Sutton & Austin, 2015). Four themes were identified from the coded data: (a) frequency of technology use, (b) effective technology, (c) strengths and weaknesses, and (d) technology relevancy. The themes emerged from specific and significant responses from the participants that led to the data being understood and applicable to the case study. Subthemes were derived from the themes. The subthemes were: availability of technological resources, types of technology use, factors that make technology effective, influence on learning, and importance of integrating technology. Table 5 displays the themes, subcategories, and quotations from the participants that emerged from the study.

Table 5

Pattern Codes Emerged from the Data Analysis

Emergence of Themes from Codes	Subcategories	Direct Participant Quotes
Frequency of Technology Use	Availability of Technological Resources Types of Technological Resources Used	“I use my iPad daily.” “I use a laptop daily.” “I use my cellphone daily.” “When the computer lab is available, we have access to desktops.” “Smartboards are available to us in the classrooms.”
Effective Technology	Factors that Make Technology Effective	“Effective technology means a better way of learning and gaining information.” “Technology that helps me learn and makes my life easier.” “Technology that is more creative for learning.”
Strengths and Weaknesses	Influence on Learning	“It helps me to research.” “It helps me to be engaged in the classroom.” “It allows me to learn in a variety of ways.”
Technology Relevancy	Importance of Integrating Technology	“Technology provides me with visuals to look at.” “I can access more information.” “Technology can be a distraction.” “Sometimes I struggle with technology.”

Summary of the Findings

Three sources of data were used to obtain data pertinent for this study. The sources were individual interviews, a student focus group, and a faculty focus group. Information from the data provided the researcher with a deeper insight into how technology is experienced, practiced, and implemented within the science curricula. The detailed practices and firsthand experiences that the participants shared with the researcher were relevant to the study. Themes and subthemes emerged from the data that was collected and analyzed through the interviews and

focus groups. The four themes were: frequency of technology use, effective technology, strengths and weaknesses, and technology relevancy. The five subcategories were the availability of technological resources, types of technology use, factors that make technology effective, influence on learning, and the importance of integrating technology.

Theme 1 revealed how frequently the participants had access to technology. All the participants responded that they have daily access to their cell phones. Some of the participants shared how they have access to technological resources such as iPads, computers, and laptops occasionally but not daily. The participants agreed that Smartboards are in all the classrooms and that they have access to them. Subcategories 1 and 2 uncovered the availability of technology and the types of technology that the participants have access to. The entire group of participants shared how often they use technology and the type of technological resources that they use.

Theme 2 discovered how effective technology has been for them in their science classrooms. All the participants agreed that technology has provided them with an opportunity for a new and advanced learning environment. Some of the participants shared how technology has enabled them to research topics faster. The participants shared that technology is effective to them because it helps them to learn and be engaged in their learning. Subcategory 3 uncovered the factors that the participants felt made technology effective such as providing the students with innovative avenues to expand their knowledge in their content subject.

Theme 3 findings revealed the strengths and weaknesses that the participants have experienced with the use of technology. Most of the participants revealed the strengths that they have with using technology such as being knowledgeable with using it. The participants shared that when they have more access to technology in strengthens their confidence in using it. One

participant stated that they still struggle with technology and they are still learning how to use it effectively. Weaknesses such as the lack of accessibility of some technology were also revealed. Subcategory 4 uncovered that the participants agree that technology influences their learning because it allows access to a plethora of information. The teachers shared strategies that they have been able to implement in the classrooms with the help of technology such as interactive websites.

Theme 4 results exposed the participants' perceptions of the relevancy of technology. All the participants agreed that technology is an integral part of their lives and education. The participants shared the experiences that they have had with technology that helped to shape their perceptions of how relevant technology is for them. The teachers agreed that technology is an effective way to prepare students for the 21st century. Subcategory 5 revealed the importance of integrating technology in the classroom. The participants discussed the importance of having technology integration in the classroom. All the participants agreed that technology integration is an effective way to reform the classroom.

Throughout the process of gathering the data for this study, each element provided a greater magnitude of knowledge to the experience and practices of implementing technology in the science curricula for students as well as for teachers. The responses from the students and the teachers helped the researcher understand how the implementation of technology in the science curricula is perceived by the students and the teachers. Attributes such as the researcher's passion for the content, interest in discovering ways that technology can be used to enhance student's learning, and to find a way to make a connection between technology and classroom strategies helped to build this study.

TPACK model and constructivist-learning theory were used as a foundation to help the researcher gain an understanding of how secondary science teachers and adult secondary science students enrolled in a high school program at a local community college experience and practice the use of technology in a science curriculum. The TPACK model was developed by Mishra and Koehler (2006) as a resource for teachers to integrate technology into their classrooms, therefore this framework was essential for this study. The constructivist-learning theory describes how learners can be provided an opportunity to be responsible for their own learning while being engaged, therefore this theory was relevant to this study.

Presentation of the Data and Results

This section presents the data that was collected and analyzed for this study. The results of the research questions that framed the purpose of this study will be answered. The two research questions that were proposed and addressed were: 1) How do secondary science teachers practice technology in a science curriculum in a high school program at a community college in NC, and 2) How do adult secondary science students in a high school program at a community college in NC experience technology in their science curriculum?

The researcher collected data from the participants' responses to the interviews, student focus group, and teacher focus group. The data were transcribed, analyzed, and coded in a way that could be understood and presented. Frequency of technology, effective technology, strengths and weaknesses, and technology relevancy were four themes that were developed from this study. Availability of technology, types of technology, factors that make technology effective, and influence on learning, and the importance of integrating technology are the five subcategories were developed from the data collected in this study. The presentation of data began with an analysis of the 14 participants' interviews.

The researcher sought to understand how often they use technology and what type of technological resources they utilize therefore this analysis was designed to get a perception on how often the participants use technology and what technological resources they have access to. Several open-ended questions were asked during the interviews which gave the researcher an insight into the participants' perceptions of technology use and how it has impacted their learning. Once the data were collected from the interviews, the researcher was able to create themes and subthemes to support the ideas and responses in this study.

Theme 1: Frequency of technology use. The theme frequency of technology use emerged from the data that was collected from the individual face-to-face interviews of the 14 participants. The findings based on the mixed responses from the participants is presented by the researcher. Each participant responded by explaining how frequently they use technology. The participants' responses to questions 3, 4, 5, 8, and 9 were connected to address this theme to understand how frequent the participants use technology and what type of technological resources are available for them to utilize. Prior experience with accessible technology helped the participants to respond to how often they use technology and what type of technological resources they use. From the responses to the questions, the 14 participants use technology daily.

The researcher wanted to know what type of technological resources the participants used daily. Various technological resources were used by the participants such as iPads, laptop computers, desktop computers, and cell phones. P2's response revealed that he used his iPad on a regular basis; P1, P3, P4, P6, P7, P9, P11, P12, and P13 stated that they used laptops; P5, P8, and P10 used desktops; and all of the 14 of the participants used their cell phones daily. This data

helped the researcher to get an idea of the types of technological resources that were accessible for the participants to utilize.

Subcategory 1: Availability of technological resources. This subcategory emerged from the data that was collected from the individual face-to-face interviews of the 14 participants in this study. The 14 participants stated that they have access to a cell phone daily. When asked if technological resources were available for the participants to use in the classroom participant P4 stated that when the computer lab is available, they have access to desktop computers. It would be difficult for classroom technology to create a measurable impact on student learning if the students do not have access to it. Teachers would also have a challenging time transforming their instructional methods if there were limited technological resources for the students to access at one time. This concept led the researcher to subcategory 2.

Subcategory 2: Types of technological resources used. This subcategory emerged from the data that was collected from the individual face-to-face interviews of the 14 participants in this study. The researcher asked the participants what type of technology they use. P1 stated that he uses his laptop and cell phone every day. P3 stated that she also uses her cell phone and laptop daily. The researcher sought to understand what type of technological resources were available for them in the classroom for learning. P6 stated that smartboards are in the classrooms in which the students can view power points and engage in learning websites. P8 stated that COWS (computers on wheels) are sometimes available for the students to use within the classroom but that the teachers must sign up ahead of time to use them.

Theme 2: Effective technology. The theme effective technology was developed from the data that was collected during the individual face-to-face interviews of the 14 participants in this study. The effectiveness of technology influenced the perceptions of the participants in this

study regarding what factors make technology effective. The participants were asked what effective technology means to them. Each participant responded by explaining what effective technology meant to them. The researcher combined the responses of the participants to question numbers 1 and 7 which addressed the theme of effective technology. The collaboration of responses from questions 1 and 7 helped the researcher to gain an understanding of what the participants considered to be effective technology.

The concept of the constructivist learning theory was the basis to which the researcher interpreted and reflected on the responses from the participants. Constructivists believe that students construct their own meaning through active engagement and by constructing their own representation of what they know (Juniu, 2006). The participants were able to use their prior knowledge and experience to respond and explain their meaning of effective technology and how it has influenced their learning. The responses to the questions yielded that the participants connected their experiences with using technology to determine which factors made it effective for them. Table 6 and Table 7 illustrate the mixed responses given by the participants.

Table 6

Responses From Participants to Question 1 From the Interview Protocol

Effective technology means to me a better way of learning and a better way of getting information quickly

Technology that helps me learn and makes my life easier

Technology that works for students

When teachers use power points to teach their students what the lesson is about

When technology is used as a source to enhance learning for students

Technology that is more creative for learning

Table 7

Responses From Participants to Question 7 From the Interview Protocol

It allows me to learn in different ways
It gives me access to things that my class may not have on hand
It helps me to research
It helps me to be engaged opposed to the textbook
It has helped me to learn which has helped me as a student to be successful

The results of this study indicated that the participants agreed that technology has impacted their learning in a positive way and that it has enhanced their learning experiences within the classroom. The findings showed that the participants felt as if technology enabled them to research things quicker and that it is a creative resource for learning. When the teacher used technology, the participants felt engaged in the lesson.

Subcategory 3: Factors that make technology effective. This subcategory emerged from the data that was collected during the individual face-to-face interviews of the 14 participants. The data that was collected was constantly evaluated, transcribed, and coded. The 14 participants stated that technology has been effective in their learning experiences and that they consider it to be a better way for them to learn. Good things from the effective use of technology for learning (Marcoux, 2015). The participants mentioned factors that they consider make technology effective. Factors such as when it becomes a creative way to learn enable them to be more engaged in the classroom, and when it helps them to get information quicker were responses given by the participants.

Theme 3: Strengths and weaknesses. The theme strengths and weaknesses were developed from the data that was collected during the individual face-to-face interviews of the 14 participants in this study. The researcher asked the participants to describe any strengths or weaknesses that they had in using technology in school. The participants responded by

describing their strengths and weaknesses regarding using technology as a tool for learning. The responses of the participants from question 6 on the interview protocol guide helped the researcher to gain an understanding of the strengths and weaknesses that the participants have experienced while using technology as a tool for learning. The responses to the question from the participants yielded that the participants had different experiences with using technology. Table 8 illustrates the mixed responses given by the participants.

Table 8

Responses From Participants to Question #6, Describe any Strengths or Weaknesses you Have in Regard to Using Technology in School.

Strengths	Weaknesses
Technology strengthens my learning by providing me with visuals to look at	Taking tests through technology is hard for me
It allows me to do research faster	It can be addictive
Just knowing how to use technology is a strength for me	I am still learning how to use technology, I struggle sometimes.
It allows me to learn more because I have access to a variety of things	Sometimes it can be hard to find a simple answer. Google gives you a variety of answers for one question
It helps me to see data	
Technology allows me to work faster	Technology can make you easily distracted
You can access more information	

The results from this study found that the participants' responses varied on the strengths and weaknesses that they had with using technology. The findings showed that most of the participants agreed that technology makes researching topics easier, it allows them to access more information in a shorter amount of time, and it provides an enhancement to their learning. On the other hand, when asked about their weaknesses with using technology in the classroom, some participants stated that technology although helpful can be a distraction. In the initial stages of implementation, teachers and students are likely to encounter difficulties such as

manipulating images, saving and sharing work, becoming familiar with specific functionalities and disruptions to learning time solving technology issues (Hutchison, Beschoner, & Schmidt-Crawford, 2012). P6 stated, “I am still learning how to use technology. It doesn’t come easy for me.”

Subcategory 4. Influence on learning. This subcategory emerged from the collected data during the individual face-to-face interviews of the 14 participants. The participants responded by explaining in detail ways that technology has influenced their learning. Table 9 illustrates the participants’ responses to question number 2 in the interview protocol. The researcher asked, “In your own words describe how technology has influenced your learning experience within the classroom?”

Table 9

Responses From Participants to Question #2, In Your own Words Describe how Technology has Influenced Your Learning?

It enhances my learning experience
I would have to say that it has made me more advanced in my labs, my science work, and provides me with more learning opportunities
It allows me to be more effective in my learning
It has helped me to research things and look up certain topics
Technology has helped me to write resumes, do power points, and learn more about science
Technology has allowed me to access things for classwork, homework, and projects
It helps me to be more engaged in my learning opposed to using a textbook
It has influenced my learning because I can research things and look up certain information pertaining to science
Technology has helped me to understand science concepts better

The results indicated that the participants overall had positive experiences with technology influencing their learning. A technology-aided learning environment adequately helps students to develop interest as well as confidence towards real work situations by fostering realistic learning (Ogbuanya & Efuwape, 2018). Most of the participants commented on how

technology has made learning easier for them because they are able to research things quicker opposed to having to look through textbooks to find answers. Participant P1 stated, “Effective technology pretty much helps the students understand things better especially when we do projects and have to research things. If we didn’t have technology, it would make certain things difficult.”

Theme 4: Technology relevancy. This theme developed from the data collected during the individual face-to-face interviews of the 14 participants. The presentation of findings indicated the results of the relevancy of technology shown from the participants’ responses to questions 11 and 13. Questions 11 and 13 focused on how important the participants felt about implementing technology and what teaching strategies worked best for them. The results indicated that the participants considered the implementation of technology within the science classrooms very important.

The responses showed that the participants have experienced technology being beneficial for them. Teaching and learning in the 21st century schools require advanced techniques that can bring about the achievement of desired results, especially when it comes to the use of technology (Ogbuanya & Efuwape, 2018). Most of the participants responded that they enjoy having power points to view versus hearing a lecture without visuals in the classroom.

Subcategory 5. Importance of integrating technology. This subcategory materialized from the responses of the participants during the interview. Today’s digital natives expect more from their teachers than did students in decades past (Downes & Bishop, 2012). When asked how important it is to integrate technology in the science classroom, participant P4 stated, “I feel like it’s very important to implement technology because more experiments can get done with technology as well as more helpful learning tips can be researched to the students learn more.”

Participant P11 stated, “In science classrooms, it’s very important. I’m not the best with science so having more technology and having more ways to get information has helped me to understand it and pass my class.”

All the participants stated that they felt that implementing technology into the classrooms was relevant and important to them as a tool for learning. The participants mentioned technologies that they have found to be helpful to them. Most of the participants that being able to research topics through Google Chrome, Internet Explorer, and Mozilla have enabled them to find answers to their questions faster and easier. P12 stated that he feels that implementing technology is extremely important because the learning websites and interactive tutorials help him to understand the lesson better.

Presentation of Focus Group Results

The data from the adult secondary science student focus group and the secondary science teacher focus group was continuously evaluated, analyzed, and coded. The participants in the adult secondary science student focus group responded to seven open-ended questions by sharing their experiences with technology implementation in their classroom. The participants in the secondary science teacher focus group responded to six open-ended questions by sharing their experiences with implementing technology into their classrooms. There were four main themes and five subcategories extracted from the data. The researcher sought to answer the research questions from the data that were collected through the two focus groups.

The data were coded using In Vivo coding to capture the words of the participants verbatim and to gain an insight into the participants’ experience and practice with technology in the classroom. Pattern coding was used to develop themes and subthemes to gain an understanding of the participants’ perceptions, experiences, and practices of the use of

technology in a secondary science classroom. The themes and subthemes were documented for this study.

Theme 1: Frequency of technology use. The data responses from the participants were evaluated by the researcher as they shared their experiences on how frequently they use technology. Theme 1 emerged from the data that was collected during both focus group sessions. Two subcategories materialized from this theme: the availability of technological resources and the types of technology use. The participants' responses enabled the researcher to organize the data in a way that would present how often the participants utilize technology. Focus Group 1 was asked to respond to: *How often would you say that you have access to technology in the classroom? Are there any specific resources that are more readily available than others?*

F4 from focus group 1 began this discussion. F4 stated, "I always have my cell phone on me, but in the classroom, we don't always have access to the laptops." F3 stated, "I agree that my cell phone is always available, but in the classrooms, we have Smart boards. The computer lab is not always available if other classes have signed up to use them." F1 added, "I have access to my phone every day and a Smart board. The computer lab is here at school so that gives me access to the desktops." F2 concluded, "my cell phone is the most available of all the resources that I have access to."

Focus group 2 was asked to respond to: *Describe the variety of teaching approaches that involve technology that you have used in the classroom?* T5 from this group led the discussion by saying,

I've used equipment that can gather data digitally and then project it as a graph visually for my students such as probe temperature probe. I've also used the iPads for students to show their learning using Quizlet or various apps.

T6 stated, "I have used Power point presentations, LCD projector lecture presentations, and the AQUA board for lecture presentations to promote learning." T1 added,

I would say Smart boards, the computers, laptops, and their cell phones. I like to pull up different activities such as programs that will help them grasp the content of the lesson. I feel that devices such as these increase their knowledge outside of the classroom as well.

T2 concluded,

I like to use technology such as Smart boards, and laptops that will keep them engaged in the classroom. I may give them a time limit to search a science topic on their phone and see who finds the answer first. This way they are engaged and learning at the same time.

The results from this present study were in line with previous study findings by Mitchell, Wohleb, and Skinner (2016) who conducted a study on teachers' attitudes towards the utilization of technology and the availability of resources and equipment to educators. Adding technology to the instructional mix ensures greater student engagement in the learning process (Mitchell et al., 2016). Mitchell et al. (2016) suggested that students expect the integration of technology from all teachers, even those who teach core academic subjects like math, science, and English. The thorough explanations and responses of both focus groups provided the researcher with the answers to subcategories 1 and 2: availability of technological resources and the types of technology used in the classrooms.

Theme 2: Effective technology. The researcher continued to analyze the data responses from the participants as they explained how they determine what makes technology effective for

them. The subcategory: factors that make technology effective were evaluated and analyzed by the researcher as the participants responded. Focus group 1 was asked to respond to: *What do you feel is being accomplished in your learning when you have technology implemented into the lesson?*

F6 stated, "I feel that my success increases with technology because it enables me to research a broad range of subjects as well as offers me tools to study with." F5 stated, "I feel a better sense of security knowing that I am able to learn easier with technology." F3 added, "I feel that I have been able to access more information with technology instead of textbooks." F2 stated, "Yes I agree, I feel like technology gives me better visuals on what I am being taught." F1 concluded, "I feel that my learning is enhanced when technology is implemented. It helps me to advance in ways that I don't think a textbook can."

Focus group 2 was asked to respond to *In what ways do you determine the effectiveness or ineffectiveness of the use of technology in your instructional activities?* T1 led the discussion by stating,

I determine that by how engaged the students are. For instance, if I send them up to the Smart board and they have no clue on what to do then I feel like they aren't learning so I try to choose technology that keeps them engaged.

T6 stated,

There are many different ways that teachers can determine effectiveness of using technology in their instructional activities. I do so by making the students apply what has been taught to them. Application is the key to helping students learn, grow, and develop.

T2 stated,

I base it off of student response and engagement. If the students respond well, then I feel as if technology is effective and if the students are actively engaged in the lesson, then I feel that technology has been effective.

T4 concluded, “The effectiveness or lack of is due to the ease of use and the responses of the students to the new technology.”

The researcher viewed the perceptions of the participants in the focus groups on factors that they consider important in determining the effectiveness of technology. Students come to the classroom ready to use technology to explore their world (Carver, 2016). The participants’ responses to the question revealed the answers to subcategory 3: factors that make technology effective. The participants expressed their ideas on how they consider technology to be effective for not only them but for their students as well.

Theme 3: Strengths and weaknesses. The researcher continued to assess the data responses from the participants as they shared their experiences with their strengths in technology as well as their weaknesses. This theme developed as the researcher continued to evaluate, analyze, transcribe, and code the data that were collected from the focus group sessions. Focus group 1 was asked to respond to: *How do you feel about using technology as a tool to increase your knowledge? Any weaknesses?*

F2 stated, “Being able to use technology to increase my knowledge is a strength to me because I have not always been technology savvy. Not understanding how to fully use technology was a weakness for me.” F1 stated, “I feel that technology helps me to expand my knowledge by providing me with information that is beneficial to me. A weakness would be limited access.” F3 added, “I think it’s amazing because it gives you more access to learning

tools and also more hands-on tools. I agree that the limited access of it would be a weakness.” F4 stated, “I feel that technology is a very helpful tool for learning. The weakness for me would be not being sure how to use it properly.” F6 concluded, “I feel that technology increases my knowledge by allowing me to understand things better and the weakness would be not being up to date on the new technologies that come out.”

Focus group 2 was asked to respond to: How do you choose technologies to use in the classroom that will enhance students’ learning? Would you say that you have things that hinder you from trying new technologies? T1 led the discussion by saying,

I like to see where the students are with what they are already using like their phones or tablets. With that, I can incorporate assignments that will require them to use their phone or either their tablet. The only hindrance I would see is not having it accessible.

T2 stated, “Like I said before if the technology will engage the student and keep them focused, I use it. The downside or hindrance would be the budget. There is usually not enough money in the budget to try new technologies.” T4 added, “I choose my technologies by collaborating with other teachers, attending professional development trainings, and exploring on my own. The biggest hindrance to new technologies is training and exposure to them.” T6 stated,

Depending on the activity that I am doing for that day, I try to encourage students to use technology to research questions. I may assign them to create a Power Point presentation based on the scientific information that they research. The things that hinder me would be not having up to date technology or old or broken equipment.

T5 concluded,

I stress Smartboards, the kids can write on it and show me their work. The students are engaged and that's important. The hindrance is the internet being slow. It affects the Smartboards and doing work on the computer in general so that hinders me.

The detailed responses of the participants in the focus groups helped the researcher to understand the strengths and weaknesses of technology use within the classroom. The results of this present study were in line with a previous study conducted by Angeli and Valanides (2009). Their study proposed an approach known as Technology Mapping™ than enabled teachers to develop complex and interrelated ideas between the affordances of technology and their pedagogical content (Valanides, 2018). The teachers explained the various technologies that they use in alignment with their lessons while explaining the hindrances that they encounter. The researcher found that a teacher's experience with technology can significantly influence his or her technology integration.

Theme 4: Technology relevancy. The researcher continued to examine the data responses from the participants as they explained how they felt about the relevancy of technology in learning. The focus groups responded to questions that sought to explore their experience and practice with how technology has been relevant to them. The researcher continued analyzing, transcribing, and coding the data responses by the focus group participants. Focus group 1 responded to: *Do you feel that technology has been relevant for your learning?* F3 stated, "I feel that technology has given me more access to information, and it has shown me more of what's out there versus trying to explore the textbook." F4 stated, "I feel that technology has also helped me to learn more, but I do feel that we need more access to it not just in class but as a whole." F5 added, "I feel that technology has provided me with a means to gain more

knowledge.” F1 concluded, “Technology has made learning more beneficial to me and the knowledge that I have gained by exploring the internet is tremendous.”

Focus group 2 was asked to respond to: *Based on your experience with technology in teaching, how relevant would you say that technology is to students learning?* T5 stated,

I would say that technology is such a broad word and that there is so much to do with it.

It has helped my students to explore topics that a textbook just can't do and has given them an interest that opens their minds.

T1 stated, “I just believe that technology is what's happening and the pencil, paper, the books, all that's fine but we as professionals and as educators have to incorporate technology because that is where the future is headed.” T2 added,

With the 21st century learners I feel that technology has been an extremely important part of their learning process. They learn differently than previous generations because technology is all they know so they learn by instantaneous response. Technology has been relevant because it helps the students to learn easier and at a faster pace.

T3 stated, “Technology is something that the overall education field has to embrace and find a way to weave it in. It's here to stay and has helped my students over and beyond.” T4

concluded, “Technology has been a big help to my students, but if you don't have training for technology it will be hard to use.”

The data collected from this study revealed that the adult secondary science students and the secondary science teachers who participated in this study each perceived the need for technology to be a continuous practice in the classroom. Access to technology seemed to be a common concern for both the students and the teachers. The data also revealed four themes that

were relevant to this study: frequency of technology use, effective technology, strengths and weaknesses, and technology relevancy.

Chapter 4 Summary

The purpose of this qualitative case study was to gain an understanding of how secondary science teachers and adult secondary science students enrolled in a high school program at a local community college in North Carolina experience and practice the use of technology in a science curriculum. The chapter gives a detailed summary of the researcher's findings as they relate to the research questions. This data for this study was collected from 14 adult secondary science students and six adult secondary science teachers. Analysis of the data was ongoing and simultaneous to data collection. Data analysis was done using Saldaña's (2015) In Vivo coding and pattern coding methods.

The themes and subcategories were discovered through the data collection by individual face-to-face interviews, student focus group, and teacher focus group. These methods allowed the participants to share their experiences and practice with technology in their learning and teaching strategies. Previous studies as reviewed by the researcher from the literature were included throughout this chapter. In connection with the conceptual framework of this study, participants agreed that students should be engaged in their learning process. A summary of the findings was reported, and the data was presented and explained thoroughly.

Chapter 5: Discussions and Conclusions

Introduction

Technology is defined as tools that are used by both teachers and students within the learning and teaching process to meet program objectives and aims (Guler & Irmak, 2018). Technology integration in classrooms today include computers, Smart boards, iPads, and laptops. Technological advancements have become visible in education and can increase student engagement, motivation, and maximize student learning when utilized. Although technology has the potential to positively impact student learning, there are barriers that may limit technology from being accessible to teachers and students. The focus while integrating technology into the classroom should be on how to transform the technical affordances of the tools to educational affordances and design powerful learning environments, which can help learners to analyze, express, organize, and evaluate their thoughts in clear and precise ways while solving authentic real-life problems (Valanides, 2018).

The purpose of this qualitative intrinsic case study was to explore how secondary science teachers and adult science students enrolled in a high school program at a local community college in North Carolina experience and practice the use of technology in a science curriculum. This study provides educators with a better understanding of the methods and strategies that other educators have practiced in their classrooms. This study also provides insight into how students have experienced the use of technology in the science classroom. Modern technological developments make it mandatory to attribute technological and scientific quality to education (Guler & Irmak, 2018). Therefore, teachers and students' perceptions of technology integration in this study can be used as a guide for harmonizing the science curriculum and technology.

Chapter 5 has a detailed discussion of the introduction of the study to provide a recap of the nature of this study, the findings and summary of the results for this present study. This chapter has a thorough discussion of the results in relation to the literature used for this study. The limitations of this study along with the implications of the results in terms of practical implications, policy implications, and theoretical implications will be discussed. Finally, a discussion of the recommendations for future research and concluding thoughts will be discussed in this chapter.

Summary of the Results

This intrinsic qualitative case study was designed to explore how secondary science students and teachers in a high school program at a local community college in North Carolina experience and practice technology. The sample was comprised of 14 adult secondary science students and six secondary science teachers. The inclusion criteria for this research was that the student participants had to be between the ages of 18 to 60 years of age enrolled in the high school program at the local community college and had experience with using technology.

The sources of data collection used in this study included interviews and faculty and student focus groups. Fourteen individual interviews were conducted and two focus groups. The two focus groups were each comprised of six participants each. The data that was collected through individual interviews, a student focus group, and a faculty focus group were analyzed, transcribed, and coded for this study. Member checking enabled the participants to check for accuracy and resonance pertaining to their experiences. In Vivo and pattern coding were used to assist the researcher in creating themes and subcategories that were relevant to this study. The data collected was categorized into four themes and five subcategories and were identified within this study. The four themes were: frequency of technology use, effective technology, strengths

and weaknesses, and technology relevancy. The five subcategories were: availability of technological resources, types of technology use, factors that make technology effective, influence on learning, and importance of integrating technology.

Two frameworks were used to guide this study: the technological pedagogical content knowledge (TPACK) and constructivism learning theory. Gaining insight into the practices and experiences of the teachers and students with technology within the classroom was an important factor that allowed the researcher to reflect on strategies that have had an impact on student learning. Additionally, the researcher found that there are barriers that play a part in teachers and students having adequate access to technology. Subsequently, the responses of the participants revealed their concerns about these barriers. It was significant for the researcher to understand the experiences that the participants have had with technology and to acknowledge the relevance of technology in the science curriculum.

Discussion of the Results

Participants in this study shared their experiences and practices using technology. They also shared strategies that they have found to be beneficial to their learning. Interviews, student focus group, and faculty focus group revealed perceptions about technology integration in the science curricula and the researcher discovered four themes for this study. The four themes were: frequency of technology use, effective technology, strength and weaknesses, and technology relevancy.

Perceptions of the sample. Four thematic categories were developed through the coding process. The four thematic categories were: frequency of technology use, effective technology, strengths and weaknesses, and technology relevancy. The thematic categories give an in depth look into the research questions: How do secondary science teachers practice technology in a

science curriculum in a high school program at a community college in NC? How do adult secondary science students in a high school program at a community college in NC experience technology in their science curriculum? The four thematic categories are explained in detail in the following sections.

Theme 1: Frequency of technology use. It is imperative that teachers increase their use of technology in the classroom to prepare our K–12 students referred to as “digital natives,” for the 21st century (Coyne et al., 2017). This study revealed how frequently the participants were able to access technology within the science classroom. The participants were asked what type of technological resources were made available to them. Classroom technology integration can be more challenging now than it was in the past due to the need for technology use being increased. Preparing students for the demands of an evolving technology-driven world can be difficult when the accessibility of technology itself may be challenging to come by.

The results of this study showed that 100% of the participants stated that they had daily access to their cell phones. Smartboards were another type of technological resource that the participants had access to. Laptops and iPads were a few of the technological resources that the participants stated that they had limited or no access to within the science classrooms.

The study gave cognizance to the established connection between the frequency of technology use and the perceptions of the participants on the integration of technology in the classroom. The National Education Technology Plan (NETP) stressed that schools are expected to ensure all students understand how to use technologies as a tool to engage in creative, productive, lifelong learning (Herold, 2016). Therefore, it is imperative that students have access to some form of technology. Research revealed that technology is an integral part of the participants’ everyday life to include their education.

Theme 2: Effective technology. Technology can be utilized as a powerful tool for learning. The integration of technology can be a pathway to enhance learning in content areas. Students need technological and informational skills to compete in the 21st century (Harris, 2016). The participants agreed that the utilization of technology in the curricula has deemed to be effective and beneficial to their learning.

Many participants stated that technology has offered them a new and advanced learning environment in which they can be engaged. There is already considerable evidence that educational science simulations can help students reach deeper levels of understanding (Biju, 2017). The student participants expressed what effective technology meant to them and how technology has been effective for them. The student participants collaboratively agreed that technology has become a fundamental aspect of their lives and can be effective in obtaining information quickly. The faculty participants provided examples of strategies and practices that they have used in the classroom with technology that proved to be effective for their students.

Theme 3: Strengths and weaknesses. The researcher sought to understand the strengths and weaknesses that the participants may have discovered while using technology in the classroom. The responses from all the participants varied when the researcher asked them to describe any strengths and or weaknesses that they have experienced while using technology. Teachers' abilities to adapt to rapidly developing technologies applicable to learning environments is connected with technology integration (Bentham, 2013; Ortega & Fuentes, 2015).

Regarding strength, the student participants provided some insights on how technology has strengthened their learning by providing them with informative information. Some of the participants mentioned how it allows them to have access to more data in comparison to a

textbook. The faculty described to the researcher the various strategies that they have been able to implement into their perspective classrooms with the help of technology. A faculty participant discussed how she likes to use particular websites that not only help the students to research but it enables them to be engaged in their learning process.

Although for the most part technology can be beneficial for the teachers and students, there are still some difficulties with technology being immersed in the classrooms. Technology itself has no value if it is not used in the right place at the right time and for the right purpose (Valstad & Pinto, 2018). Some of the students mentioned how they struggle from time to time with technology. Insight was given on how technology can be helpful yet addictive. One participant also mentioned it how it can be difficult sometimes to maneuver through some websites when asked to retrieve information when they aren't as comfortable with technology as other students are.

The faculty shared their experiences in technology use and the majority agreed that the lack of accessibility to technology can be a weakness. Having limited technological resources can be a barrier when trying to implement technology. There are so many students without accessibility, and the digital divide still exists in schools today (Harris et al., 2016). One faculty participant mentioned the lack of training that can deter teachers from wanting to introduce technology into their lessons. With more and more emphasis being placed on student learning and achievement, schools are looking at making changes and immersing students and teachers with technology (Harris et al., 2016); therefore, it is important to make sure that the faculty are knowledgeable on how to integrate technology into their classrooms.

Theme 4: Technology relevancy. The study revealed conclusive results for the perceptions of using technology in the science curriculum from the participants based on their

thoughts on how relevant technology integration is in the classrooms. Numerous positive perceptions of the participants were uncovered in the study. The results of the study revealed that the participants agreed that technology is a way for students and teachers to obtain information and enables students to be engaged in their learning.

Most of the student participants explained how they prefer to view power points versus listening to lectures without visuals. Students report an overall positive inclination toward technology and a desire for more technologies to be incorporated into their learning experiences (Dahlstrom, Brooks, Grajek, & Reeves, 2015). Technology has the potential to provide learners with a variety of tools for learning such as interactive websites, power points, and paves a variety of pathways for individualized learning.

Many factors have appealed to teachers that have prompted them into using technology in their classrooms. The faculty participants agreed that integrating technology is an effective way to prepare the students for computer self-efficacy, create a learning atmosphere that increases the collaboration among teachers and students, and makes the students responsible for their learning. Successful technology integration is what makes a difference in reforming a classroom (Gilakjani et al., 2013). The participants agreed that incorporating technology into the classrooms is the right path to take to reach the needs of students.

Discussion of the Results to the Literature

This study was designed to explore how secondary science teachers and science students enrolled in a high school program at a local community college in North Carolina experience and practice the use of technology in a science curriculum. The student participants in this study provided the researcher with insight on the experiences that students have encountered with technology use in their classrooms. The faculty participants shared with the researcher strategies

and tools that they have implemented in their classrooms with the help of technology. The results of this study relate to the literature in various ways. Delgado et al. (2015), Vickrey et al. (2018), Harris (2016), Coyne et al. (2017), Aljuzayri et al. (2017), Gilakjani et al. (2013), Guler and Irmak (2018), and Costley (2014) were just a few noted studies that relate to the results of this present study from the literature.

Delgado et al. (2015) explored the transitions that technology has made over the years not only in society but in education as well. Delgado et al. (2015) referred to the transition as the “digital revolution.” According to Delgado et al. (2015), numerous technological instructional strategies are being used to integrate technology into K–12 classrooms. The results of this present study were in line with Delgado et al. (2015) study. The participants revealed experiences and practices that they have had with technology in the classrooms. Strategies such as using interactive websites that engage the students were a few strategies that were discussed in this present study.

Vickrey et al. (2018) conducted research on the kinds of instructional technologies that have been used and aimed to discover the meaningful integration of technology in instructional practices. This study was relevant to the results of this study. Instructional technologies such as interactive simulations and mobile devices have become more common in higher education (Vickrey et al., 2018). All the student participants mentioned that they have daily access to their cell phones which can be utilized as an educational tool. Technology resources such as iPads, computers, and laptops were a few resources that the participants stated that they could access.

Harris (2016) noted that technology has become a fundamental part of our daily lives, being infused into entertainment, business, workforce, and educational environments. This supports the results in this study that technology is an integral part of education and can be

beneficial for researching as well as constructing knowledge. According to Harris (2016), the International Society for Technology in Education was founded on the principle of preparing students to compete in a technology-driven world by providing them with the skills to be technology literate; therefore, the integration of technology in the classrooms is important. The participants in this study all agreed that technology is all around them. They noted that technology is an integral part of their lives and that it is important in preparing them for the 21st century.

Coyne et al. (2017) explored the crucial role that technology plays in education while uncovering barriers that may hinder teachers and students from receiving the full benefits of technology integration. The participants provided the researcher with insight on barriers that they have faced while experiencing and practicing technology in the classrooms. A key element in the plan is the need to move from passive to active use of technology (Coyne et al., 2017). The results from this study were also consistent with previous studies by Aljuzayri et al. (2017), who conducted a study about high school science teachers' confidence with classroom technology integration. Aljuzayri et al. (2017) indicated that teachers need confidence in using technology to effectively integrate technology into classrooms. A faculty participant responded that it is hard to integrate technology if the teachers have not received adequate training on technology.

Gilakjani et al. (2013) studied teachers' use of technology and constructivism. Gilakjani et al. (2013) explained whether technology by itself can make the education process more effective or if technology needs an appropriate instructional theory to indicate its positive effect on the learner. There is a close relationship between technology and constructivism, the implementation of each one benefiting the other (Gilakjani et al., 2013). For this present study,

the conceptual framework was drawn from the TPACK model that was developed from Mishra and Koehler (2006) and the constructivist-learning theory; therefore, Gilakjani et al. (2013) provided relevant information pertinent to this study. The results from this present study discovered similar findings in those teachers who are more comfortable and knowledgeable with technology integrate it more in their classrooms. The participants emphasized how receiving adequate training on technology integration can motivate them to use it more effectively.

Guler and Irmak (2018) conducted research on content analysis of research on technology use in science education. Modern technological developments make it mandatory to attribute a technological and scientific quality to education (Guler & Irmak, 2018). Using technology in education has numerous benefits for students and teachers. The participants in this study disclosed the benefits that they have experienced while using technology such as retrieving information faster, being engaged in their lessons, and being able to view visuals to help them with their learning. The participants revealed that being in a student-centered learning environment that fosters learning through technology motivates them to learn.

The findings from this present study were consistent with previous studies conducted by Costley (2014). His study found that technology has a positive impact on student learning, allows students to be more engaged, and helps them to retain more information. Costley (2014) study found that most students use some form of technology daily to include: texting, social networking, and web surfing. The participants in this present study revealed the various technologies that they are accustomed to using.

Limitations

Few strengths and weaknesses resulted in limitations for this study. The study was able to be conducted as intended with no modifications to the procedures or protocol guides

associated with this study. Limiting the content area to science was a limitation to this present study. There were studies within the topic of technology integration for K–12 education but none that focused on how science students and secondary science teachers experience and practice technology in a high school program in a local community college in NC.

This study may require a wider scope of study in which the study is expanded to more high schools either in the county or district. The limitations of this study were: the researcher's choice to focus on an intrinsic, qualitative case study; the small number of participants (20) involved in the study, and the focus and context in which only secondary science teachers and adult science students enrolled in a high school program at a local community college in North Carolina were selected to participate. The goal of the study was to explore how secondary science teachers and adult science students experienced and practiced the use of technology in a science curriculum.

Implication of the Results for Practice, Policy, and Theory

The foundation of the conceptual framework used in this study was TPACK and constructivist-learning theory. There is abundant research available on technology integration in the classroom, but this research serves as an additive to knowledge that is imperative for gaining an understanding of how science teachers and students experience and practice technology in a high school program at a local community college. The researcher aimed to gain an insight into the positive and negative experiences that science students have had pertaining to technology use. The researcher also sought to understand the methods and practices that secondary science teachers have experienced while implementing technology into their classrooms.

This study is pertinent to the existing literature because it will provide future researchers with data that shed light on the perceptions of science students and teachers on how technology

has been beneficial to them. The findings in this study indicated that the participants found technology to be an advancement in education. The participants' perceptions of how relevant the technology being integrated into the science classrooms is played a significant role in the responses that they provided to the researcher.

The data that was obtained from this research study led the researcher to identify implications for practice, policy, and theory based on the findings from this present study. Secondary school leaders, school administration, teachers, and staff should continue to collaborate and research strategies that will provide students with an education that incorporates technology. As the needs of the 21st century learners increase, the willingness to implement advanced technologies should increase as well. This present study provided an avenue for teachers and students to have the opportunity to utilize technology as an educational resource and a means for the students to be engaged in their learning.

Practice implications. This qualitative case study documents the experiences of 14 science students and practices of six science teachers in the use of technology in the science curriculum. Using the results of this study, the researcher offered practical suggestions for secondary school leaders, school administration, and staff concerning how they can collaborate with the teachers on finding ways to effectively integrate technology into the classrooms. The coded research data that were collected during the study answered the research questions and identified practical recommendations to guide teachers and future researchers.

Teachers are important providers of educational sustainability (Coklar & Yurdakul, 2017). A dimension of sustainable development is technology integration. Technological innovation is imperative within the field of education. Integrating technology into the classroom

is a way of opening doors for quality education for students, creating a student-centered learning environment in which they can be engaged, and preparing them for a technology savvy society.

The more technology that students are exposed to in the classrooms the more comfortable they will become in using it. Some of the participants stated how they struggle from time to time using technology due in part to not having adequate experience in using it. Using the latest technology such as Smartboards, Aqua boards, and other technological tools will also make learning interesting for the students.

Policy implications. Implications for policy pertaining to this present study shows the need to implement a policy that helps teachers to receive proper training and assistance with implementing technology into their classrooms. Having support is a crucial element in technology integration. A faculty participant noted that without proper training it is almost difficult to utilize technology.

The Internet can be deemed as a common reference source not only for teachers but for the students as well because technology plays a critical role in student learning. Professional development classes that focus on technology integration can provide the teachers with multiple strategies that can be used in their classrooms. There is a need to develop and design technology-enhanced curricula as well as student-centered learning environments; therefore, technology could be the starting point to achieve this.

Theoretical implications. This intrinsic qualitative study utilized two theories: the TPACK model developed by Mishra and Koehler (2006) and constructivist-learning theory. The TPACK framework has been employed to “unpack” the complexities of teaching with technology (Foulger et al., 2015). TPACK describes in detail the knowledge bases that teachers

need to know to effectively integrate technology in the classroom. The TPACK Model is a way to link the relationship between technology, teachers, and students.

Understanding the relevancy of incorporating technology into the curriculum could drive teachers to embrace the idea of implementing technology more. TPACK is a conceptual tool that has been used in previous studies that consider incorporating technology into the classroom; therefore, this theory was prominent for this present study. It has been suggested that greater emphasis must be placed on pedagogical and content knowledge using the TPACK framework to provide teacher candidates with the skills and background to integrate technology more fully into classroom instruction (Foulger et al., 2015). Being knowledgeable about the components that contribute to the development of the TPACK model can assist the teachers in designing lessons that support teaching the contents with the help of technology.

The constructivist learning theory is the idea that learners will construct knowledge for themselves. A constructivist learning environment creates an environment in which the students and teachers can collaborate while using a variety of tools to enhance their learning. This theory was relevant to the present study because it is imperative for teachers to create a learning environment that promotes students being in control of their learning. As educators, a priority is to ensure that all students learn the same concepts, carefully analyze the students' understandings, and customize teaching approaches that are essential steps to educational reform that result in increased learning (Miller & Ballard, 2017).

In this present study, the researcher utilized the constructivism theory to analyze the experiences and practices of the participants shared regarding using technology in the classroom. Learners activate prior knowledge and try to relate new information to the knowledge they already possess (Miller & Ballard, 2017); therefore, this was relevant to this study because the

participants used their prior knowledge and past experiences to answer the interview and focus group questions. The participants mentioned that technology integration in the classroom motivates them to learn because they have the opportunity to learn new things.

The student and teacher participants reflected on times where technology had been integrated into the classroom and the results that they experienced from implementing it. The faculty participants shared with the researcher the different technological tools that they have found to be effective in the classroom. The faculty agreed that when the students understand how to use technology properly as an educational tool it will motivate them to learn. Once an educator provides a motivational challenge, he or she must nurture and provide the necessary criteria, planning, timelines, resources, and support to accommodate this kind of student success (Miller & Ballard, 2017).

Recommendations for Further Research

This qualitative study focused on a single local community college's high school program located in North Carolina. The population for the high school was relatively small compared to high schools located in the district. Recommendations for future research would look at two to three high schools or maybe even a district. Both recommendations would allow for more participants. Expanding the research study would allow for a comparison to be made amongst other high schools.

Knowledge was gained from conducting this study pertaining to the experiences and practices of secondary science students and secondary science students in a local community college high school program with technology integration in a science curriculum. As an educator, it is imperative to constantly seek ways to improve teaching methods and strategies. This study allowed me to think about the topic from a student's viewpoint and gain an

understanding of their experiences good and bad with technology. Collecting data from students and teachers was essential for this study.

There is room for advancement in integrating technology in the classroom. Based on the results of this study there is a need for future research on the benefits of technology integration. Future research on this topic should include conducting observations in science classrooms. Observing the teachers and students would allow the researcher to visibly see the student-teacher collaboration while incorporating technology and to gain a better perspective. Observations will allow the researcher to investigate how engaged the students are, the technological tools that are being utilized, and the interest of the learners.

Conclusion

This dissertation explored the experiences and practices of secondary science students and secondary science teachers with technology integration in science classrooms. Additionally, the research associated with this research focused on the perspectives of the teachers and students on how relevant technology is in the education field. This study was significant because it presents educators, students, administrators, and school leaders with the insight of science teachers and science students' experiences and practices with technology integration. This study details the positive and negative perspectives that the students and teachers have developed regarding technology.

Students today are characterized as “digital natives” and technology is an integral element in their daily lives. The emphasis on designing and developing technology-enhanced curricula is growing tremendously to foster their educational needs. The vision to expand technology into the education field is growing as well.

Technology has the potential to enhance the academic performance of students, increase engagement in their learning, motivate them to learn, and prepare them to effective 21st century learners. Effective technology integration requires proper and adequate training for teachers. Implementing professional developments that will train teachers on how to incorporate technology into their lessons will benefit the teachers and students as a whole.

It was determined from the findings in this study that secondary science students and science teachers found technology to be beneficial in numerous ways to include helping them to research topics. The participants expressed their desire to learn more about technology and to have more experiences with using it for their education. The teachers expressed the importance of feeling confident and comfortable with presenting technology-based lessons. Increasing the accessibility of technology for the students and teacher is a starting point to ensure that technology is being utilized to its fullest potential for educational purposes.

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Appendix A: Letter to Potential Participants

Greetings to you. My name is Tamekia Whitfield, and I am an Education Doctorate candidate at Concordia University–Portland, and it is for this purpose that I am reaching out to you. My dissertation is a study of how secondary science teachers and adult secondary science students enrolled in a high school program at a local community college in the coastal region of North Carolina experience and practice the use of technology in science classes. This study is important because it will address integrating technology into the curricula of students to promote learning skills that will benefit them as learners and adults.

I am emailing you to request your participation in my study. As part of this study, I will be conducting interviews. The interviews will take approximately 30 to 45 minutes. No identifying information will be used in any materials created from these interviews. All participants will be required to sign consent forms before completing the initial interview.

If you have any questions about the nature of this study, the interview, or consent form please email me at _____. Please let me know the date, time, and provide me with a contact phone number in your email so we can discuss any questions or concerns you may have regarding this study. I am willing to set up an interview schedule that is most convenient for you. Thank you in advance for considering my request to participate in my study.

Sincerely,

Tamekia Whitfield

Appendix B: Interview Protocol

Research Topic: How do secondary science teachers and adult secondary science students enrolled in a high school program at a local community college located in the coastal region of North Carolina experience and practice the use of technology in a science curriculum?

Interview Location: _____

Interview Date: _____ **Interview Time:** _____

Name of Interviewer: _____

Name of Interviewee: _____

ID number assigned: _____

Demographic Information:

Please provide the following demographic information. This information will assist the researcher in gaining an insight on how technology is perceived by a diverse generation of participants. Please fill in the circle that pertains to you

Generational Age Group:

Millennials (ages 18–35)

Generation X (ages 36–47)

Baby Boomers (ages 48–66)

Gender: Female

Male

Access to Technology: (fill in all that apply)

Home

School

Work

No Access

How often would you say that you access technology?

Quite often

Sometimes

Rarely

My signature below verifies that I have completed the participant informed consent form and give permission for this interview to be recorded and transcribed for the purpose of this study.

Signature: _____ Date: _____

Introductory Protocol

To facilitate taking notes, I would like to audio record our conversation today. As your consent form stated, I must remind you that this session will be audio recorded. The recordings will be deleted immediately following transcription and member-checking. All other study-related materials will be kept securely for 3 years from the close of this study and then be shredded and destroyed. Please sign the release form. Essentially this document states that: (1) all information will be held confidential, (2) your participation is voluntary and you may stop at any time if you feel uncomfortable, and (3) I do not intend to inflict any harm. Thank you again for agreeing to participate.

Opening Questions:

1. What does effective technology mean to you?
2. In your own words describe how technology has influenced your learning experience within the classroom?

General Questions:

3. How often do you use technology? Explain what types of technology you use.
4. How would you rate your level of technology engagement within your classes?

Personal Experience with Technology Questions:

5. How often do you use a computer/Ipad/laptop/smartphone outside of class for school?
6. Describe any weaknesses and or strengths to using technology in school?
7. How do you perceive technology contributing to your learning?
8. What tools do you use to complete your school work to help you learn and study?
9. What technological resources are available for you to access in class? (you may have more than one)
10. To what extent do you utilize the technological resources mentioned in question #9 during the semester?
11. How important do you feel it is to integrate technology in the science classrooms?
12. What type of resources do you prefer to use when learning? For example, reading? Visuals? Learning websites?
13. Which teaching strategies work best for you?

Closing Remarks/ Question:

- This is the conclusion of our interview. Is there any question that you would like to elaborate on that may be useful for this study?

- Thank you so much for your time and for your willingness to participate in this study. I would like to remind you that this interview is confidential and the information that was obtained from this interview will be used solely for the purpose of this study.

Appendix C: Adult Secondary Science Students Focus Group Protocol

Interview Date: _____

Interview Location: _____

Start Time: _____ End Time: _____

Interviewer: _____

Type of Focus Group: _____

Introduction:

Hello, I would like to start off by thanking you for agreeing to be interviewed and being a part of this study. My name is Ms. Tamekia Whitfield and I will be the moderator for this group. I am conducting this interview to explore how adult secondary science students enrolled in a high school program at a local community college located in the coastal region of North Carolina experience and practice the use of technology in a science curriculum. This focus group will provide me with information that will be beneficial to this study. As your consent form stated, I must remind you that this session will be audio recorded. The recordings will be deleted immediately following transcription and member-checking. All other study-related materials will be kept securely for 3 years from the close of this study and then be shredded and destroyed. Before we get started, I would like the group to introduce themselves by telling us your name and a little something about yourself.

Requirements:

As members of this focus group there are just a few things that I have to go over before we began. I ask that we show each other respect by allowing each other to speak without interrupting them. There are no right or wrong answers. Your responses to the interview questions are completely confidential and your responses will not be disclosed to anyone. The

moderator will be the only person taking notes during this interview and the only person that is allowed to audio record it. The names of the participants in this focus group will only be on the consent forms which will not be included in the analysis report for this study. Your responses will not be connected to you or your school.

Overview of the Topic:

The purpose of the proposed study is to explore how secondary teachers practice technology and how adult secondary science students experience technology in a science curriculum. Another focus of this study is to gain insight on how secondary teachers perceive the use of technology in the classroom and the strategies that they use to integrate technology in the curriculum. This study is significant because it will provide knowledge on the strategies and methods that adult secondary science students have experienced while taking science courses and how it has affected their learning. It will also provide insight on how teachers and students perceive the use of technology as an educational resource within the classroom. Now let's begin.

Questions:

1. How do you feel about using technology as a tool to increase your knowledge? Any weaknesses?
2. How often would you say that you have access to technology in the classroom? Is there a specific resource that is more readily available than others? (Smartboard, cell phone, notebook, etc.)
3. What teaching techniques would you say motivate you to learn? (Note taking, lecture, technology, etc.)

4. What do you feel is being accomplished in your learning when you have technology implemented in the lesson?
5. Do you feel that technology better prepares you as a student in comparison to traditional teaching methods such as textbooks? Why or why not?
6. Do you feel that you have adequate amount of access and resources to use technology in your classroom? Why or why not?

Closing:

7. Do you feel that technology has been relevant for your learning?

Thank you very much for participating in this focus group and for providing me with information that will assist me in this study.

Appendix D: Faculty Focus Group Interview Protocol

Interview Date: _____

Interview Location: _____

Start Time: _____ End Time: _____

Interviewer: _____

Type of Focus Group: _____

Introduction:

Hello, I would like to start off by thanking you for agreeing to be interviewed and being a part of this study. My name is Tamekia Whitfield and I will be the moderator for this group. I am conducting this interview to explore how secondary teachers practice technology in the classroom. This focus group will provide me with information that will be beneficial to this study. As your consent form stated, I must remind you that this session will be audio recorded. The recordings will be deleted immediately following transcription and member-checking. All other study-related materials will be kept securely for 3 years from the close of this study and then be shredded and destroyed. Before we get started, I would like the group to introduce themselves by telling us your name and how many years you have been teaching.

Requirements:

As members of this focus group there are just a few things that I have to go over before we began. I ask that we show each other respect by allowing each other to speak without interrupting them. There are no right or wrong answers. Your responses to the interview questions are completely confidential and your responses will not be disclosed to anyone. The moderator will be the only person taking notes during this interview and the only person that is allowed to audio record it. The names of the participants in this focus group will only be on the

consent forms which will not be included in the analysis report for this study. Your responses will not be connected to you or your school.

Overview of the Topic:

The purpose of the proposed study is to explore how secondary teachers practice technology and how adult secondary science students experience technology in a science curriculum. Another focus of this study is to gain insight on how secondary teachers perceive the use of technology in the classroom and the strategies that they use to integrate technology in the curriculum. This study is significant because it will provide knowledge on the strategies and methods that secondary teachers use to increase achievement levels within the classroom. It will also provide insight on how teachers and students perceive the use of technology as an educational resource. Now let's begin.

Questions:

1. What aspects of a classroom environment do you feel are essential for maximum learning?
2. What motivates you as a teacher to use innovative teaching or technological resources as a tool for teaching?
3. What are your best examples of technology incorporation in your teaching? How has it affected student learning?
4. Would you say that you have things that hinder you from trying new technologies? If so what?
5. In what ways do you determine the effectiveness or ineffectiveness of the use of technology in your instructional activities?

Closing:

6. Based on your experience with technology in teaching, how relevant would you say that technology is to students learning?

Thank you very much for participating in this focus group and for providing me with information that will assist me in this study. You will receive a transcribed copy of this focus group session for your approval through an email for your acknowledgement.

Appendix E: Statement of Original Work

The Concordia University Doctorate of Education Program is a collaborative community of scholar-practitioners, who seek to transform society by pursuing ethically-informed, rigorously- researched, inquiry-based projects that benefit professional, institutional, and local educational contexts. Each member of the community affirms throughout their program of study, adherence to the principles and standards outlined in the Concordia University Academic Integrity Policy. This policy states the following:

Statement of academic integrity.

As a member of the Concordia University community, I will neither engage in fraudulent or unauthorized behaviors in the presentation and completion of my work, nor will I provide unauthorized assistance to others.

Explanations:

What does “fraudulent” mean?

“Fraudulent” work is any material submitted for evaluation that is falsely or improperly presented as one’s own. This includes, but is not limited to texts, graphics and other multi-media files appropriated from any source, including another individual, that are intentionally presented as all or part of a candidate’s final work without full and complete documentation.

What is “unauthorized” assistance?

“Unauthorized assistance” refers to any support candidates solicit in the completion of their work, that has not been either explicitly specified as appropriate by the instructor, or any assistance that is understood in the class context as inappropriate. This can include, but is not limited to:

- Use of unauthorized notes or another’s work during an online test
- Use of unauthorized notes or personal assistance in an online exam setting
- Inappropriate collaboration in preparation and/or completion of a project
- Unauthorized solicitation of professional resources for the completion of the work.

Statement of Original Work (continued)

I attest that:

1. I have read, understood, and complied with all aspects of the Concordia University–Portland Academic Integrity Policy during the development and writing of this dissertation.
2. Where information and/or materials from outside sources has been used in the production of this dissertation, all information and/or materials from outside sources has been properly referenced and all permissions required for use of the information and/or materials have been obtained, in accordance with research standards outlined in the *Publication Manual of The American Psychological Association*.

Tamekia M. Whitfield

Digital Signature

Tamekia M. Whitfield

Name (Typed)

September 8, 2019

Date