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EDUCATORS' PERCEPTIONS OF BENEFITS AND BARRIERS OF THE INCLUSION OF CODING IN K-8 CURRICULUM: A QUALITATIVE STUDY

Jennifer Lynn Dralle-Moreano,

EDUCATORS' PERCEPTIONS OF BENEFITS AND BARRIERS OF THE INCLUSION OF CODING IN K-8 CURRICULUM: A QUALITATIVE STUDY

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ABSTRACT

EDUCATORS' PERCEPTIONS OF BENEFITS AND BARRIERS OF THE INCLUSION OF CODING IN K-8 CURRICULUM: A QUALITATIVE STUDY

Jennifer Dralle-Moreano

The 21st century has seen a rapid growth in technological use in schools. Many schools now use computers and other digital devices in order to meet the academic needs of their students. The purpose of this qualitative study was to explore the benefits and barriers that K-8 educators experienced when integrating or teaching coding curriculum in their classrooms. This qualitative phenomenological study, informed by the Zais model of curriculum design (1976), Johnson (1977), and Beauchamp's curriculum theory (1968), involved data collection through semi-structured interviews with six K-8 teachers, one instructional leader, one middle school principal, one assistant superintendent, and one superintendent, as well as completing a focus group with five participants. A document analysis that examined the coding curriculum and processes of the school was also completed. The results of the study found five themes that emerged from the data set that highlighted instances of how coding is integrated and taught in the classroom, the benefits associated with coding, the barriers associated with coding, and how K-8 educators overcame barriers that were experienced during the process.

DEDICATION

To my three children, I hope I have shown you what going for goals means. Gabi and Jaimie, you spent many Sundays without me during my administrative classes and Tuesday nights while I took courses at St. John's, taking care of each other. I realize it was difficult, and I appreciate the sacrifice you both made as you wanted my attention when I "had to do work." I hope you continually set goals and never let anything hold you back. We can do hard things!

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CHAPTER 1: Introduction

Since the introduction of computers in the mid-1970s, technology has spurred many discussions about how it can improve K-8 student learning (Carver, 2016). The 21st century has seen rapid growth in technological use; many schools adopted computers and other digital devices in order to meet the academic needs of their students (Collins & Halverson, 2018). With the aim of using technology to increase academic learning and achievement, many schools offer students a variety of devices such as printers, video projectors, digital whiteboards, iPads, iPods, high-speed Internet, and smartphones in order to continually transform the educational landscape (Hallisey, 2017). Although technology has been used to increase test scores across schools and districts, research has demonstrated that reading and mathematics test scores are at similar levels to those of 40 years ago. This fact demonstrates that despite introducing technology into schools and classrooms, the positive impact of technology does not occur automatically (Beland & Murphy, 2016; Carver, 2016; Rashid & Asghar, 2016). Many educators agree that there are many benefits of technology use in the classroom, as evidence suggests that a student's motivation level, attitude, engagement, and self-confidence can all be positively affected, including that of organization and study skills (Carver, 2016; Domingo & Garganté, 2016).

Hoffmann and Ramirez (2018) discussed how educators can fall behind trends in their understanding and expertise in today's technology. For example, many educators have not been exposed to the International Society for Technology in Education (ISTE) Standards (ISTE, 2017, 2020). The 2017 ISTE Standards for Educators provide direction when making decisions pertaining to curriculum, instruction, professional learning, and the use of technology in the classroom and are not solely standards for technology. The ISTE Standards are used in school districts, buildings, and classrooms across the United States and around the world. ISTE designed five sets of standards for (a) students, (b) educators, (c) education leaders, and (d) coaches. The 2017 ISTE Standards for Educators included seven standards: (a) Learner, (b) Leader, (c) Citizen, (d) Collaborator, (e) Designer, (f) Facilitator, and (g) Analyst. Additionally, Liao et al. (2017) have highlighted that professional development does not consistently accompany teachers' experience of new technologies in K-8 environments, which leaves many educators without the training to use new technologies. The introduction of coding in the curriculum in K-8 grades is one of these new technologies.

Heiser (2015) reported that coding was first introduced to schools in the state of New York in 2012, with approximately 186 public schools currently teaching coding within their curriculum. The push to introduce coding to schools in the state of New York came about when the Department of Education highlighted that there were many new careers in the computer science and programming field offering students strong compensation packages and a positive work/life balance (Levy, 2019). By offering coding to students, students will then be presented with long-term benefits of careers in computer science and the skills needed to achieve will be equitably distributed, such that underrepresented groups, such as women and minorities, and equity as both women and minorities will have opportunities to enter the field (Heiser, 2015).

Therefore, the goal of this study was to explore the barriers and benefits of adopting coding into a curriculum and the experiences that K-8 educators encountered during the integration and teaching of coding curriculum to their students. This study's focus on integrating coding in K-8 is due to the fact that, historically, computer programming and coding are offered in high school. The New York State Computer Science and Digital Fluency Learning Standards were conditionally approved by the Board of Regents in January 2020 (New York State Education Department, 2020). These standards are New York State's first ever learning standards for computer science and digital fluency.

Purpose of the Study

The purpose of this qualitative phenomenological study was to explore the benefits and barriers that K-8 educators experienced when integrating and teaching the coding curriculum in their classrooms, by gaining insight into the perspectives of a variety of educator stakeholders regarding coding implementation. Hoffmann and Ramirez (2018) discussed how educators could lag behind in their understanding of technology trends. For instance, many educators and students have not been exposed to the ISTE Standards (2017), as mentioned above. Educators are not keeping up with emerging technologies, leaving many ineffective when integrating or teaching new approaches into their schools (Liao et al., 2017).

Theoretical Framework

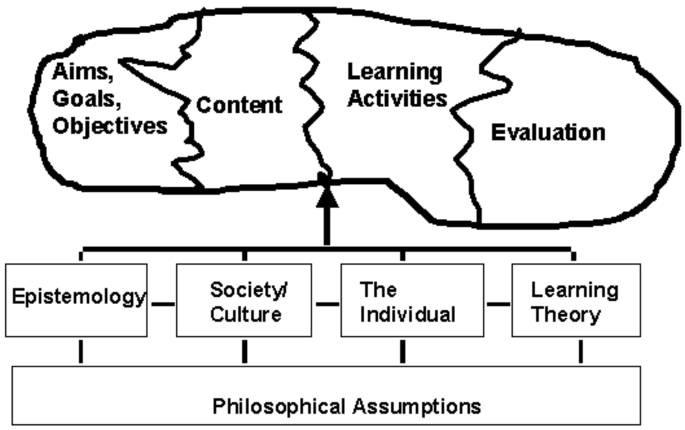
This study rested on the curriculum theory work of Zais (1976), Johnson (1977), and Beauchamp (1968). Curriculum theory is a scientific approach that examines and shapes academic curricula. Because this study examined the benefits and barriers that K-8 educators experienced when integrating or teaching the coding curriculum in their schools, curriculum theory supported this research by highlighting how curriculum was shaped by teaching values, historical analysis of curriculum, and current educational policies in relation to student learning outcomes when experiencing coding in the classroom (Pinar, 2019). Additionally, when completing the initial analysis of the data, curriculum theory helped the researcher to highlight the different components of a curriculum in relation to the participants' responses.

The Zais (1976) model for curriculum design is a well-regarded tool for the development of culturally responsive science and math (Cajete, 1999). The model is composed of four interrelated pairs of components and foundations and allows for a comprehensive understanding and application of curriculum design in a school (see Figure 1). Zais conceptualized the curriculum in terms of its foundation and structure. The foundations of a curriculum are philosophical in nature. The philosophical bases are the underlying values and beliefs that influence the curriculum structure. Decisions made by educators regarding curriculum are influenced by their philosophical assumptions about the epistemology, society/culture, the individual (specifically, the learner), and learning (how a person learns and what learning theories the curriculum should be based on). Curriculum structure refers to the various components of a curriculum. These components (which are linear) include aims, goals, objectives, content, learning activities, and evaluation. Zais summarized historical developments in thinking about the roles of activities in curriculum and instruction. Distinguishing between learning activities as specified in curriculum plans and the actual learning experiences that occur as students confront the response demands built into those activities, Zais noted that it is the experiences that influence what is actually learned. Zais also offered criteria for the selection of learning activities, stating that the primary standard should be how well they contribute to the attainment of curricular goals.

Johnson (1977) further highlighted four main components to experience a deeper understanding of how curricula were designed and implemented in a school system: structuring criteria, selection criteria, learning outcomes, and teaching repertoire. Structuring criteria or foundation relates to whether the curriculum should be subject-based, learner-based, or a combination of both. Structuring criteria also describe the different kinds of relationships between the elements of a curriculum (Dong et al., 2015). Selection criteria ensure that the curriculum is united with the goals and objectives of the school and the information that the students need to know (Talavaki et al., 2018); learning outcomes focus on the ability to measure what students are learning in order to ensure that the material is relevant (Mirriahi et al., 2015); and teaching repertoire focuses on how the material is integrated into the classroom and how students will be taught the curriculum (van Akker & Nieveen, 2017). These four different components were useful when identifying initial codes and their subsequent themes after the study was completed.

Figure 1

Curriculum Theory



(Zais, 1976)

According to Beauchamp (1968), curriculum theory is useful for educators in the development of a curriculum, and within curriculum design, there are instructional systems that would benefit students via teaching repertoires (Johnson, 1977). Teaching repertoires or instructional strategies are techniques teachers use to help students become independent, strategic learners. These teaching strategies become learning strategies when students independently select the appropriate ones and use them effectively to accomplish tasks or meet goals. Instructional strategies can motivate students and help them focus attention, organize information for understanding and remembering, and monitor and assess learning. Johnson's (1977) research was helpful in framing the barriers teachers experienced. The barriers became more relevant in teachers' alignment with what Johnson was advocating.

Beauchamp's (1968) model highlights five critical decision-making areas for curriculum development. The first area is the setting for curriculum engineering or scope of development process. This could be defined as a classroom, a school, or a school district. The second area is selecting key people. This could be defined as teachers, specialized personnel, or any stakeholder. The third area in Beauchamp's model is organization and procedures for curriculum planning. This area defines the procedures to be followed by those who establish curriculum goals and objectives, select the content and learning activities, and determine the overall design. The fourth area is curriculum implementation. This area relates to this study, as Beauchamp advises careful planning in this area to anticipate possible implementation barriers. The fifth area is curriculum evaluation. This area has four dimensions: (a) evaluation of the teacher's use of the curriculum, (b) evaluation of the curriculum design, (c) evaluation of student outcomes, and (d) evaluation of the curriculum engineering system. Data collected from this evaluation will help improve the curriculum. Although Beauchamp's model is not a recent one, the five areas described for curriculum development are still applicable.

This study rested on the curriculum theory work of Zais (1976), Johnson (1977), and Beauchamp (1968) for an understanding of how these benefits and barriers were aligned within an educational system, how the coding curriculum was shaped, and how it followed teaching values that were beneficial to the students. Therefore, this theoretical framework of curriculum theory strengthened the researcher's understandings of benefits and barriers when integrating a coding curriculum, along with the student learning process and teaching initiatives.

Significance of the Study

Technology is increasingly embedded in the K-8 school environment and curriculum developers are actively integrating technology into the 21st-century classroom. Coding, programming, and computational thinking have become commonplace in K-8 curriculums, with the goal of increasing a student's ability to increase their cognitive and social-emotional skills (Bers, 2017). There are varying studies that discussed the benefits of coding concerning the increase of academic achievement. For example, Moreno-León et al. (2016) investigated 129 students of the 2nd and 6th grades, assessing the impact that coding could have on their levels of academic achievement. The results of the study found that, for 6th-grade students, coding activities demonstrated a statistically significant improvement in regard to their level of academic performance; however, this was not the case with 2nd-grade students (Moreno-León et al., 2016). Although the authors discussed how older students' cognitive abilities were typically more mature than their younger counterparts, a teacher's level of comfort with technology could also play a role when teaching advanced computational thinking in their lesson plans.

To date, most research has focused on the benefits of coding activities in the classroom in relation to academic performance; it has not highlighted educators' perceptions of integrating this coding curriculum into the K-8 environment. The present study addresses research needs by focusing specifically on supporting educators in better understanding of benefits and barriers experienced when designing, structuring, and integrating the coding curriculum into their schools, as well as highlighting how students could better be served when learning this important skill in relation to their academic achievements. Educators and school administrators can use the results of this study to help support implementation of a coding curriculum in schools.

Research Questions

The study explored the benefits and barriers that K-8 educators experienced when integrating or teaching the coding curriculum to their students. It was guided by the following four research questions:

RQ1: How do K-8 educators in a suburban school district implement or teach the coding curriculum to students?

RQ2: How do K-8 educators in a suburban school district describe the benefits experienced when integrating or teaching the coding curriculum to their students?

RQ3: How do K-8 educators in a suburban school district describe the barriers experienced when integrating or teaching the coding curriculum to their students?

RQ4: How do K-8 educators in a suburban school district overcome experienced barriers when integrating or teaching the coding curriculum to their students?

Definition of Terms

Coding

Coding is the process of learning how to use programming language to get a computer to behave in the way one wants it to behave (Bell, 2016). It is important to teach students coding in school as it can act as a means for students to learn sequencing skills, counting, problem-solving, logical thinking, cause and effect, and critical thinking skills.

Curriculum

In this study, curriculum was defined as a subject comprising of a course of study in a school (Mathews, 2018). In this study, the curriculum being explored was that of coding, within the field of computer science.

Curriculum Theory

Curriculum theory is a scientific approach that examines and shapes academic curricula (Pinar, 2019).

CHAPTER 2: Literature Review

Introduction

Coding was first introduced to schools in the state of New York in 2012, with approximately 186 public schools currently teaching coding within their curriculum (Heiser, 2015). The push to introduce coding to schools in the state of New York came about as the Department of Education highlighted that there are many new careers that offer students strong compensation packages and a positive work/life balance that are in the computer science and programming field. By offering coding to students, they will then be presented with long-term benefits and equity as both women and minorities will have opportunities to enter the computing science field (Heiser, 2015). Hoffmann and Ramirez (2018) discussed how educators could lag behind in their understanding of technology trends while highlighting how educators were not keeping up with emerging technologies. Many educators are ineffective when integrating or teaching new approaches into their classrooms (Liao et al., 2017). Therefore, the purpose of this qualitative phenomenological study was to explore the benefits and barriers that K-8 educators experienced when integrating or teaching the coding curriculum in their schools.

This chapter will provide an overview on the academic research conducted into this topic. First, a brief discussion of the literature review search process will be explained, followed by an articulation of the overarching theoretical framework that guided this study, which was the curriculum theory. An analysis of emerging technologies found in education is additionally discussed, highlighting how coding programming and computational thinking were introduced into schools, how curriculums were developed, and how they were integrated into the classroom. The purpose of this literature review was to highlight the gap that ensured the need for and viability of this study.

Literature Review Search Strategy

This researcher's literature review included a variety of peer-reviewed articles and studies that were focused on emerging technologies in the K-8 environment, specifically those that focused on coding programming and computational thinking. This literature also focused on the historical background of emerging technologies found in educational environments and how educators have adapted their teaching practices in order to be successful in the classrooms. As such, a review of the existing literature was conducted in order to gain a broader understanding of all relevant topics closely related to emerging technologies, including that of coding programming and computational thinking in relation to a K-8 environment. Additional references, such as published government/industry reports and online sources and professional industry-focused websites were identified concerning emerging technologies and how teachers integrate these curriculums into their classroom and effectively teach the material to their students. Key search parameters included the following: *emerging technologies, emerging technologies and K-8, coding, coding and elementary schools, coding and middle schools, coding programming and K-8 education, coding programming and elementary schools, coding programing and middle schools, computational thinking, computational thinking and K-8 education, computational thinking and elementary schools, computational thinking and middle schools, curriculum and coding programming, curriculum and coding programming and K-8 education, curriculum and coding* *programming and middle schools,* and *curriculum and coding programming and elementary schools.*

Theoretical Framework

Curriculum Theory

The theoretical framework that was used in this study was that of curriculum theory (Beauchamp, 1968; Johnson, 1977; Zais, 1976). Curriculum theory is a scientific approach that examines and shapes academic curricula (Pinar, 2019). In other words, an educational institution decides what is necessary to learn and teach, and how learning will be measured. According to Beauchamp (1968), curriculum theory can provide the foundation for educators in the development of a curriculum but also that of any instructional systems that would benefit their students via teaching repertoires.

Curriculum theory has been used as a guide in a variety of studies that have focused on technology and the integration of curriculums in an educational environment. Fluck et al. (2016) used curriculum theory when making an argument to include computer science into a school's curriculum. The authors purported that computer science is a discipline of dispute in many elementary and middle schools. The authors suggested that schools need to view computer science as its own separate discipline, simply because it brings about economic, social, and cultural benefits. The authors argued that computer science is becoming critical in education as it allows students to access new information; thereby, this discipline should be taught as a distinct subject in order to promote research, thinking, and knowledge skills among students. Curriculum theory was able to play a role in the authors' study, because one aspect of their discussion was that computer science should become its own distinct subject in all schools; thus, the theoretical framework highlighted how the economic, social, and cultural benefits need to be reflected into the curriculum as it is being developed (Fluck et al., 2016). Curriculum design is often a contested process and teachers can suffer from initiation fatigue. The authors concluded that teachers would benefit from keeping up with professional development opportunities that would allow them to become comfortable with the technology, in order to be able to effectively teach the subject to their students (Fluck et al., 2016).

Additionally, Mabingo (2015) used curriculum theory to complete research on how to integrate emerging technologies when teaching Ugandan traditional dances to K-12 students in New York City. Because some schools in the New York City area have integrated Ugandan traditional dances into their curriculum, many teachers are using emerging technologies to aid in dance instruction during classroom time. For example, teachers were able to use online platforms such as iPads, smartboards, iPods, YouTube, and Wikispace when teaching students Ugandan traditional dances. The use of integrating emerging technologies into the curriculum allowed teachers to engage students, offer reflective and interpretive analyses of the dances, and explore issues related to dance. The use of technology in this instance followed Fluck et al.'s (2016) assertion that computer science aided in bringing upon economic, social, and cultural benefits. Economic benefits are supported through innovation and development. Students will reap social benefits from being active creators and producers versus being passive consumers of society (Fluck et al., 2016). The cultural aspect includes the integrity of local values and customs. In Mabingo's study, the use of emerging technologies demonstrated these three benefits, as students could afford to utilize emerging technologies on their own, increase social exposure, and view the cultural significance of the Ugandan traditional dances in real time.

Curriculum theory has also been used on a global scale to research educational issues in regards to integrating technology into curriculums in different educational settings. Huang (2015) investigated the technology transfer when it came to the Information and Communication Technology (ICT) curriculum in Taiwanese schools. The ICT curriculum aims to equip students with strong abilities to become familiar and understand a variety of devices, tools, and applications, in order to obtain information and knowledge throughout their education. Using curriculum theory, the author found that there are productive examples of how the ICT can be properly implemented within a school system. For example, schools must ensure that educators understand the curriculum in order to effectively offer it to their students, which, in essence, will reestablish a teacher's role when it comes to integrating the curriculum into their classrooms, as well as ensuring that their students' life experiences are appropriately reflected during the coursework. Huang suggested teachers need to recognize that the cultural assumptions behind ICT may differ from the real cultural context in the classroom.

Because the researcher was exploring the benefits and barriers that teachers experienced when integrating and teaching the coding curriculum to their students, curriculum theory was able to guide this study when it came to understanding how these benefits and barriers were aligned within an educational system, how the coding curriculum was shaped, and how it followed teaching values that were beneficial to the students. Therefore, this theoretical framework helped strengthen the understanding of benefits and barriers when integrating a coding curriculum and the student learning process and teaching initiatives.

Review of Related Literature

Emerging Technology in Education

Emerging technology in education are innovations that allow teachers to track students' academic performances and behaviors to aid in improving courses and curriculums that are offered within the school. Technology has been introduced into schools over the past 20 years that have included the use of computers and interactive whiteboards, while more recent emerging technology has included the use of social media, mobile phone and smart devices, and tablets. Liu et al. (2017) completed a study that focused on technology integration into classrooms at K-12 schools. The authors completed a multilevel path analysis model, with the aim of designing and testing a model that supports the integration of technology into K-12 classrooms. Collecting data from 1,235 K-12 teachers, the authors studied 336 schools in 41 districts throughout the state of Florida, and found that a teacher's experience with technology significantly influenced how technology was integrated into the classroom. This study highlighted an important aspect of emerging technology being integrated into curriculums: a teacher's confidence level. With lower levels of confidence, teachers will struggle to integrate technology into their classroom, which aligns with this proposed study where teachers struggle to understand how to appropriately utilize technology in their classrooms, combined with a lack of professional development opportunities that can stunt their ability to effectively teach their students.

Additionally, Carver (2016) explored teacher perceptions regarding the barriers and benefits of technology use in the K-12 classroom. Obtaining data from 68 graduate students in education, the authors requested that participants complete an open-ended survey, and some interesting themes emerged. The themes that were found included that although the availability of technology appeared to be a barrier for teachers, at times teachers also tended to experience content instructional issues and issues with knowledge on how to operate or utilize the technology in the classroom setting. Because technology is important and useful within a K-12 environment, other studies have examined pre-service teachers and the preparation techniques used to ensure their comfortability and competence once they reach the classroom as a professional. Admiraal et al. (2017) reported that the quality of how technology is integrated into the K-12 classroom is dependent on how student teachers apply technology in secondary schools after their graduation. In order to better understand this concept, the authors evaluated two technology-infused courses from a teacher education program. After evaluating the courses, the authors found that because student teachers are offered education that strengthens technology, pedagogical, and content knowledge, student teachers should practice what is learned in the teacher education programs and receive feedback from their students, as well as ensuring that the curriculum aligns with the use of technology.

There is also a strong link between a teacher's pedagogical belief and how they integrate and use technology in their classrooms. Tondeur et al. (2017) completed a study that highlighted how a teacher's pedagogical mind frame was related to how they integrated technology into their classrooms through the curriculums. Following a qualitative meta-aggregative approach, the authors compiled the results of 14 previous studies that were completed and found three synthetic themes: there is a bi-directional relationship between pedagogical beliefs and the use of technology, teachers' beliefs of perceived barriers affected how they integrated technology into their classrooms, and the context of the school played a role when it came to technology use.

Examining pedagogical beliefs is important when teaching in a digital age, as there are many educators who strive to use technology in order to improve their students' learning abilities. For example, McKnight et al. (2016) completed a study with a purpose to document digital instructional strategies that teachers use to enhance and transform student learning. Completing a qualitative study, the authors collected data by completing focus groups and semi-structured interviews. From their study, the authors found that a teacher's familiarity with the technology that they were using was paramount in increasing student learning in their classroom. To demonstrate student learning abilities through the use of a more recent technological introduction to the classroom, Crompton et al. (2017) completed a study that focused on mobile learning. Completing a systematic review across the years of 2010 to 2015, the authors aimed to understand mobile learning in PK-12 education. The findings of their study concluded that science was the most common subject in PK-12 education that utilized mobile devices, as 40% of the time, teachers aligned learning activities using mobile devices with a behaviorist approach. The authors highlighted some drawbacks with mobile learning in the PK-12 environment, some of which included that although the students were able to consume knowledge regarding the subject matter being studied, they did not necessarily use the full breadth and potential of the mobile devices in order to acquire said knowledge.

To continue understanding mobile and smart devices in education, Leinonen et al. (2016) completed a study that explored how mobile device applications could support reflection for learning in the K-12 environment. The authors were able to discuss how the majority of mobile applications tend to support single-person learning, whereas collaborative learning is rare when it comes to the use of this technology. The authors' research into understanding how mobile applications can support student learning concluded that there is a potential for practicing the act of reflection when using this technology with the use of audiovisual recordings. Audiovisual recordings appeared to be the most reflective experience that students encountered when using mobile applications for smartphone technology.

Outside of student learning and teachers' pedagogical classroom goals, social media has been found to be utilized with K-12 school environments by school leaders. Sauers and Richardson (2015) completed a study that analyzed how K-12 school leaders use Twitter, a social media platform. In order to better understand this phenomenon, the authors collected data by examining 115 K-12 school leaders who used Twitter and reviewed over 180,000 tweets from these individuals. The results of the study indicated that school leaders utilize Twitter for educational purposes and also create communities of practice, utilized in order to highlight important educational issues.

Emerging Technology and Student Achievement

It is essential to better understand how technology and current forms of emerging technology can aid in affecting student achievement levels, especially as these platforms are being utilized more regularly throughout the K-12 school environment. The use of technology aids in the engagement of students while allowing teachers the ability to individualize curriculums to better meet the needs of their students. Studies have demonstrated many benefits of technology in K-12 schools, such as that of Brasiel et al. (2016). The authors completed a study that explored how technology can positively impact students who are studying mathematics. Collecting data from over 200,000 K-12 students, the authors ensured that the students were using at least one of 11 mathematical software programs when they were randomly assigned to either the intervention or control group. The goal of their study was to understand the successes, challenges, and barriers to implementation, and they found that the use of technology in a mathematics setting can significantly increase student achievement, while also allowing for personal tailoring to individualize material so that students can reach their full potential. Brasiel et al. concluded that the results from the first year of implementing mathematics educational technology show the promise of more individualized instruction, practice, and automatic feedback to students. Additionally, the authors' findings were consistent with prior research, which has shown that teachers have challenges integrating technology into the classroom.

In terms of individualization of curriculum in order to increase student achievement, it is also important to consider how individualization of teaching and instructional strategies can also aid in student success. For example, McClung (2019) explored whether there were any relationships between one-to-one technology and student achievement in K-12 schools. Currently, many K-8 schools throughout the United States utilize traditional technology learning platforms, that is, where teachers instruct the entire class using a form of technology, rather than one-on-one instruction. McClung completed a quantitative study with a quasi-experimental design using survey instruments. Collecting data from 2,640 students from seven middle schools, along with 63 staff members working at the same schools, the author aimed to determine if one-on-one instruction using technology increased student achievement in relation to traditional, or group teaching methods. The results of the study actually concluded that one-on-one instruction using technology did not produce significant results, highlighting that individualized and group teaching methods while using technology produced similar student achievement levels. However, the results also concluded other interesting findings, namely that of the perceptions of teachers who agreed that the use of technology in the classroom is beneficial for student learning, instruction, and overall education quality. Moreover, teacher perceptions also included that technology does not only aid in increasing educational quality and student achievement, but also prepares students to engage in a competitive workforce.

Jenkins (2017) explored the use of instructional technology and how it promotes student achievement in rural K-12 settings, simply because technology can produce many more benefits to rural school students than to their urban and suburban counterparts. Additionally, technology can also aid in ensuring that all school students in the United States have equal access to education, no matter their geographical location. Gathering data from one isolated school district in the southern United States, Jenkins sought to explore how technology can impact 9th- through 12th-grade student achievement levels. Completing a qualitative study, the author found five themes that were identified during her analysis. The themes highlighted that student achievement and the use of technology depended on the operation of the school, in terms of the culture and climate of the school, the role of instructional technology, the outcomes of using instructional technology, and resource requirements. Essentially, the results highlighted that technology did in fact enhanced the efficiency of the operation of the school, while also having a positive impact on student achievement.

Hall (2015) explored the effects of access to technology on both the achievement and attitudes of 46 sixth graders, collecting data from two survey instruments and the students' tests scores. The researcher analyzed reading and math scores of third and fifth graders and compared them to fourth and fifth graders, finding that students with technology in their homes had an increase of test scores, student achievement levels, and a more positive attitude toward their education. Student achievement can not only be measured through test scores that have been achieved within the classroom environment, as technology has also appeared to increase achievement levels outside of the classroom. For example, Roschelle et al. (2016) completed a study that sought to understand the relationship between the use of technology when completing mathematics homework and student achievement. Collecting data from 2,850 seventh-grade mathematics students across 43 different schools, the authors aimed to determine if the technology program ASSISTments increased student achievement. ASSISTments is an online tool where students can receive tips and feedback when completing their homework, while providing teachers with organized information regarding their students' work. Results of the study indicated that the use of the online tool increased student achievement levels, as demonstrated by increased student scores at the end-of-the-year standardized mathematics assessment.

Coding and Programming

Coding is a current emerging technology that is being introduced into schools throughout the United States; for example, Heiser (2015) reported that coding was first introduced to schools in New York state in 2012, with approximately 186 public schools currently teaching coding within their curriculum. The push to introduce coding to schools in the state of New York came about as a result of the Department of Education's emphasis on new careers in the computer science and programming field that offer students strong compensation packages and a positive work/life balance. In 2018, the New York State Legislature passed, and the governor signed into law, legislation requiring the New York State Education Department to create a workgroup and present a draft of NYS K-12 Computer Science Standards to the Commissioner of Education and the Board of Regents for approval. This draft is currently being revised. Teaching students coding presents them with long-term benefits and equity as both women and minorities will have opportunities to enter the computing science field (Heiser, 2015). Outside of career opportunities, coding and programming can help students throughout their educational journeys, as it highlights the improvements of soft skill sets, such as that of perseverance and problem-solving abilities. Outside of learning the ability to code, students can also obtain an increase in the understanding of math concepts, logic, project design, communication and collaboration, and the acceptance of constructive criticism (Gadanidis et al., 2017).

To place this claim into recent research, Zhu et al. (2016) completed a study where they conducted four different coding workshops for children, with an interest in better understanding both the advantages and disadvantages of graphical and tangible interfaces when teaching coding to children. The results of the study concluded that the graphical input of coding aids children in remaining focused on problem-solving versus the tangible elements of coding. The authors reported that the tangible interfaces of coding better support schema construction and causal reasoning, while promoting stronger classroom discussions, participation, and engagement. Before further understanding the benefits of coding on an academic level, it is essential to highlight that coding opens up opportunities to disadvantaged students. For example, Miller et al. (2018) discussed the benefits of exposing K-12 students to computer science and coding through summer camps. The authors examined the CS@SC summer camp, where students are exposed to a weeklong program that introduces students to computer science. Within this camp, many underrepresented students attend: 40% of campers are girls, 70% are from minority groups, and 80% are from low-income families. The authors found that camps that offer introductory exposure to the computer science field found a 12% increase in future individuals indicating that they would like to study STEM (Science, Technology, Engineering, Mathematics), increasing diversity in the field.

Various studies discuss the benefits of coding in relation to the increase of academic achievement; Moreno-León et al. (2016) completed a study that focused on the benefits of coding in the K-12 classroom. During their study, the authors investigated 129 students of the 2nd and 6th grades, assessing the impact that coding could have on their levels of academic achievement. The results of the study found that for 6th-grade students, coding activities demonstrated a statistically significant improvement in regard to their level of academic performance; however, this was not the case with 2nd-grade students (Moreno-León et al., 2016). Although the authors discussed how older students' cognitive abilities are typically more mature than their younger counterparts, a teacher's comfort level with technology can also play a role when teaching advanced computational thinking in their lesson plans.

Computational Thinking

Computational thinking can be defined as thought processes involved in expressing solutions as computational steps or algorithms that are carried out by a computer, such as in the act of coding. Duncan (2018) highlighted the reported development of computational thinking through computer science, finding out some benefits of primary school students. Duncan's study demonstrates that the introduction of coding and computational thinking practices is global, with countries such as New Zealand and Australia adopting such academic practices in 2018. The author completed a study that aimed at understanding how computational thinking concepts should be taught in schools as well as the positive impact that it can have on students. Building on a previous research study that was conducted in 2014, Duncan collected data between the years of 2015 and 2016 from 18 primary school teachers throughout the country of New Zealand. Teachers completed online surveys and semi-structured interviews. The results of the study highlighted that computational thinking promoted positive impacts on students' general learning, with minimal negative impacts, as long as the course was implemented appropriately, with the teachers having knowledge of how to use the technology during their instruction.

Other benefits of computational thinking include this skill allowing students to articulate problems and think logically. Essentially, computational thinking aids in strengthening the ability to identify cause and effect relationships, while analyzing how specific actions impact any given situation. Kush (2019) discussed the benefits of computational thinking and computer science in education, while highlighting the importance for schools and teachers to ensure that computational thinking is seen as a pedagogical tool. The author analyzed ways in which computational thinking can be integrated into curriculums in order to identify and highlight the benefits for students. The author discussed that computational thinking aids in reducing complex problems into smaller and more manageable ones, making it easier for students to solve problems either with or without a computer. Kush discussed the importance of teaching computational thinking to young children, as many components of this skill are essential for child development throughout education. For example, pattern recognition is considered to be one of the most important aspects of computational thinking, as it allows students the ability to search and understand trends, differences, similarities, and regularities in a particular data set. From this, Kush concluded that it is essential for teachers to integrate computational thinking into their lesson plans, either utilizing the skill set as a stand-alone lesson or one that is integrated into different subjects.

Curriculum Planning and the Use of Technology

Educators must practice effective technology integration. Curriculum planning should reflect this. Leary et al. (2016) discussed the designing of a science curriculum and the importance of ensuring that technological aspects of the course are clearly embedded into the curriculum. The authors completed a study that examined the impacts of technology on teacher learning within a biology unit. Collecting both qualitative and quantitative data, the authors sought to better understand any barriers that inhibit the implementation of a digital curriculum and the extent to which teachers are involved in the designing process. The results of the study highlighted that the more teachers were involved in the designing process of a curriculum that is embedded in technology, the more they will understand and learn how to use the technology that they are teaching, lessening any barriers while using technology in their classrooms. This highlights an important component of curriculum design: the more involved the teachers are when integrating technology into their curriculums, the higher success rate will be experienced, due to their ability to be involved and understand the process.

Cristol et al. (2015) reported that curriculums utilizing technology must follow a 21st-century curricular framework. A 21st-century curricular framework stems from President Obama's administration's goals that prioritize education, raising the proportion of college students from 39% to 60% and closing the achievement gap, so that students who graduate from high school are college and career ready. Therefore, a 21st-century curricular framework ensures that K-8 education encompasses technology, so that students can experience a powerful and engaging learning experience within their classroom. Cristol et al. highlighted that mobile learning has been integrated into curriculums, as it provides flexibility and a mechanism where students can experience education in a seamless manner throughout all academic disciplines. Bull et al. (2016) also reported that including technology into curriculums enhances learning across a broad array of subjects. When developing curriculums that involve technology, Bull et al. reported that different factors should be considered, such as pinpointing the exact acquisition of technology, the placement and support of the technology, safety, the alignment of educational standards and learning objectives, scheduling, and professional development opportunities.

Mayes et al. (2015) argued that when planning curriculums and integrating them into a school district, it is important for teachers to be involved. The authors reported many challenges on integrating technology into the curriculums found in 21st-century educational practices, mainly that on the offerings that schools can provide to their students in terms of specific types of technology and the manner in which it is implemented. Mayes et al. reported that when developing curriculums embedded with technologies, school leaders and teachers should keep in mind privacy issues and system security issues, outside of issues that are experienced by students.

Integrating Coding Into a K-12 Curriculum

Popat and Starkey (2019) discussed that students who learn to code while in school learn skills that reach beyond the coding itself; however, the authors urged the importance of understanding that curriculum and pedagogy influences the range of skills that will be learned while in the classroom. Therefore, when integrating coding into a K-8 curriculum, it is important for teachers and school leaders to think outside the box, ensuring mathematical problem-solving, critical thinking, and social skills, along with areas that focus on self-management in relation to one’s academic journey (Popat & Starkey, 2019). To demonstrate how coding has been integrated into a K-12 curriculum, it is important to review research studies that have demonstrated different levels of effectiveness when teaching students. For example, Goyal et al. (2016) discussed how the majority of coding tool kits that can be used to integrate coding into a curriculum are over-sized, bulky, and expensive, influencing schools to struggle in understanding the most effective ways in which this subject can be taught. The authors were able to discuss how Code Bits, a paper-based, tangible computational thinking tool kit is the least expensive, and allows schools to successfully integrate material into the curriculum. While using Code Bits, students have the ability to create programs using tangible paper bits on any flat surface, then use a mobile application infused with an augmented reality-based camera to improve their computational thinking skills. The benefits of using this tool kit in the classroom is that the software can be found on any Android mobile device, as it uses the device's camera in order to aid students in increasing their computational thinking and coding skills. The tool kit additionally aids in allowing students to collaborate together, increasing social skills and other important elements in a student's development.

Other software programs are being utilized by teachers when teaching coding, including that of Scratch (Resnick, 2013). Scratch is a block-based visual programming language online community, allowing students to create online projects using block programming. Ching et al. (2018) also discussed how Scratch can be used to teach students coding in a school environment. The author reported that Scratch is an effective tool to teach coding to younger individuals, simply because it is more creative and funnier, while allowing students to approach coding using a variety of functions from different devices. Additionally, Scratch provides a variety of animations, games, arts, and stories in order to make learning easier for students. Scratch can teach anyone coding, simply by following the instructions provided in its accompanying book. This is an important aspect for teachers integrating technology into the classroom because it allows teachers to be able to understand the integration of this technology in a simple format.

Relationship Between Prior Research and Present Study

Because technology continues to increase in both communities and the K-12 school environment, it is important for curriculum developers to continuously strive to integrate technology into the 21st-century classroom. Therefore, coding programming and computational thinking has seen a major push into K-12 curriculums, increasing a student's ability to increase their cognitive and social-emotional skills (Bers, 2017). There appeared to be mixed studies that discussed the benefits of coding in relation to the increase of academic achievement; Moreno-León et al. (2016) completed a study that focused on the benefits of coding in the K-12 classroom. During their study, the authors investigated 129 students of the 2nd and 6th grades, assessing the impact that coding could have on their levels of academic achievement. The results of the study found that for 6th-grade students, coding activities demonstrated a statistically significant improvement in regard to their level of academic performance; however, this was not the case with 2nd-grade students (Moreno-León et al., 2016). Although the authors discussed how older students' cognitive abilities were typically more mature than their younger counterparts, a teacher's comfortability with technology could also play a role when teaching advanced computational thinking in their lesson plans. Hoffmann and Ramirez (2018) also discussed how teachers can lag behind in their understanding and expertise in today's technology, as there appeared to be a wide age gap between the current generation of students in K-8 classrooms and teachers in addition to professional development opportunities. Therefore, this highlighted the purpose of the study, as teachers were not keeping up with emerging technologies, leaving many ineffective when integrating and teaching new approaches into their classrooms (Liao et al., 2017).

Because this study was focusing on the perceptions and experiences of K-8 teachers who implemented coding into their curriculum and the benefits and barriers when teaching the material to their students, this study was aligned with the curriculum theory, which aided in understanding the results through a theoretical lens.

Previous research had highlighted the benefits of coding activities in the classroom in relation to academic performance yet had failed to highlight educators' perceptions of integrating this coding curriculum into the K-8 environment. Therefore, this study was significant in the fact that it aided educators in better understanding benefits and barriers experienced when designing, structuring, and integrating the coding curriculum into their classrooms, as well as highlighting how students could better be served when learning this important skill in relation to their academic achievements. An additional benefit from this study was that it could aid teachers in better understanding effective and appropriate teaching strategies that could be used in alignment with a strong coding curriculum.

Summary

The purpose of this qualitative phenomenological study was to explore the benefits and barriers that K-8 educators experienced when integrating or teaching the coding curriculum in their schools. This chapter provided an overview on the academic research conducted into this topic. First, a brief discussion of the literature review search process was explained, followed by an articulation of the overarching theoretical framework that guided this study, which was curriculum theory. An analysis of related research was examined that focused on emerging technologies found in education, highlighting how coding programming and computational thinking were introduced into schools, how curriculums were developed, and how they were integrated into the classroom. The purpose of this literature review was to highlight the gap that ensured the need for and viability of this study, which concluded the chapter when discussing the relationship between prior research and this current study.

CHAPTER 3: Methodology

Introduction

The purpose of this qualitative phenomenological study (van Manen, 2016) was to explore the benefits and barriers that K-8 educators experienced when integrating or teaching a coding curriculum within their schools. This chapter highlights the study's methodology by presenting the research questions, the setting, the participants, data collection procedures, and the trustworthiness of the design. This chapter concludes with a discussion of the study's ethical assurances; how the researcher approached the data analysis; how the credibility, reliability, and overall trustworthiness of the study was ensured; and the participants' role in the study.

Methods and Procedures

Research Questions

This study was guided by four research questions:

RQ1: How do K-8 educators in a suburban school district implement or teach the coding curriculum to students?

RQ2: How do K-8 educators in a suburban school district describe the benefits experienced when integrating or teaching the coding curriculum to their students?

RQ3: How do K-8 educators in a suburban school district describe the barriers experienced when integrating or teaching the coding curriculum to their students?

RQ4: How do K-8 educators in a suburban school district overcome experienced barriers when integrating or teaching the coding curriculum to their students?

Setting

This study was completed at School District A, located in Mineola, New York, United States. This school district had five schools, with approximately 1,026 students. At the time of this study, the district employed 73 teachers who integrated and taught a coding curriculum to their students. Integrating coding into a curriculum occurs when teachers ensure that their students are following learning objectives, completing educational activities, and increasing skills in order to learn the craft of a subject (Henson, 2015). Before beginning the study, the researcher obtained permission from School District A, providing her the ability to enter the site to complete the research at the five schools, and then sought study approval from her university's Institutional Review Board (IRB; see Appendix A). The superintendent of the school district had provided approval for the researcher to access all educators at different grade levels across the K-8 spectrum (see Appendix B).

Participants

This study collected data from five different participant groups that consisted of a variety of educator roles found within a K-8 school: teachers, an instructional leader, a principal, an assistant superintendent, and a superintendent. A sample of six teachers between K-8 grades were interviewed from the population of 73 teachers who integrated and taught a coding curriculum to their students at School District A. Additionally, one K-8 instructional leader, one middle school principal, one assistant superintendent, and one superintendent were also interviewed in order to triangulate the data that was collected through semi-structured interviews, a focus group, and document analysis.

The selection criteria for the K-8 teachers included that each teacher had a teaching license from the state of New York, was currently employed by School District A, was currently teaching coding in School District A, had taught coding for a minimum period of one year, and had experience in implementing coding curriculum into their classroom. The selection criteria for the K-8 instructional leader included that each instructional leader was currently employed by School District A, had experience in designing and implementing a coding curriculum into their schools, and their job duty was defined as an individual who monitored lesson plans, managed curriculum, allocated resources, and evaluated teachers on a regular basis (Terosky, 2016). The selection criteria for the middle school principal and assistant superintendent included that they were currently employed by School District A and had experience in designing and implementing a coding curriculum into their schools. The selection criteria for the superintendent included that the superintendent was currently employed by School District A and had experience in designing and implementing a coding curriculum into their schools in relation to working with the assistant superintendent.

The researcher utilized a snowball sampling method (Creswell, 2013), through which she recruited participants from recommended acquaintances or colleagues of existing participants who had already been accepted as participants in the study. A snowball sampling method allowed the researcher to reach populations that were otherwise difficult to sample, while ensuring that the participants met the study's criteria (Etikan et al., 2016). Table 1 presents a description of the participants.

Table 1

Description of Participants

Participant	Title	Gender	Age	Education	Years in Current Role	Tenure Status	Criteria Met
T1	Teacher	Female	53	Master's	23	Tenured	x
T2	Teacher	Female	64	Master's	25	Tenured	x
T3	Teacher	Female	33	Master's	4	Tenured	x
T4	Teacher	Female	26	Master's	3	Not Tenured	x
T5	Teacher	Female	41	Master's	8	Tenured	x
T6	Teacher	Female	32	Master's	2	Not Tenured	x
S	Superintendent	Male	54	Doctorate	11	N/A	x
AS	Assistant Superintendent	Male	47	Master's	3	Not Tenured	x
IL	Instructional Leader	Female	42	Doctorate	4	Tenured	x
P	Principal	Female	32	Master's	5	Tenured	x
FG1	Teacher	Female	32	Master's	5	Tenured	x
FG2	Teacher	Female	53	Master's	24	Tenured	x
FG3	Teacher	Female	28	Master's	3	Not Tenured	x
FG4	Teacher	Female	27	Master's	4	Tenured	x
FG5	Administrator	Male	35	Master's	2	Not Tenured	x

Data Collection Procedures

Qualitative studies are concerned with the process of research, not just simply the result or outcomes. Qualitative researchers formulate questions to elicit from their participants "what they are experiencing, how they interpret their experience, and how they themselves structure the social world in which they live" (Bogdan & Biklen, 2007, p. 6). The goal of this qualitative study was not to reach generalization, but rather, to provide a rich, contextualized understanding of a human's experience through the intense exploration of a phenomenon (Payne & Williams, 2005). In this study, the phenomena examined were the benefits and barriers that K-8 educators experienced when integrating and teaching coding curriculum in their classrooms.

Through a series of interviews utilizing open-ended questions, a focus group, and a document analysis, this study's goal was to gain meaning from and insight into the perspective and expectations that stakeholders had of the implementation of coding into the curriculum. Open-ended interviews allowed the researcher to "access the world of perspectives of the person being interviewed" (Bogdan & Biklen, 2007, p. 6), whereas the focus group asked the participants 10 open-ended questions in a group format, in which they were allowed to answer the questions in any manner that they saw fit, while also providing feedback to other participants' responses (van Manen, 2016). The purpose of a focus group was not to confirm or deny information collected, but rather to enhance findings.

Before collecting the data, the researcher obtained approval from her university's Institutional Review Board (IRB). She obtained site approval from School District A. After both IRB and site approval had been received, the researcher then contacted the prospective participant groups by sending an email to teachers, instructional leaders, the principal, the assistant superintendent, and the superintendent who were currently integrating or teaching coding within a K-8 school. The researcher received email addresses of possible participants from the school district and emailed information regarding her study to the prospective participants. Once participants had responded to the email expressing interest, she ensured that they met the eligibility criteria and then sent them a consent form (see Appendix C).

Additionally, each participant was asked to refer a colleague or acquaintance to participate in the study by providing the researcher the individual's name, job title, and email address. The researcher reached out to these individuals in the same manner as listed above and provided them with a consent form to sign once they had met the eligibility criteria. After receiving the signed consent forms and confidentiality agreements, the researcher set up times with each participant for a semi-structured private interview. The interviews were conducted via WebEx, a virtual conferencing software, which supported confidentiality. Virtual interviews took place due to governmental policies and guidelines from the Department of Health in response to the coronavirus (COVID-19) pandemic, which prevented in-person contact. Confidentiality was supported by the researcher ensuring that other individuals were not in the vicinity of the interview; additionally, the researcher did not use identifying information of the participant during the interview and the environment was limited in terms of distractions.

During each of the semi-structured interviews, the researcher asked each of the participants the same 12 open-ended questions (see Appendix D). The researcher additionally asked follow-up questions during the same interview if she did not understand an answer or needed further clarification of a given response. Each semi-structured interview lasted between 30 to 45 minutes and was electronically recorded and transcribed in preparation for data analysis. After the interview had been transcribed, the researcher met with each participant via WebEx and reviewed the transcript with them, checking for reliability of the data to ensure that it reflected exactly what each participant had said in their responses to the semi-structured interview questions.

The researcher also recruited an additional five individuals who met the same criteria as listed above, using the same sampling method from the same sample of educators. The researcher completed a focus group by asking the participants 10 open-ended questions (see Appendix E) in a group format via WebEx. During the focus group, each participant was allowed an opportunity to answer the open-ended questions, while also providing feedback to other participants' responses. The focus group was a guided discussion (Carey & Asbury, 2016), and the researcher electronically recorded and transcribed the group session in preparation for data analysis. During the group session, the researcher also noted group dynamics and individual behaviors that had occurred. After receiving the transcripts from the focus group, the researcher met with each of the focus group participants via WebEx where they checked the transcription for accuracy, to ensure that what was recorded was reflected as exactly what the participants had stated.

Qualitative researchers sometimes supplement interview or observation data with documents that provide background information regarding an organization's everyday functions (Bogdan & Biklen, 2007). In qualitative research, documents can provide insight into leadership styles, as well as what participants attend to and value. Official documents were collected for this study, which Bogdan and Biklen further categorized into internal documents, external communication, and student records. Internal documents include “memos and other communications that are circulated inside an organization such as a school system” (Bogdan & Biklen, 2007, p. 137). In this study, internal documents included the coding curriculum scope and sequence. This document is used by the district’s educators to implement and teach the coding curriculum. Collected documents were analyzed in comparison with data collected via semi-structured interviews and the focus group to achieve data triangulation.

Trustworthiness of the Design

There are four aspects of trustworthiness that qualitative researchers must follow, which include credibility, dependability, transferability, and confirmability. In order to maintain credibility in this research, the researcher ensured that the study’s problem statement, purpose of the study, research questions, theoretical framework, and methodology were in alignment. This way, the researcher could then create a strong interview protocol that was used when collecting the data. This additionally aided the researcher in being able to answer the research questions from a neutral standpoint.

Dependability also acted as a construct of trustworthiness, as it demonstrated that the study’s findings were consistent and repeatable (Tong & Dew, 2016). To increase dependability, the researcher provided an audit trail by describing in detail how data was collected, how categories were derived, and how decisions were made throughout the inquiry (Merriam, 1998). Because the researcher built an interview protocol, this aided in ensuring that the study was in alignment and that each participant was asked the same 12 questions. When developing an interview protocol, the researcher requested a panel of experts to review the interview questions to ensure that they were in alignment with the study's purpose, problem statement, research questions, methodology, and theoretical framework. When building a panel of experts, the researcher reached out to three individuals who had similar professional and educational experiences as her own, and requested for them to review the proposal and interview questions, providing feedback if any changes in alignment needed to take place. This allowed for an unbiased examination of the study in order to ensure that there was a decrease in researcher bias and that the questions posed could answer the research questions in full (Connelly, 2016).

Transferability is also important in qualitative research; it refers to the degree to which the results could be generalized to other populations (Finfgeld-Connett, 2010). For example, Anney (2014) stated that in order to ensure transferability of qualitative data, "the researcher must collect thick descriptive data which allows the comparison of one context to other possible contexts in which transfer might be contemplated" (p. 274). Although in this current study the researcher was collecting strong and robust qualitative data, this process could also appear to be a limitation of this study. The researcher explored perceptions and experiences in K-8 schools. Other populations may have different experiences and perceptions, such as high school or college students. Therefore, the researcher could not guarantee that the results were generalized to other populations, but could demonstrate that there could be inferences.

Finally, confirmability was completed in this study by the researcher completing member checking. Member checking occurred when the different educator participant groups—such as the teachers, instructional leaders, the principal, the assistant superintendent, and the superintendent—provided feedback to the researcher as to the validity of the data. During member checking, the participants reviewed the transcripts of their interviews and focus group, and highlighted any areas of the transcript that they did not believe were reflective of what was said. This allowed the researcher to make any changes if needed, while ensuring that the data was reliable and valid before data analysis began (Birt et al., 2016).

Research Ethics

As noted above, before beginning the study, the researcher received approval from her university's IRB and permission to conduct research in School District A. After recruiting individuals and before collecting the data, the researcher provided each participant with a consent form and confidentiality agreement, in accordance with the Belmont Report's ethical guidelines (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). The consent form highlighted the study's aims and purpose, while also stating the level of risk of participating in this study. The level of risk in this study was minimal. Additionally, the researcher also discussed how each participant could remove themselves from the study at any time, without fear of any repercussions.

Confidentiality was maintained in this study, as the researcher only referred to participants in numerical fashion (e.g., Participant 1, Participant 2, etc.). The researcher only referred to the school district as School District A, in order to maintain confidentiality of their workplace. Once data had been collected and the study had been completed, the researcher retained all physical and electronic records in a locked filing-cabinet or password-protected and encrypted file folder on a removeable flash drive. This data was stored in the personal residence of the researcher, with only her having access to this information. All physical and electronic copies of confidential information will be destroyed 5 years after the completion of the study.

Data Analysis Approach

This study utilized an inductive qualitative data analysis approach. This form of data analysis was flexible as it allowed the researcher to be an instrument in the study, while understanding, highlighting, and reporting a rich and detailed account of the data that was collected, identifying and analyzing themes that had emerged from the data set (Mihas, 2019; Yin, 1989). When completing the data analysis, the researcher used NVivo 12.0 and a qualitative codebook. NVivo 12.0 is a qualitative software program that the majority of research universities use, which coded the data and highlighted emerging themes from the data set. The qualitative codebook was used to highlight participants' quotations that demonstrated the emerging themes of the data, while allowing the researcher to become intimately familiar with the material. NVivo coding used the actual language found in the data or the terms used by the participants themselves (Saldana, 2016). Coding with the actual words of the participants allowed for a better understanding of the participants' views. Using both NVivo 12.0 and a qualitative codebook aided in decreasing any instances of biases in the analysis, as the computer software ensured that the themes that had emerged from the data were appropriate and based on the transcripts of the interviews. The researcher utilized multiple phases of coding. Phase one coding was descriptive coding, also known as topic coding, which used words or short phrases that briefly summarized the basic topic of the data. Descriptive coding seeks to answer questions such as "What is going on here?" and "What is this study about?" (Saldana, 2016).

Phase two coding was conducted with the goal of developing a more select list of categories, themes, and concepts. Phase two coding included pattern coding, which pulled together data from the first cycle coding into more meaningful and parsimonious units of analysis (Saldana, 2016). Creswell (2013) encouraged researchers to use multiple and different sources to provide validating evidence. The researcher collected data from interviewing multiple stakeholders. Including multiple perspectives provided validity to the findings. Because this study was collecting data from four different stakeholders (teachers, instructional leaders, a principal, and a superintendent), the researcher utilized data triangulation. Data triangulation aided in increasing the validity and reliability of the data, as it was collected through more than one mean and sample. Data triangulation occurred in this study following four main constructs: enrichment, refutation, confirmation, and explanation (Cavell, 2018). When following enrichment, the researcher used different instruments in order to collect data. In this study, the researcher used both semi-structured interviews and a focus group. This ensured that value was added to the exploration of a phenomenon by highlighting different aspects of an issue. Refutation and confirmation also occurred when the researcher could either negatively or positively answer the overarching research questions after identifying overarching themes that were found in the data set. Finally, when completing the construct of explaining, the researcher was able to shed light on any unexpected findings that had been encountered (Flick, 2018).

Researcher Role

In qualitative research, the researcher is the primary research instrument. What the researcher brings to the investigation from his/her background and identity should be treated as his/her bias (Kaplan & Maxwell, 2005). Because the researcher had her own preconceived notions and ideas regarding the phenomenon and topic being studied, it was important to acknowledge how these preconceived notions and ideas limited instances of researcher bias. During the study, the researcher structured her data collection methods through the alignment between her problem statement, the purpose of the study, the research questions, and the methodology, using NVivo 12.0 and a qualitative codebook for data analysis. This process was helpful in reducing biases, while also ensuring that the study stayed aligned with the research questions.

Another crucial aspect of the role of the researcher was to protect and safeguard the participants and the data (Slembrouck, 2015). This occurred by the researcher following the strict protocols outlined by her university's IRB that had been in place, along with ensuring that the participants were not harmed and protecting their private information and following confidentiality (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979).

Finally, the researcher ensured triangulation of data. The triangulation of data allowed the researcher to increase the reliability of the research by collecting data from more than one data collection method. This aided in limiting research bias by collecting information from more than one source. In this study, the researcher triangulated the data by using both semi-structured interviews, a focus group, and document analysis.

Conclusion

This chapter highlighted the study's methodology, which provided an overview of the research questions, study settings, and participants, while also discussing the data collection procedures and ways in which the study remains trustworthy. This chapter concluded with a discussion of the role of the researcher, ethical assurances, and the data analysis plan, with the next chapter providing an overview of the results from the data collection.

CHAPTER 4: Results

Findings

This study collected data from five different participant groups consisting of a variety of educator roles found within a K-8 environment: teachers, an instructional leader, a principal, an assistant superintendent, and a superintendent. A sample of six teachers between K-8 grades were interviewed from a population of 73 teachers who integrated and taught a coding curriculum to their students from a single school district located in New York, United States. Additionally, one K-8 instructional leader, one middle school principal, one assistant superintendent, and one superintendent were interviewed in order to triangulate the data that was collected through both semi-structured interviews, a focus group, and a document analysis.

The findings of the data analysis are divided into the different research questions, with themes being highlighted by the teachers, administrators, the focus group, and a document analysis. Table 2 illustrates the significant themes that emerged from the data analysis, with the descriptive NVivo codes and examples, consisting of quotes from the participants.

Table 2

Significant Themes

Theme	Descriptive NVivo	Examples
Implement coding curriculum slowly, with an emphasis on teaching and listening skills (Teaching Strategies) How to Implement	Communication Communication skills Listening Listening skills Strategy Slowly Modeling Not one particular way Nontraditional way of teaching Following directions Unplugged	Our coding requires a lot of listening and following directions. I think modeling, but also explaining it unplugged by having students physically act out what the sprites would do. The main mantra that I would say for teachers and for all people to remember, that there's not one particular way of teaching. It's not your traditional way of teaching.
A Variety of Tools How to Implement	Chromebooks iPads KidOYO Platform The Internet Keyboarding Skills Hatch Python	I use Chromebooks, the KidOYO platform, and the Internet. Oftentimes, students will reference a video or slides that are posted by our teachers to help the students with the code. There are a bunch of different coding languages students can learn such as Hatch and Python.
Problem-solving, Creative Problem-solving, Critical Thinking as a Benefit	Problem-solving Core concepts Coding Learning as we go Intelligence Student futures Explore different ways	Coding benefits students later on down the line. Kids have an outlet for their technological thinking brain.

	of thinking Different opportunities Thinking algorithmically	It's also opening their world to something they wouldn't normally have the opportunity to be doing at this age. Coding forces kids to think through all steps to solve a task. These skills that when they develop them early enough through coding, they can also transfer to any aspect of life. The benefits of teaching coding to kids is it gives them a different opportunity to explore different ways of thinking, different ways to solve problems, and to use a skill they didn't even really know at this time they had the ability to do. They can realize the that they can change things and they can make change in the world that they see.
High-engagement as a Benefit	High engagement Apply knowledge Collaboration Value	At this level, students see coding as a game. It's high engagement for most students who've already had the experience with coding in previous grades. They see it as an opportunity to apply the knowledge they're gaining in a different medium and since they already enjoy coding, they then enjoy taking their knowledge and showing what they've learned in that format.

Professional Development as a Barrier and to Overcome Barriers	Barriers Professional development Skill levels Technologically invested Lack of training Lack of skills Communication Lack of communication Encouragement Value Resources Comfort level Learning the material District wide committee	Barrier number one for me is professional development. I wish I knew more about it. Having the expectation that all students and teachers are going to be involved with coding when not all teachers have been trained to teach coding is a barrier. Individuals who don't have computer science training feel inadequate. Having training for them to help them feel more comfortable delivering it. Teacher's own fear of teaching coding. Teachers have to see the value in it.
Student Abilities as a Barrier and to Overcome Barriers	Student abilities Abilities Reading abilities Disparities Team approach Collaboration	Proficiency level of the kids. The skills of the students were inconsistent. Another barrier is expecting all students to complete a certain number of projects when they have learning disabilities or a language barriers. Our students' reading abilities are a barrier. So there are difficulties especially in our population with students who English is not their first language. Paired programming can help. Either I break it down into small pieces or pair students with a buddy.

		Students can collaborate.

Research Question 1 Asked: How Do K-8 Educators in a Suburban School District Implement or Teach the Coding Curriculum to Students?

The researcher sought to examine how various educational stakeholders perceive the experience of how they implement a coding curriculum to students. Interview data revealed educators are in agreement on how implementation can occur. For example, many participants used the words *communication*, *communication skills*, *listening*, *listening skills*, as well as discussing technology used to teach coding such as *Chromebooks*, *iPads*, *KidOYO platform*, and *the Internet.*

Theme One: Implement the Coding Curriculum Slowly and Developmentally, With Emphasis on Listening and Communication Skills

Teacher 1 (T1) stated the following:

> I think listening skills for our particular coding, maybe the higher grades, they do it more independently, I don't know. But the coding that we used, it was a lot of listening instructions and following directions, so we felt that that was a struggle for us, where their following directional skills were lacking. So there was a lot of repeating, there was a lot of going back, there was a lot of distraction and refocusing, and so I think just practicing the following directions step-by-step (T1).

Additionally, Teacher 2 (T2) reported:

> I think that taking it slow in the beginning. I'll just give you an instance. When Tom used to come in, I don't know, everybody was doing it and he was letting them all kind of go at their own pace, and he was running around trying to help everybody and then getting other kids to help them. I think the way you showed it to us in training, I did it that way on the white board. We did one step at a time and kind of waited for everybody, if anyone needed help, we stopped, paused for a second. I think that strategy was better until the kids are a little bit more skilled (T2).

Teacher 4 (T4) reported that they tend to slow things down by taking time to explain different concepts to her students and modeling expectations for students. This emphasis was evident when she stated:

> I think modeling, but also explaining, so I know when I teach them how to do draw squared, I actually make them model it like as a human Sprite. So I make a student actually walk around and explain to me in words what they're doing, so that way it's not just copying and pasting code block, but understanding what code block they're using. Sometimes I'll get them started on a challenge and I make them finish the challenge, so that way they have something to go off of, but they don't have all the code to just copy and paste (T4).

Other teacher participants were able to discuss how the district started offering coding to earlier grade levels so that students could learn coding at a slower pace, while building skills as they moved forward in their grade levels. Teacher 5 (T5) stated:

> We started out very minimal and as we are implementing it and putting it out to the different grade levels, we've now started earlier and earlier. I think the way

> we're doing it is great. I just need a little bit more content in order to keep it up throughout the whole year (T5).

Similarly, Teacher 6 (T6) reported:

> Very forward-thinking in bringing coding to K-to-eight, actually pre-K to eight. I love that it's a focus and that they're trying to do the entire continuum. The district uses OEO very heavily. I think that that can be incredibly empowering for some students. It allows the students who are really into it to go ahead (T6).

It became evident in the course of the interviews and through the analysis of the data and codes that educators were giving much attention not only to coding, but also on motivating students, on building a positive attitude, on engaging students, on building their self-confidence and organizational study skills. These findings, therefore, supported the introductory literature on technology use and coding (Carver, 2016; Domingo & Garganté, 2016).

Theme Two: Implement the Coding Curriculum With a Variety of Tools and Teaching Strategies

Many of the participants were able to discuss how they are using technology and different platforms to implement and teach coding in K-8 environments, as highlighted by the middle school principal (MSP) when they stated:

> We use the KidOYO platform to engage students in coding. And we primarily do this using Chrome books that support the flash and everything that's needed in the coding platform, but also, with an external keyboard because we find that, obviously, keyboarding skills are very important when we are introducing and teaching coding. That is not to say that students are not using their iPads (MSP).

The MSP also reported:

> Oftentimes, students will reference videos or slides that are posted by our teachers to help them with the code. So it's a normal sight to see when students are coding that they are using an iPad to help them with some of the strategies and playing videos that they are typing on a Chromebook to actually code themselves. And oftentimes, there is something in the form of an anchor that is either projected on the board or referenced back to, for the students as they go (MSP).

FGP4 reported that she follows a hands-off approach to deal with implementing the coding curriculum:

> I think having a hands-off approach on it, there's only so much that I know about it, so there's only so much I can help them. So letting them dive in, seeing what they know and problem solving on their own has helped me overcome any issues that we have. A lot of the times I get it. I'm always impressed at how well they really end up doing. So hands-off (FGP4).

The assistant superintendent (AS) also discussed different technologies that are important to implementing the coding curriculum into the classroom as they stated:

> We have embedded in our platform, the opportunity for kids to go off on their own and pursue whatever languages going up to Python, Hatch. There's a bunch of different, going all the way up to like really serious web-based language, and they can learn all this stuff on their own. And just like with any initiative, when you give kids the power and autonomy to choose to go through it and pursue what they're passionate about, you'll see kids take off (AS).

Similarly, the superintendent (S) was able to discuss how the use of KidOYO is implemented into the classroom when he reported:

> KidOYO is a web-based platform that provides students with instruction in a multitude of coding languages. And then once the children finish the lessons, they're given challenges to complete. If they complete the challenge, they get issued a badge that shows satisfactory knowledge of very a specific challenge (S).

The MSP reported the reasoning of why technology plays an important role when it comes to the integration of the coding curriculum when he stated:

> It is awesome to see how the district is really pushing to integrate coding and not see it as separate and apart from or a single coding and computer science class. We are really looking at how K to eight can build a very solid foundation to allow the students to accomplish very challenging coursework, and also, be creative with projects that they implement at the high school level and beyond (MSP).

Finally, the IL discussed how there is no traditional or correct way of implementing the coding curriculum into the classroom. The IL stated:

> The one main mantra that I would say for teachers and for all people to remember, that there's not one particular way. So, this is not your traditional way of teaching. It doesn't lend itself to traditional teaching at all. It's not a particular subject where you're saying, "Okay, this is what you need to know and this is what you do and then that's it." So when introducing it, and how I would recommend teachers to teach it, is to really be problem-based. The reason, that reason being, is that that's the way that students are going to truly understand what they're coding. So in terms of that, looking at the . . . Let's say looking at a particular challenge or

> something and saying, "This is what I want something to do." Or, "This is what I want to happen. How do I get there? How do I do that?" And having to go through the thought process of doing that (IL).

Many participants also discussed how they implement and teach the coding curriculum to their students by using a variety of technology. Teacher 4 (T4) reported:

> I basically use Chromebooks, the KidOYO platform, the Internet, and I guess it doesn't work when the Internet's down (T4).

FGP2 reported that while teaching her students the basics and core concepts, she liked to include technology through her integration of the coding curriculum into the classroom. FGP2 stated:

> The whole purpose is that we're learning as we go. And if you notice the kids are getting frustrated, if you're working on the Chromebook or the iPad, take a break. Take a step back. I think that's the best way to get the kids re-motivated. And do an unplugged activity. You're working on loops, for example, do a dance using loops. There are so many activities that you can look online that don't involve a Chromebook or an iPad and the kids are still learning those coding strategies. So I think those three tips will definitely help any teacher (FGP2).

Other participants reported that when they are not using technology, they use the whiteboard to explain concepts or teach coding, which they reported students responded well to. When integrating the coding curriculum into the classroom, FGP3 reported that she has a particular method when it comes to teaching her students strategies:

> I like to start with a we-do approach to it. So the students come, I'm doing it on the board, they have a partner, turn and talk, do you have what your partner has, if

> you don't, why, what do you need to fix? Then maybe the second project I invite kids who want to be doing it with me to the front of the room but if you're confident to go on your own or work with friends, do that. And then by the third project I like to ease them into doing it on their own completely, without me. But I find when we start all together, we start to learn some of the wording together and it just gives them an opportunity to communicate with each other, which I think is so important. So I do like to start whole group with the first project at least (FGP3).

FGP3 also stated:

> I think that collaboration is key, like other participants have said. We need the support of other teachers, the experts, the librarians, and for me the homeroom teacher, so if the kids aren't finished with something and they're so close, a lot of their homeroom teachers will be willing to take that coding back and finish it in the classroom with them as best as they can. They're not experts in it either but they're open or willing to learn. So I think collaboration has definitely helped me implement the coding curriculum (FGP3).

Through the document analysis it was shown that the school district's curriculum emphasizes the importance of specific technologies that are to be utilized when teaching the curriculum to the students, namely that of KidOYO, a technological platform that develops, implements, and stores the coding curriculum.

Research Question 2 Asked: How Do K-8 Educators in a Suburban School District Describe the Benefits Experienced When Integrating or Teaching the Coding Curriculum to Their Students?

The goal of the second question was to better understand how K-8 educators described the benefits experienced when integrating or teaching the coding curriculum to their students. The researcher sought to examine how various educational stakeholders perceive the benefits experienced when implementing the coding curriculum to students. Interview data revealed educators are in agreement regarding the benefits of implementing a coding curriculum into the K-8 curriculum. Common words and phrases that the participants used that pointed to the theme included that of *intelligence*, *problem solving*, *student futures*, *different opportunities*, and *exploring different ways of thinking*, *high engagement*, *opportunities*, *applying knowledge*, and *engagement.* These words and phrases appeared to demonstrate the benefits of coding in the school.

Theme Three: The Benefits of Implementing a Coding Curriculum Are Problem-Solving, Creative Problem-Solving, and High Engagement Through Problem-Solving

The third theme brought to light through the data and coding from Research Question 2 is the shared consensus that when implementing coding in K-8 environments, learning is centered on problem-solving techniques along with creative problem-solving skills. The consensus that there were many benefits, specifically, the students' future and the promotion of different ways of problem-solving. Participants used similar words and phrases that point to this theme, such as *problem-solving*, *core concepts*, *coding*, *technology*, *learning as we go*, *high engagement*, *opportunities*, *applying knowledge*, *engagement*, and *creative problem-solving.*

When discussing that learning is centered on problem-solving techniques, participants had a lot to say regarding their perceptions and experiences. For example, focus group participant 1 (FGP1) stated:

> Problem solving is something that our students need to be explicitly taught because no longer are they going outside and making games with their friends and playing without their parents watching them during play dates, so they don’t always have these opportunities to always self-learn how to problem solve. So we have to help them see that this is an opportunity to continue to grow in that area because it’s not only important for coding, it’s important for just them as humans and interacting in this world (FGP1).

Additionally, FGP5 stated:

> Not just obviously teaching the coding itself, but the core concepts behind, as some people have already said, collaboration with other students is very big right? There’s certain students learn well from each other if they teach each other. I think the problem solving aspect, just in any course you’re teaching, or any content area, the more students learn to troubleshoot their own behaviors or their own struggles in a curriculum, that strategy can be applied to other parts of life and coding and debugging, as someone said. That is exactly critical for doing coding so you need to not get stumped. The growth mindset piece is clearly important. That’s been a big push the past few years. That coding you’re supposed to run into bugs, that’s part of the process. The key is how do you then overcome it. So I think the more you can embed those skills into your regular

> lesson, the better the students are going to adapt to coding when they're presented with coding challenges (FGP5).

This was made evident by T1 when they stated:

> It [coding] benefits them [K-8 students] later on down the line. Possibly there are some kids that have that intelligence, that technology part of their brain that sparks, they can go in that direction later on in life. So the benefits for those kids are great, where they have an outlet for their technological thinking brain (T1).

Similarly, T2 reported:

> I think it's also opening their world to something that they wouldn't normally have the opportunity to be doing at this age (T2).

T3 was able to discuss how coding can really assist students with problem-solving techniques when they stated:

> So coding definitely really forces kids to think through all of the steps to solve a task. . . . But these are skills that when they can develop them early through coding, they can also transfer to any aspect of life. So a lot of benefit we see through this is communicating during group work in class, which then will help them in the real world as adults in the workforce (T3).

T4 reported that there are many benefits outside of simply learning coding, as it can expose students to other ways of thinking and also other experiences that can benefit their future. T4 stated:

> It gives students an opportunity to learn about coding, learn about computer science, and get an opportunity to see something that they might not normally see, unless they went into it in college, which would be too late, so now they have an

> avenue to explore something that they . . . Like they can get an interest in something that they might not have known that they had an interest in (T4).

T5 reported that teaching coding to students can promote stronger problem-solving skills and different ways of thinking and approaching problems. They reported:

> The benefits of teaching coding to the kids is it gives them a different opportunity to explore different ways of thinking, different ways to solve a problem, and to use a skill that they didn't even really know at this time that they had the ability to do. . . . I think it really does benefit everybody to see a different way of thinking and solving problems (T5).

Finally, T6 discussed how students can become empowered by making coding their own. This was evident when they stated:

> They can make it do something different. So they can make the technology their own, and so many of these things that they're so used to and are kind of black boxes, that you can actually change it and do it. And I think that that's very empowering for a student to be able to make the robot do what they want or make the code do what they want. So that they can realize that they can change things and they can make change in the world that they see (T6).

Participants highlighted that the main benefits of teaching coding to students included the students' futures and promoting different ways in examining and solving problems. This was evident when MSP reported:

> I see coding as a skill and a language that students can use far beyond the confines of their more formal education through high school and even into college. I think it's an opportunity for students to express themselves, to revise and to edit. I think

> it's an opportunity for them to truly challenge themselves to learn something new (MSP).

The MSP continued to state:

> It's also a way for students to showcase content knowledge just as they would use any other educational tool. So I think that it adds to students' portfolios and if they can challenge themselves to learn coding K through eight at such a young age and challenge their minds to think in this way, it really opens them up to many different opportunities moving forward (MSP).

Additionally, the AS stated:

> I think there are three concrete benefits to teaching coding in K-8. Number one, just like I said before, it gets the students to think algorithmically, to think algorithmically and think in patterns (AS).

The AS continued to report:

> The other piece that I think is really important is that it teaches kids how to methodically debug something. So it's important with coding that every comma is at its place and every semi-colon is where it's supposed to be, otherwise the program doesn't work. So it requires students to be meticulous and go through line by line of code so that they can make sure that that project works as they expect it to. The third benefit is that it shows students, demonstrates to students and teach students a demonstrable skill that they will need in jobs of the future (AS).

The superintendent of the school also discussed benefits by stating:

> Well, I think coding, in and of itself, is a good, a good knowledge base to have as they move on to school and into life. I think the benefits include all the things we always teach kids: sequencing, algorithms, how to get from Point A to Point B in a logical sequence (S).

Finally, the IL was able to discuss benefits that included the promotion of thinking and communication skills. The IL stated:

> I think coding in general helps students make connection to things that they see as discrete when it's presented and a lot of information in our world is presented as discrete facts. And then seeing things come together as a whole picture and seeing how they interconnect and how they're woven together. I think benefits of teaching coding will help students to communicate. Help students to think through the problem solving process (IL).

Participants were able to discuss how the benefits of teaching coding to students included that of a very valuable experience due to high engagement and the learning of new problem-solving techniques. This was apparent when FGP1 reported:

> I think it's showing the value. It's having kids speak to the value. I think when you're a teacher and your colleagues are doing something that you're not, you kind of feed off of one another on how to scale that (FGP1).

Additionally, FGP2 stated:

> It's high engagement for most of the students who've already had experience with coding in the previous grades. They see it as an opportunity to apply the knowledge that they're gaining in a different medium and since they already

> enjoy coding on the kidOYO platform they then enjoy taking their knowledge and showing what they've learned in that format (FGP2).

The third focus group participant was able to discuss that they see the learning experience similar to that of a game, forcing them to want to problem-solve in a different way, which increases engagement. FGP3 stated:

> I think even at our lowest levels, the kids love it. For us, they see it as almost like a game. When they're on kidOYO and they're trying to code the robot and solve the problems they love it. So it's definitely high engagement. A benefit is definitely they have to think critically and at our lowest levels we see it. They talk to each other, they collaborate, and they want to problem solve, so when they don't get it right, they don't shut down. They're very eager to try to solve the problem and look at where they went wrong. And I think that's great because then it goes into their other academics. In math, they're not so eager . . . they won't shut down as easily because they've learned in coding that they have to debug, they have to problem solve. So I think it goes across all academics, the skills that they're learning (FGP3).

FGP4 discussed how a benefit of coding is that it is very engaging for students. They stated:

> I like that it's self-paced so students have opportunity to take their time with it. And it gives kids opportunity to work individually if that's what they like, or with other students, with their peers in a group or team. I think that they like that choice aspect of it all (FGP4).

Finally, FGP5 stated:

> Something else that we've seen is, I think, a higher level of creativity from these coding challenges year over year. How we're asking kids to do it and how we merge them with the curriculum. And so it allows you to merge the math brain with the part of your brain, the other side, of being very creative. Because you're trying to make something for yourself. With that component of problem solving leads to a lot of really higher order thinking. And so I think it really pushes kids forward and then, like other participants have reported, those skills then transfer into other parts of their schooling (FGP5).

Research Question 3 Asked: How Do K-8 Educators in a Suburban School District Describe the Barriers Experienced When Integrating or Teaching the Coding Curriculum to Their Students?

Research Question 4 Asked: How Do K-8 Educators in a Suburban School District Overcome Experienced Barriers When Integrating or Teaching the Coding Curriculum to Their Students?

The third research question sought to better understand how K-8 educators described the barriers experienced when integrating or teaching the coding curriculum to their students, while the fourth research question sought to better understand how K-8 educators overcome the described barriers when integrating or teaching the coding curriculum to their students. Similar to the other research questions, the researcher collected data from completing semi-structured interviews with teachers and administrators, while also completing a focus group and a document analysis. When examining barriers and overcoming barriers of coding in the school, the participants used words and phrasing that emerged from this question. For example, common words and phrases used included *professional development, time*, *technologically invested*, *lack of training*, *communication*, *encouragement*, *stigma*, *myths*, *teaching time*, *resources*, *lack of resources*, *material*, *comfort level*, *professional development*, *district-wide committee*, *missions and goals*, *platforms*, *creativity*, *the value of coding*, and *student abilities*, *reading abilities*, *disparities*, and *different abilities.*

Theme Four: Professional Development

Participants were able to identify different barriers that have been experienced when it came to teaching coding and integrating the curriculum into their classrooms. Some of the participants were able to discuss barriers in relation to educators, while others discussed barriers in relation to the students. T1 stated:

> So barrier number one is professional development for me, that I wish I knew more about it. Again, like I said, my first experience this year, I was definitely one step ahead of the kids. I knew what to do, I knew the steps to complete the coding project, but I wish I knew a little bit more. So that's one barrier, the professional development (T1).

Additionally T1 continued:

> Number two [barrier], time. We all wish we had more time in the day to implement the coding. Number three, I found this year was that the skills of the students were inconsistent. So, their skill level this year I felt was completely dependent upon the skill level of last year's teacher. So if last year's teacher wasn't technologically invested or they didn't truly understand how things work or didn't necessarily have that technological brain, that then their students might not have the necessary skills to move to the next grade (T1).

Finally, T1 discussed all barriers they had experienced as evidenced by them, stating:

> So I think that barrier, you could definitely see the different proficiency levels of the kids, depending on the previous year's teacher. So I think if we had one teacher, it would be consistent for everybody (T1).

T2 was able to discuss barriers by reporting:

> I guess the barriers would definitely be my knowledge and their knowledge. I think they know more about it than I do, so that's a barrier. But like I said, to push through that barrier, I know when I did it in the classroom the last time, the second time, I remembered a lot of what we had done at the first training session and I just used the kids to help the other kids. So, that's how I overcome the barrier. Then of course, just asking for your help is helpful too (T2).

T3 discussed difficulties when it came to languages, making communication difficult between teachers and students:

> Having the expectation that all students and teachers are going to be involved with coding when not all teachers have been trained in how to teach coding. And another barrier that I've seen a lot also is expecting all students to complete a certain number of projects when they have learning disabilities or language barriers, either they're language impaired, which again, even though they're coding, coding is a language. So it really is hard for them. When they speak Spanish, even though some of the languages can be translated into Spanish like Hatch, if they don't know what those blocks mean in Spanish, they're not going to be able to use the language tool. So those are barriers that make it difficult. And another barrier I would guess would say time. Just finding the time to really fit in

> coding during different units of curriculum because as much as you try to integrate it, it still takes up time if they do not have the foundational skills to complete different projects (T3).

Finally, T6 discussed the importance of professional development:

> Individuals who don't have computer science training feel inadequate, whether that inadequacy . . . I would say it's most of the time not really justified. But just having that training for them to feel more comfortable to deliver it, because in general, K-to-eight coding is not going to be taught by someone with a computer science degree (T6).

The IL reported:

> One barrier I would say is just the stigma or the myths of what coding is. The other barrier I would say is just in general in terms of content, in terms of curricula. Time, teaching time with students in terms of what's in the curricula. And do we have, quote unquote, space in the curricula in order to also teach coding? I think this comes up a lot, this came up with the whole notion and movement of project-based learning. Came up with the whole system when you think of block scheduling and when you think of schools and content areas and teaching in certain ways (IL).

MSP also discussed anxieties that can come along with coding, especially when connected to different stigmas. The MSP reported:

> While we are definitely thinking about the needs of our current students and how that could meet the future, how those skills can be integrated into their future world, I think that a lot of our teachers did not grow up with education like that.

> And coding can sometimes have a little bit of a visceral reaction like, Oh my goodness, I can't do this. It's so specialized or it's a language, how am I going to learn a full language? So I think, also, kind of the de-escalating some of the anxieties that come along with the teacher wanting to be the expert and be able to teach things flawlessly (MSP).

Both the AS and the S were able to discuss teachers being their own barrier with how they approach coding and how they respond to the challenges that they experience. As stated:

> One of the barriers is I think is the teacher's own fear of, I don't know this, so how am I going to teach it? And that has been worn away over time. Four years ago when we first thought of the idea of putting coding projects in each grade level, there was significant resistance, and we had to wear that down by providing support staff in each of the buildings to help teachers facilitate those programs (AS).

The superintendent (S) reported:

> I think teachers have to see the value in it. When teachers see the value in it, it becomes a lot easier to implement. And we certainly have some teachers that don't believe it's important or don't believe it's their job to teach it. So when you integrate it, you have to find ways that make it manageable and meaningful, in spite of some viewpoints around it (S).

Teacher participants discussed how training, professional development, and simplifying materials helps in overcoming many barriers. This was apparent when T1 stated:

> Well, one was to give a suggestion, like I just said. That was probably one of them. Well, the one, I think it was the second point I made or the first one I made that professional development, I did go to you, the coding person of the building, and we had talked about maybe doing something together and being part of the next project so I would be more involved and have a better understanding. I forgot what the other barrier is. Oh, time. There's nothing I can do about that (T1).

T2 stated:

> I guess taking a step back and just allowing it to go and not getting so frustrated, realizing it's a learning curve for everybody. Knowing that I'm not going to be doing this too much longer (T2).

T3 reported how training has helped when it comes to overcoming barriers. They stated:

> So I feel like in comparison to some of my colleagues, I'm lucky because I had so much training with coding, so I try to help my colleagues with ways that they can teach coding to their students. Specifically what I do to start the year off is I have the kids do more so investigative problem solving with coding to refresh their skills rather than telling them what to do. I'll say, "Okay, we want it to move. How do we do that?" And we'll brainstorm together and they'll play around with the blocks so that way it sets the stage for the rest of the school year. They know that I'm not going to give them the answers. They need to really play around and figure it out themselves but I'm there to support them. For my students that have language impairments, whether it means they don't speak the language or for different learning difficulties, I'll write out step by step instructions just really to fulfill the need that all students have to complete the projects (T3).

Finally, T6 highlighted how self-teaching aided in overcoming barriers:

> So I guess just self-teaching, right? So trying to bring my own comfort level up. And then also just collaboration. Talking to others, finding out what works and doesn't work. And in constant iteration of whatever you're doing (T6).

Showing the value of coding contributed to overcoming barriers that were previously identified. This was evident when the IL stated:

> We've done professional development and we've offered district-wide professional development, which is choice for teachers. But we first started doing professional development in the district-wide committee. And ensuring that we're all on the same page in terms of our mission and goals of the committee and where we're headed as a district in terms of our coding and computer science initiatives (IL).

The MSP reported:

> It's very important that I continue to support my teachers and my students when incorporating something new and coding still can be considered pretty new, in terms of an initiative in the district, especially the K through 8 continuum. I think their communication is very important in terms of how things build, so that teachers can understand that this is something that the district is vested in. I think getting, this might not be politically correct to say, but down and dirty with it also, sit down, learn from the experts, understand the platform, not see it as just something that I am helping to facilitate from above, but really participate in the classes and understand it from a resource level so then I can learn alongside some of the teachers (MSP).

Many of the processes that the participants were able to discuss are highlighted in the school district's coding curriculum. For example, focusing on problem-solving skills and computational thinking is one of the main tenets of the curriculum, which begins in the Pre-K curriculum. The curriculum document reveals how the school district has a coding committee that meets on a monthly basis and reviews how the coding curriculum is integrated. Additionally, the coding committee will review and revise the coding curriculum periodically, while planning for future changes. Interestingly, none of the teacher participants either in the semi-structured interviews or the focus group highlighted the coding committee; however, they were able to discuss individuals within the school district whom they could contact if they had any problems or questions. These findings suggest that the school district has a designated committee comprised of key stakeholders, a planned coding curriculum that is fluid and under periodic review, along with guidelines to implement the coding curriculum.

Theme Five: Student Abilities as a Barrier

Participants were able to contribute to key phrases in Research Questions 3 and 4. The fifth theme that emerged from the data set was that when implementing coding in K-8 environments, there are many barriers, with a main one being the different abilities that students present with when learning in the classroom. The different abilities students have include, but are not limited to technology skills, reading levels, and following directions.

Participants reported that student abilities acted as a barrier when integrating and teaching coding in a classroom. FGP1 reported:

> The different abilities in the classroom. So I have some children that are still logging on and other children that are on their third continent already, have the map up and can follow the directions. First of all they can read, which is an added bonus, they can read the directions that are up on the Promethean, they can follow directions, and then other children are still struggling to spell their last name into the Chromebook properly. So it's that disparity that we always play with. They should have the opportunity to finish a project they start but when is that project being finished when we have to move on? Well first of all, I only have the Chromebooks for a day, you know what I mean? So then that's when you sit a fourth grader with them, but is the fourth grader doing it? Or is my third grader doing it? I'm not real sure (FGP1).

FGP2 stated:

> Our student's reading abilities. Are they able to read the directions or do they understand what is being asked of them? Because other participants said earlier how it's a lot of following directions then implementing those direction into their ability to code and what happens when our students don't speak English as a first language or have very limited English proficiency skills. So that becomes a major challenge for them, when there's a lot of language involved and then it's so high level language such as coding terms. Which had been said before, how are they supposed to access that? Then becomes copy and paste into the translator or translate their screen, it becomes difficult then when someone is assisting them if they can't understand the translated language. So there are difficulties especially

> in our population with students who English is not their first language and working with them to complete the projects (FGP2).

FGP4 reported that when they experience different abilities in the classroom, it is important to do something about it. They reported:

> So there are kids that definitely help but for many subject areas having them realize what helping is rather than doing for, I think FGP2 mentioned something about that. So I'll have kids pair up, one student who's struggling, one student who's doing well, but I can never really gauge if the student is helping them, teaching them the language, teaching them what they're doing, or taking the Chromebook out of their hands and getting it done for them so they can move on as well (FGP4).

T4 discussed simplifying the material for students in order to overcome barriers:

> Either I break it down into small pieces. Sometimes I'll pair them up with buddies, or I know for one of my challenges, the basic quiz game, I let them choose topics that they wanted their quiz to be on, so that way it was relevant to them, and it gave them more of an incentive to want to work on it, because it was more catered to their interests (T4).

The document analysis of the curriculum indicates that library media specialists are available to help the teachers to continue building and reinforcing the basic foundations of coding to students during library.

Summary

The major themes identified in this chapter have shown a consensus among the various educator participants. The educators who participated in this study included six teachers, four administrators (an instructional leader, a middle school principal, an assistant superintendent, and the superintendent), an additional five teachers who completed one focus group, and analysis of the K-8 coding curriculum document. With the goal of answering the four research questions, this study found five themes that emerged from the data set, which highlighted instances of how coding is integrated and taught in the classroom, the benefits associated with coding, the barriers associated with coding, and how K-8 educators overcame barriers that were experienced during the process. Themes that emerged were that teachers should proceed slowly and developmentally with emphasis on communication skills, and a variety of technology tools and teaching strategies should be used when implementing the coding curriculum. Benefits of implementing coding in K-8th grade include an increase in creative problem-solving abilities when coding, critical thinking, and high engagement are additional benefits of teaching coding to students. Barriers included the need for professional development for teachers and awareness of student abilities, such as reading level and technology skills. When overcoming barriers, the themes that emerged were the need for teachers to be self-taught by taking ownership over learning how to teach coding, the need for more professional development, the idea that collaboration is important, and the need for teachers to understand the value of implementing a coding curriculum in the K-8 curriculum.

The following chapter will provide a discussion on the results in alignment with previous literature that has been completed on coding curriculum in educational settings, alongside the study's implications, recommendations, recommendations for future research, and experienced limitations.

CHAPTER 5: Discussion

Introduction

The purpose of this qualitative phenomenological study was to explore the benefits and barriers that K-8 educators experienced when integrating and teaching coding curriculum in their classrooms. The researcher collected data by conducting semi-structured interviews, a focus group, and document analysis with the aim of answering four core research questions. Overall, this study found five themes that emerged from the data set that highlighted instances of how coding is integrated and taught in the classroom, the benefits associated with coding, the barriers associated with coding, and how K-8 educators overcame barriers that were experienced during the process. The themes that emerged were that teachers that should proceed slowly and developmentally with emphasis on communication skills, and a variety of technology tools and teaching strategies should be used when implementing the coding curriculum. Benefits of implementing coding in K-8th grade included an increase in creative problem-solving abilities, critical thinking, and high engagement. Barriers included the need for professional development for teachers and awareness of student abilities, such as reading level and technology skills. When overcoming barriers, the themes that emerged were the need for teachers to be self-taught by taking ownership over learning how to teach coding, the need for more professional development, the idea that collaboration is important, and the need for teachers to understand the value of implementing a coding curriculum in the K-8 curriculum.

This chapter will conclude the dissertation by providing a discussion on the results in alignment with previous literature that has been completed on coding curriculum in educational settings, alongside the study's implications for future research, implications for future practice, and experienced limitations.

Interpretation of Results

RQ1: How Do K-8 Educators in a Suburban School District Implement or Teach the Coding Curriculum to Students?

The findings of this study highlight that K-8 educators each have their own interpretation regarding the implementation and teaching of coding; however, there appear to be some strong foundational aspects as to how to teach the material. For example, all K-8 educators discussed the importance of technology when it came to teaching coding. For example, both teachers and administrators were able to discuss technology platforms such as the use of the Internet, KidOYO, and the use of iPads and Chromebooks to assist with the course. It should be noted that many participants noted that there was not one direct way to integrate the teaching or coding curriculum into classrooms; however, the coding curriculum designed by the school district reported otherwise, as there were direct steps laid out for what material needs to be included in each grade level. These results suggest that teachers should follow the curriculum, yet have flexibility in how they teach the material to their students.

RQ2: How Do K-8 Educators in a Suburban School District Describe the Benefits Experienced When Integrating or Teaching the Coding Curriculum to Their Students?

All participants were able to discuss the benefits of integrating and teaching the coding curriculum to their students, which included teacher participants reporting increased future opportunities and an opportunity to explore different ways of thinking, and the level of engagement found in the classes. It is interesting to note that the administrator participants perceived the benefits differently, as they reported more cerebral benefits in nature: increased critical thinking skills, problem-solving skills, and the ability to learn to think algorithmically.

RQ3: How Do K-8 Educators in a Suburban School District Describe the Barriers Experienced When Integrating or Teaching the Coding Curriculum to Their Students?

All participants were able to discuss different barriers experienced within the K-8 environment when it came to integrating and teaching the coding curriculum to students. Teacher participants in both the semi-structured interviews and the focus group were able to discuss how student abilities, professional development, and communication issues acted as barriers. The administrator participants were able to determine barriers such as that of the stigmas of coding, the learning of the material for both students and teachers, and the resources that are available when it comes to teaching the curriculum. One administrator participant reported that their school district has the resources of iPads for all students; however, the administrator did acknowledge that this could be a barrier in other schools outside of the district.

RQ4: How Do K-8 Educators in a Suburban School District Overcome Experienced Barriers When Integrating or Teaching the Coding Curriculum to Their Students?

The majority of participants were able to discuss how to overcome barriers when integrating and teaching the coding curriculum to their students. The focus group and the semi-structured interviews revealed the use of a team approach alongside instances of increased training and self-teaching modes. The administrator participants highlighted how it is important to demonstrate the advantages of coding, alongside ensuring that all teachers continue to take part in professional development opportunities. The document analysis of the curriculum corroborated the evidence from the interviews. The coding curriculum documents described a team environment with professional development opportunities, alongside professional staff that can aid in overcoming any barriers. This combined with a coding committee that meets monthly demonstrates that the curriculum is being periodically reviewed and revised for both current and future students.

Relationship Between Results and Prior Research

To address the problem that educators can fall behind in technology trends in their understanding and expertise, the purpose of this study was to explore the benefits and barriers that K-8 educators experience when integrating and teaching the coding curriculum in their classrooms. In this study, it is important to discuss the relationship between the results and prior research in order to highlight any differences between the two. Each research question and their corresponding results will be discussed in relation to prior literature.

RQ1: How Do K-8 Educators in a Suburban School District Implement or Teach the Coding Curriculum to Students?

Two themes emerged through thematic analysis from the different participant groups: the teachers who participated in semi-structured interviews, the administrators who participated in semi-structured interviews, and the teachers who participated in a focus group.

Theme One: Implement the Coding Curriculum Slowly and Developmentally, With Emphasis on Listening and Communication Skills

The first theme highlighted that educators perceived that the implementation of a coding curriculum occurs slowly, with an emphasis on teaching listening and communication skills. Listening skills appeared to be an important factor for teachers, as they reported that it was crucial for students to listen in order to follow directions or instructions. Additionally, a variety of technology was reported to be used when implementing the coding curriculum, such as that of Chromebooks, iPads, the Internet, and the KidOYO platform. Previous research has appeared in alignment with this theme, as Goyal et al. (2016) reported the benefits of coding programs such as that of Code Bits, which allow for schools to successfully integrate material into the curriculum. Additionally, Ching et al. (2018) discussed how another coding program called Scratch could be used to teach students coding in a school environment. Ching et al. reported that Scratch is an effective tool to teach coding to younger individuals, simply because it is more creative and funnier, while allowing students to approach coding using a variety of functions from different devices. Therefore, the results of this study are in alignment with these prior research studies, as the school under exploration in this current study was able to utilize KidOYO and a variety of devices such as that as iPads and Chromebooks, when integrating coding into the curriculum. In terms of listening skills, Bers (2017) reported that when integrating coding into the curriculum, it is important to focus on students' cognitive and social skills. Teachers were able to discuss this too, as they reported that cognitive abilities such as memory, listening, and following specific directions are important when working within a coding curriculum.

Theme Two: Implement the Coding Curriculum With a Variety of Tools and Teaching Strategies

The second theme that emerged from the data set was that when implementing the coding curriculum, a variety of tools and teaching strategies are used. Participants were able to discuss different platforms that were used to implement the coding curriculum and highlighted the usages of technology such as KidOYO, Python, and Hatch, as well as a variety of teaching strategies. Some of the teaching strategies that were identified by participants included that of the utilization of Chromebook and iPads, as well as focusing on the teaching of keyboard skills. Some participants reported that there was not one particular way of teaching coding to students, as some nontraditional methods have to be used. This theme is in alignment with previous research where it has been discussed how different teaching strategies are important in order to engage the students. For example, Cristol et al. (2015) reported that curriculums utilizing technology must follow a 21st-century curricular framework. Therefore, the authors reported that a 21st-century curricular framework ensures that K-8 education encompasses technology so that students can experience a powerful and engaging learning experience within their classroom. Additionally, Bull et al. (2016) reported that including technology into curriculums enhances learning across a broad array of subjects. When developing curriculums that involve technology, Bull et al. reported that different factors should be considered, such as pinpointing the exact acquisition of technology, the placement and support of the technology, safety, the alignment of educational standards and learning objectives, scheduling, and professional development opportunities.

Additionally, educators were able to discuss the importance of integrating technology as part of the coding curriculum and a variety of teaching strategies they use when implementing the coding curriculum. In relation to previous literature, Zhu et al. (2016) completed a study where they conducted four different coding workshops for children, with an interest in better understanding both the advantages and disadvantages of graphical and tangible interfaces when teaching coding to children using technology. The results of the study concluded that the graphical input of coding aided children in remaining focused on problem-solving versus the tangible elements of coding. The authors reported that the tangible interfaces of coding better support schema construction and causal reasoning, while promoting stronger classroom discussions, participation, and engagement.

RQ2: How Do K-8 Educators in a Suburban School District Describe the Benefits Experienced When Integrating or Teaching the Coding Curriculum to Their Students?

The second research question aimed at understanding how educators described the benefits experienced when integrating or teaching coding curriculum to their students.

Theme Three: The Benefits of Implementing a Coding Curriculum Are Problem-Solving, Creative Problem-Solving, and High Engagement Through Problem-Solving

The third theme that emerged from the data set was that problem-solving, exploring different ways of thinking, and the future of students were the benefits of integrating and teaching coding to their students. In other words, many benefits also were experienced outside of the classroom. This was in alignment with previous research such as that of Gadanidis et al. (2017). The authors reported that coding and programming can help students throughout their educational journeys, as it highlights the improvements of soft skill sets, such as those of perseverance and problem-solving abilities. Outside of learning the ability to code, students can also obtain an increase in the understanding of math concepts, logic, project design, communication and collaboration, and the acceptance of constructive criticism. This was also highlighted in research completed by Miller et al. (2018), who discussed the benefits of exposing K-12 students to computer science and coding through summer camps. The authors examined the CS@SC summer camp, where students are exposed to a weeklong program that introduces students to computer science. Within this camp, many underrepresented students attend: 40% of campers are girls, 70% are from minority groups, and 80% come from low-income families. Miller et al. found that camps that offered introductory exposures to the computer science field found a 12% increase in future individuals indicating that they would like to study STEM, thus increasing diversity in the field.

Participants perceive coding curriculum benefits to include critical thinking and problem-solving skills, as well as the ability to think algorithmically. Duncan (2018) highlighted the reported development of computational thinking through computer science, finding some benefits for primary school students. Duncan’s study appears in alignment with this theme, as he demonstrated that the introduction of coding and computational thinking practices is global, with countries such as New Zealand and Australia adopting such academic practices in 2018. The author completed a study that aimed at understanding how computational thinking concepts should be taught in schools as well as the positive impact that it can have on students. Building on a previous research study that was conducted in 2014, the author collected data between the years of

2015 and 2016 from 18 primary school teachers throughout New Zealand. Teachers completed online surveys and semi-structured interviews. The results of the study highlighted that computational thinking promoted positive impacts on students' general learning, with minimal negative impacts, as long as the course was implemented appropriately, with the teachers having knowledge of how to use the technology during their instruction. Kush (2019) discussed the benefits of computational thinking and computer science in education while highlighting the importance for schools and teachers to ensure that computational thinking is seen as a pedagogical tool. The author analyzed ways in which computational thinking can be integrated into curriculums in order to identify and highlight the benefits for students. Computational thinking aids in reducing complex problems into smaller and more manageable ones, making it easier for students to solve problems either with or without a computer. Kush discussed the importance of teaching computational thinking to young children, as many components of this skill are essential for child development throughout education. For example, pattern recognition is considered to be one of the most important aspects of computational thinking, as it allows students the ability to search and understand trends, differences, similarities, and regularities in a particular data set. From this, Kush concluded that it is essential for teachers to integrate computational thinking into their lesson plans, either utilizing the skill set as a stand-alone lesson or one that is integrated into different subjects.

Participants reported that the value of coding being integrated into a curriculum includes high engagement and the learning of problem-solving techniques. High engagement is indicated by observations of students by their teachers when coding in the classroom. In alignment with previous research, Goyal et al. (2016) reported that by students being exposed to different kinds of technology and platforms when being taught coding, that in itself can create high engagement and exposure to a variety of problem-solving techniques. For example, the authors reported that Code Bits, a paper-based, tangible computational thinking tool kit, is the least expensive and allows schools to successfully integrate material into the curriculum. While using Code Bits, students have the ability to create programs using tangible paper bits on any flat surface, then use a mobile application infused with an augmented reality-based camera to improve their computational thinking skills. The benefits of using this tool kit in the classroom is that the software can be found on any Android mobile device, as it uses the device's camera in order to aid students in increasing their computational thinking and coding skills. The tool kit additionally aids in allowing students to collaborate together, increasing social skills and other important elements in a student's development.

Additionally, Ching et al. (2018) discussed Scratch, a block-based visual programming language online community, allowing students to create online projects using a block-like interface. Ching et al. also discussed how Scratch can be used to teach students coding in a school environment. They reported that Scratch is an effective tool to teach coding to younger individuals, simply because it is more creative and funnier, while allowing students to approach coding using a variety of functions from different devices. Additionally, Scratch provides a variety of animations, games, arts, and stories in order to make learning easier for students. Scratch can teach anyone coding, simply by following the instructions provided in its accompanying book. This is an important aspect for teachers integrating technology into the classroom because it allows teachers to be able to understand the integration of this technology in a simple format.

RQ3: How Do K-8 Educators in a Suburban School District Describe the Barriers Experienced When Integrating or Teaching the Coding Curriculum to Their Students? and RQ4: How Do K-8 Educators in a Suburban School District Overcome Experienced Barriers When Integrating or Teaching the Coding Curriculum to Their Students?

The third research question aimed to better understand how K-8 educators described the barriers experienced when integrating or teaching the coding curriculum to their students. The fourth research question aimed to better understand how K-8 educators overcame any barriers experienced when integrating or teaching the coding curriculum to their students.

Theme Four: Professional Development and Theme Five: Student Abilities

The fourth and fifth themes that emerged from the data set highlighted how teachers and administrators perceived barriers as being that of lack of professional development and communication. In alignment with previous research, Hoffmann and Ramirez (2018) discussed how teachers could fall behind in their understanding and expertise in technology. To support this statement, Liao et al. (2017) reported that because teachers are not keeping up with emerging technologies, many are ineffective when integrating and teaching new approaches in their classrooms.

Student abilities act as a barrier, as participants reported that reading and coding abilities get in the way of effective teaching. For example, some students were reported as having stronger reading abilities, which made it easier for them to follow directions when coding. Other students had stronger coding skills than others, which delayed their learning because teachers had to move more slowly with other students who may not have understood the concepts as quickly. In alignment with previous research, McClung (2019) explored whether there were any relationships between one-to-one technology and student achievement in K-12 schools. Currently, many K-8 schools throughout the United States utilize traditional technology learning platforms, that is, where teachers instruct the entire class using a form of technology, rather than one-on-one instruction. McClung completed a quantitative study using a quasi-experimental design using survey instruments. Collecting data from 2,640 students from seven middle schools, along with 63 staff members working at the same schools, the author aimed to determine if one-on-one instruction using technology increased student achievement in relation to traditional, or group teaching methods. The results of the study actually concluded that one-on-one instruction using technology did not produce significant results, highlighting that individualized and group teaching methods while using technology produced similar student achievement levels. Therefore, it is important to highlight how group technology learning environments can be just as effective as individualized instruction, especially when it comes to coding.

In order to overcome barriers, teacher participants reported that training, self-teaching, and simplifying aids are the best approaches in order to become successful. In alignment with previous research, Carver (2016) explored teacher perceptions regarding the barriers and benefits of technology use in the K-12 classroom. Obtaining data from 68 graduate students in education, Carver requested participants to complete an open-ended survey and found some interesting themes. The themes that were found included that although the availability of technology appeared to be a barrier for teachers, at times teachers also tended to experience content instructional issues and issues with knowledge on how to operate or utilize the technology in the classroom setting. Because technology is important and useful within a K-12 environment, other studies have examined pre-service teachers and the preparation techniques used to ensure their comfort level and competence once they reach the classroom as a professional.

The administrators also discussed the value of coding by reporting that professional development opportunities can aid teachers in overcoming barriers experienced within the classroom. Similarly to Carver (2016), Liu et al. (2017) completed a study that focused on technology integration into classrooms at K-12 schools. The authors completed a multilevel path analysis model, with the aim of designing and testing a model that supports the integration of technology into K-12 classrooms. Collecting data from 1,235 K-12 teachers, the authors studied 336 schools in 41 districts throughout the state of Florida, and found that a teacher's experience with technology significantly influenced how technology was integrated into the classroom. This study brought up an important aspect of emerging technology being integrated into curriculums: a teacher's confidence level. With lower levels of confidence, teachers will struggle to integrate technology into their classroom, which aligns with this study where teachers struggle to understand how to appropriately utilize technology in their classrooms, combined with a lack of professional development opportunities that can stunt their ability to effectively teach their students.

When it comes to team approaches, there are some studies that support this theme. Mayes et al. (2015) argued that when planning curriculums and integrating them into a school district, it is important for teachers to be involved. The authors reported many challenges on integrating technology into the curriculums found in 21st-century educational practices, mainly concerning the offerings that schools can provide to their students in terms of specific types of technology and the manner in which it is implemented. Mayes et al. reported that when developing curriculums embedded with technologies, school leaders and teachers should keep in mind privacy issues and system security issues, outside of issues that are experienced by students.

Limitations

There are some limitations that must be discussed when it comes to this study, including those of the participants and geographical region. This study was completed in a single school district located in Mineola, New York, United States. Therefore, although this study can be conducted in other geographical regions, the results of this study may not be transferrable to schools outside of this geographical region. If future researchers would like to understand barriers experienced when implementing coding into K-8 environments in other geographical areas, future research studies need to be completed. The researcher only collected data and completed her study on K-8 schools; therefore, any school grades outside of a K-8 environment would require additional research to understand barriers in the implementation of coding curriculums. This can also be said for other types of schools, such as charter and private schools.

Implications for Future Research

There are some implications for future research that also need to be discussed, including those of research designs and different grade levels outside of K-8. Because this researcher only focused on K-8 environments, future research could additionally be directed to all K-12 levels, in order to determine any effects of coding curriculums throughout the entire school landscape. Although research has demonstrated the importance of teaching coding earlier on in a K-12 environment (Moreno-León et al., 2016), it would behoove researchers to focus on how these students and teachers fare over the course of time, and how teachers in higher K-12 grade levels continue or approach the integration of coding curriculum to their older students. Additionally, future research should focus directly on the barriers that were identified in the results of this current study, as researchers should have the ability to focus on how schools follow a team approach when integrating the curriculum as well as the exact professional development opportunities that teachers experience when it comes to technology and the teaching of the coding curriculum. Because many teachers in this study reported limited professional development opportunities, it would be important for future research to specifically focus on this area.

Additionally, other research designs could also be completed, including that of quantitative research, now that this topic has been explored. Future research could focus on any statistical relationships between professional development opportunities and teachers' levels of self-efficacy when it comes to implementing the coding curriculum in their classrooms. Quantitative studies could also allow future researchers to focus on problems or barriers over longer courses of time, making for a longitudinal study.

Implications for Future Practice

The results from this study highlighted implications for future practice. It is apparent from the results of this study that the teacher participants perceived major barriers as being that of a lack of professional development opportunities when it came to implementing a coding curriculum to their classrooms. The inclusion of professional development activities geared to pedagogy and technology can support teachers in promoting a student-centered learning environment (Liao et al., 2017). Additionally, Liao et al. have highlighted that when experiencing new technologies in K-8 environments, professional development opportunities are oftentimes not accompanied, leaving many educators ineffective when teaching new technologies.

Teacher participants stressed that their classrooms were populated with students who have diverse abilities, which were a barrier when implementing the coding curriculum. Many learners find engagement in reading and writing highly challenging tasks for a wide variety of reasons. Students who are particularly advanced or students who find learning challenging require supportive practices and diverse materials. This requirement may be even greater in computer coding, as such literacy tasks become more challenging as learning activities involve complex conceptual information. As diversity and innovation in schools continue to increase, so does the need for professional development on multiple instructional strategies. While diversity provides a variety of experiences that can enrich the classroom environment, it can be challenging for teachers to adapt instruction for students of different levels of achievement (Delisle, 2015). Teachers and teacher professional development are fundamental to any effective educational innovation implementation effort. Those supporting differentiated instruction state that it is the only effective way for teaching students in a mixed ability classroom (Tomlinson, 2002). School District A should consider offering educators a series of professional development sessions on differentiating instruction to accommodate the range of students' abilities mentioned by educators.

It is important for schools and school districts to provide professional development opportunities in both areas of coding information and technology use, as it is important for students to be exposed to coding curriculums via the use of technological platforms that aid in learning opportunities. If there is a lack of professional development opportunities, then teachers may find it difficult to teach their students effectively. In practice, schools also need to have the ability to include their teachers in the designing and implementation of the curriculum, mostly working within a team environment. For teachers to be involved in decision-making processes, it allows for stronger communication between the administrators as well as a stronger knowledge base of how to apply the coding curriculum in their classrooms. By following these practices, coding curriculums in K-8 environments can be strengthened with teachers' experiences of higher self-efficacy levels, allowing teachers to use effective teaching strategies to ensure that students are successful in coding. This will help students reap benefits such as problem-solving techniques, computational thinking, and cognitive and social skills.

APPENDIX A: INSTITUTIONAL REVIEW BOARD APPROVAL

IRB-FY2020-465 - Initial: Initial Submission - Expedited - St. John's
irbstjohns@stjohns.edu <irbstjohns@stjohns.edu>
Wed 4/8/2020 3:32 PM
To: delveccr@stjohns.edu <delveccr@stjohns.edu>; Jennifer Dralle-Moreano <jennifer.drallemoreano17@my.stjohns.edu>

ST. JOHN'S UNIVERSITY

Federal Wide Assurance: FWA00009066 Apr 8, 2020 3:32 PM EDT
PI: Jennifer Dralle-Moreano CO-PI: Rosalba Del Vecchio Ed Admin & Instruc Leadership

Re: Expedited Review - Initial - IRB-FY2020-465 *Educators' Perceptions of Benefits and Barriers of the Inclusion of Coding in K-8 Curriculum: A Qualitative Study*
Dear Jennifer Dralle-Moreano:

The St John's University Institutional Review Board has rendered the decision below for *Educators' Perceptions of Benefits and Barriers of the Inclusion of Coding in K-8 Curriculum: A Qualitative Study*. The approval is effective from April 8, 2020 through April 7, 2021
Decision: Approved

PLEASE NOTE: If you have collected any data prior to this approval date, the data must be discarded.

Selected Category: 7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Sincerely,

Raymond DiGiuseppe, PhD, ABPP Chair, Institutional Review Board Professor of Psychology

Marie Nitopi, Ed.D. IRB Coordinator

APPENDIX B: SITE APPROVAL

From: Nagler, Michael <mnagler@mineola.k12.ny.us>
Sent: Monday, November 18, 2019 2:10 PM
To: Dralle-Moreano, Jennifer <jdrallemoreano@mineola.k12.ny.us>
Subject: RE: Dissertation Study

We are happy to support your research. I believe it is vital contribution to education in this century

Michael P. Nagler, Ed.D.
Superintendent of Schools
Mineola Public Schools
121 Jackson Ave
Mneola, NY 11501
http://michaelnagler.oyosite.com/
@NaglersNotions

From: Dralle-Moreano, Jennifer
Sent: Monday, November 18, 2019 1:57 PM
To: Nagler, Michael <mnagler@mineola.k12.ny.us>
Subject: Dissertation Study

Dear Dr. Nagler,

I am following up to previous our email in which you granted me permission to conduct my research in Mineola. I met with my committee today to propose my dissertation topic. The title of my dissertation is: Educator Perceptions of Benefits and Barriers of the Inclusion of Coding in the K-8 Curriculum: A Qualitative Study. I would like to interview approximately 10 staff members (including, but not limited to Central Office and instructional Leaders) and conduct a focus group. My mentor is Dr. Rosalba Corrado Del Vecchio. I expect to gain IRB Approval and begin researching in February 2020. I will, of course, keep you abreast of my timeline. Thank you again for the opportunity to investigate the implementation of coding.

Sincerely,
Jennifer Dralle-Moreano
Library Media Specialist
Jackson Avenue School
300 Jackson Avenue
Mineola, NY 11501
516.237.2340
Twitter: @jenmoreano

APPENDIX C: PARTICIPANT CONSENT FORM

ST. JOHN'S UNIVERSITY

Dear Prospective Participant:

You are invited to take part in a research study to learn more about the benefits and barriers that K-8 educators experience when integrating and teaching the coding curriculum in their classrooms. This study will be conducted by Jennifer Dralle-Moreano, St John's University School of Education, Department of Administration and Supervision as part of her doctoral dissertation. Her faculty sponsor is Dr. Rosalba Corrado Del Vecchio, from the school of education, St. John's University.

If you agree to be in this study, you will be asked to do the following:

1. Complete a questionnaire about your background (age, gender, education, etc.);
2. Take part in an interview via WebEx, a virtual conferencing software, concerning the benefits and barriers that K-8 educators experience when integrating and teaching/implementing the coding curriculum in their classrooms; and
3. Complete a follow-up interview via WebEx online conferencing before completing the research. The follow-up interview will allow you to review the transcripts of your interview to ensure that all of the information is accurate.

If you agree to take part in this research study, you will be asked to participate in a one-on-one interview. WebEx, a virtual conferencing software, will be used to synchronously meet online, so there will not be a face-to-face interview.

Participation in this study will involve approximately one hour of your time: 15 minutes to complete the questionnaire and approximately 30 minutes for the initial interview and 15 minutes for the follow-up interview. The interviews will be held at least two weeks apart.

There are no known risks associated with your participation in this research beyond those of everyday life.

Although you will receive no direct benefits, this research may help the investigator better understand the benefits and barriers that K-8 educators experience when integrating and teaching the coding curriculum in their classrooms.

The interview will be recorded using WebEx, which will be stored online on St. John's University secure servers, behind a firewall and 256-bit encryption with a secure password that only the researcher has access to. The researcher will keep the recordings until the study is complete, then delete them. She will be the only one to review the raw data. These transcriptions, along with the signed consent forms, will be saved on her personal machine and encrypted using a data encryption program called VeraCrypt, so even if the machine was compromised, no one could access the data without the encryption code and password.

Confidentiality of your research records will be strictly maintained as the researcher will only refer to participants in numerical fashion (e.g. Participant 1, Participant 2, etc.). The researcher will only refer to the school district as School District A, in order to maintain confidentiality of the workplace. Once data has been collected and the study has been completed, the researcher will retain all physical and electronic records in a locked filing-cabinet or password-protected and encrypted file-folder on a removeable flash drive. This data will be stored in the personal residence of the researcher with only her having access to this information. All physical and electronic copies of confidential information will be destroyed five years after the completion of the study.

If you are completing in the focus group, your responses will be kept confidential by the researcher, but the researcher cannot guarantee that others in the group will do the same.

Participation in this study is voluntary. You may refuse to participate or withdraw at any time without penalty. For interviews, questionnaires or surveys, you have the right to skip or not answer any questions you prefer not to answer.

If there is anything about the study or your participation that is unclear or that you do not understand, if you have questions or wish to report a research-related problem, you may contact Jennifer Dralle-Moreano at 516-353-4039 or jennifer.drallemoreano17@my.stjohns.edu, or her faculty sponsor, Dr. Rosalba Corrado Del Vecchio at 718-990-5277 or delveccr@stjohns.edu.

For questions about your rights as a research participant, you may contact the University's Institutional Review Board, St. John's University, Dr. Raymond DiGiuseppe, Chair digiuser@stjohns.edu 718-990-1955 or Marie Nitopi, IRB Coordinator, nitopim@stjohns.edu 718-990-1440.

You have received a copy of this consent document to keep.

Agreement to Participate

____

Subject's Signature

____

Date

APPENDIX D: SEMI-STRUCTURED INTERVIEW QUESTIONS

1. How would you define coding when it comes to teaching K-8 students?
2. Describe the benefits of teaching coding to K-8 students.
3. Discuss training opportunities that you have experienced when it comes to integrating/teaching coding to K-8 students.
4. What areas do you feel you would need additional training or professional development opportunities in when it comes to integrating/teaching coding to K-8 students?
5. What are your views on how the district in implementing coding in the K-8 curriculum?
6. Describe any barriers when it comes to integrating/teaching coding to K-8 students.
7. How do you overcome barriers that are experienced when integrating/teaching coding to K-8 students?
8. Discuss how K-8 students have responded to the coding curriculum through integration and/or teaching.
9. What teaching strategies do you use/recommend teachers to use when teaching coding to K-8 students?
10. Describe the technology that is used when it comes to teaching coding to K-8 students.
11. Discuss your level of comfort with this technology when teaching coding to K-8 students.
12. How would you describe your ability to autonomously decide to include/exclude aspects of a coding curriculum to K-8 students?

Demographic Questions

1. Gender:
2. Age:
3. Tenure Status:
4. Years of Experience as educator/teacher in current role:
5. Education Level:

APPENDIX E: FOCUS GROUP SEMI-STRUCTURED INTERVIEW QUESTIONS

1. How would you define coding when it comes to teaching K-8 students?
2. Describe the benefits of teaching coding to K-8 students.
3. Discuss training opportunities that you have experienced when it comes to integrating/teaching coding to K-8 students.
4. What areas do you feel you would need additional training or professional development opportunities in when it comes to integrating/teaching coding to K-8 students?
5. What are your views on how the district in implementing coding in the K-8 curriculum?
6. Describe any barriers when it comes to integrating/teaching coding to K-8 students.
7. How do you overcome barriers that are experienced when integrating/teaching coding to K-8 students?
8. What teaching strategies do you use/recommend teachers to use when teaching coding to K-8 students?
9. Describe the technology that is used when it comes to teaching coding to K-8 students.
10. Discuss your level of comfort with this technology when teaching coding to K-8 students.

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Vita

Name	*Jennifer L. Dralle-Moreano*
Baccalaureate Degree	*Bachelor of Arts*, *Buena Vista University, Storm Lake, Iowa* *Major: Elementary Education*
Date Graduated	*June, 1996*
Other Degrees	*Master of Science*, *Long Island University, Old Brookville, New York* *Major: Library and Information Science*
Date Graduated	*May, 2008*