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Elementary Teacher Professional Development for Computer Science and Digital Game-Based Learning

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Abstract

The purpose of this qualitative case study research is to understand the professional development needed for elementary school (Grades K–6) educators to effectively teach computer science as part of the Computer Science for All initiative. Two research statements guided this study: Professional development training is needed for Florida elementary school educators to effectively teach the topics in the Computer Science for All initiative; Florida elementary school educators use digital game-based learning to effectively teach the topics in the Computer Science for All initiative. The sample was a purposeful sample consisting of 15 elementary school teachers at an elementary school in Florida. The data collection instruments were face-to-face interviews, teacher observations, professional development artifacts, and member checking sessions. Initial coding and pattern coding were used to identify codes and to collapse and reorganize these codes to identify emergent themes. The inductive and topological analysis models were used to analyze data collected. The key findings of this study were that teachers had limited professional development trainings in the areas of computer science and digital game-based learning in their academic and professional careers. The participants described the professional development training that is needed for them to effectively teach computer science using digital game-based learning. The participants stated that they would need professional development trainings that were hands-on, involve modeling of instruction, understanding of the pedagogical background and benefits that goes into computer science and digital game-based learning, and access to resources. The results contribute to the existing body of research.

Keywords: computer science, digital game-based learning, educational technology, professional development

Dedication

I would like to dedicate this dissertation to my loving family who have supported me throughout this whole process. This would not have been possible without the help and guidance from my wife Lauren, my mother Denise, my father Steve, and my sister Jessica. Thank you for putting up with me through the rough patches and supporting me down the home stretch. I would also like to dedicate this dissertation to my uncle, Nicholas Becker. He would have loved to see me graduate, and I know he will be watching down on me.

“There is no doubt that it is around the family and the home that all the greatest virtues… are created, strengthened and maintained.” –Winston Churchill

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Chapter 1: Introduction to the Problem

During the January 2016 State of the Union Address, President Barack Obama stated that, "In the coming years, we should build on that progress, by … offering every student the hands-on computer science and math classes that make them job-ready on day one" ("State of the Union," 2016). This Computer Science for All Initiative was another push in a movement that had already begun to ensure that schools across the nation provide access to computer science courses for students. The plan initially called for funding for states to increase access to K–12 computer science training for teachers, expanding access to instructional materials, as well as partnerships between schools and technology companies. Schools would use the money for computer science courses, as well as provide the professional development necessary for educators to effectively teach the skills required for computer science.

The momentum that began even before the State of the Union Address carried into the state and local levels. This statement was echoed by Code.Org founder Hadi Partovi, who stated that "The president's announcement of the importance of computer science symbolically amplifies and increases the level of attention on this important field" (Kastrenakes, 2016, p. 6). Since computer science became an academic discipline in the late 1960s, the level of interest in the field and the number of students taking courses has grown (Nager & Atkinson, 2016). States such as New York, Florida, and many others have created state standards at the K–12 and college levels. This has led to schools and outside entities creating curriculum resources to teach these standards. Additionally, one of the main tools that many of these computer science resources use to effectively teach these standards is digital game-based learning.

Video games have also become a growing trend in society through the use of different console gaming systems such as Atari, PlayStation, and more recently, Microsoft's Xbox. Video games have enormous mass appeal and reach audiences in the hundreds of thousands to millions of players (Mayo, 2009). The Entertainment Software Association (ESA) which conducts business and consumer research, published statistics on video game usage, sales, and demographic data for 2018. According to the report:

- The U.S. video game industry generated a record $43.4 billion in revenue for 2018, up 18% from 2017 (Entertainment Software Association, 2018).
- 64% of U.S. households own a device that they use to play video games (Entertainment Software Association, 2018).
- 60% of Americans play video games daily (Entertainment Software Association, 2018).
- 70% of parents believe video games have a positive influence on their children’s lives (Entertainment Software Association, 2018).
- 61% of frequent game purchases are male, while 39% are female (Entertainment Software Association, 2018).
- 56% of the most frequent gamers play multiplayer games at least once a week (Entertainment Software Association, 2018).

As video games have become popular in culture, research has been conducted to understand the benefits for players as many games involve collaboration, competition, sharing, searching for information which develop a sense of community of learning (Costa et al, 2017). Beginning in the 1980’s, games such as *Number Munchers* and *Word Munchers* were used in classrooms to help children develop basic math and grammar skills. A study by the Federation of American Scientists approved of video game use in education and cited that fact that video game systems were used in most households (Tashiro & Dunlap, 2007). Additionally, kids favored learning through video games and could be used to facilitate analytical skills (Tashiro & Dunlap, 2007). Moving into the 21st century, modern video games task players to require dexterity, precise timing of control inputs, and tasks that demand logical thinking and problem solving (Klimmit et al, 2009). These tasks require strategic planning and management of complex riddles and objectives for the user to complete. This also includes the intrinsic benefits that players receive from completing these tasks. This could include positive emotions such as pride, joy, and competence (Klimmit et al, 2009).

Digital game-based learning is a fast growing and popular tool across classrooms and is being used to teach complex concepts in K–12 schools (Martin-Parraga & Marin-Diaz, 2014; Novak, 2016). Digital game-based learning can be defined as the use of digital games to serve an educational purpose containing two elements: entertainment and an educational component (All, 2015, p. 91). The use of digital game-based learning as a tool to teach computer science at the elementary level is growing as curriculum resource companies such as Code.Org, Scratch MIT, and Code Monkey incorporate this educational strategy (Burke, 2016; Martens & Lemmens, 2014; Stewart, 2012). However, while more support has been given to teachers to teach these standards using a variety of available resources, this is still a relatively new subject area and a new tool for educators.

For computer science and digital game-based learning to be incorporated in the K–12 classroom setting, it is important for the teachers to have effective professional development training to feel comfortable and properly prepared to turnkey the information and content. Before technology can effect changes in the classroom, it is important for the teachers that are conducting the lesson to be considered. Teachers must learn to use technology and allow it to change their present teaching paradigm (Bitner & Bitner, 2002). Without the proper training, fear, concerns, and anxiety can be obstacles that dissuade teachers from implementing new content or instructional strategies. Another theme of teachers who struggle to adapt to new technology is to use the devices and fit them into their own model of teaching instead of trying something new. Teachers will have a tendency to “domesticate” innovative technologies by incorporating them into their existing repertoire of teacher-directed practices (Herold, 2015). This keeps the teachers within their comfort zone, and they can still claim that they are incorporating technology, even if it is not effective. Furthermore, in addition to the internal challenges that a teacher faces with the confidence of implementing technology, teachers have indicated that external barriers exist that impact technology integration, such as a lack of professional development training, a lack of available technology, and restricted curriculum (Ruggiero & Mong, 2015).

Because elementary school teachers may not have been trained in teaching computer science or using digital game-based learning, the focus of the study is to understand the professional development that is needed for elementary school educators to effectively teach computer science using digital game-based learning.

Conceptual Framework for the Problem

The conceptual framework for this study is the constructivism theory of learning. Constructivism is a learning theory that explains how people might acquire knowledge and comprehend information. According to Creswell (1998), “individuals seek understanding of the world in which they live and work” (p. 8). To effectively teach computer science and digital game-based learning, educators must be given the proper training to understand the proper pedagogical skills needed. Von Glasersfeld (1995) continued this constructivist definition by explaining that “the thinking subject has no alternative but to construct what he or she knows on the basis of his or her own experience” (p. 18). This trickles down to students and their experiences in the classroom. Research has shown that one of the main factors in student achievement is teacher professional development and skill level (Rahmatullah, 2016). Furthermore, research has shown that high quality professional development serves a key factor in improving teacher quality (Darling-Hammond, 2009; Green, 2015; Shakman 2016; Skourdoumbis, 2014). Given this understanding of constructivism, it is important for research to be conducted on the professional development for elementary school teachers in computer science and digital game-based learning.

Statement of the Problem

There is a problem in professional development in education. One problem in professional development is the lack of knowledge regarding the professional development that is needed for elementary school educators to effectively teach computer science using digital game-based learning. There is research that discusses the importance of professional development for educators (Darling-Hammond, 2009; Green, 2015; Ladd, 2011; Rahmatullah, 2016; Shakman, 2016; Skourdoumbis, 2014), however the research does not discuss the importance of professional development in computer science and digital game-based learning. Currently, there are initiatives, such as the 2016 Computer Science for All Initiative at the federal level, as well as in some local contexts, such as the New York City Department of Education (“About CS4All,” 2018). However, in Florida, while there is a push for computer science in education (“Standards and Instructional Support,” 2018; “Code.org advocacy state sheet”, 2018), more research is needed to understand the professional development that elementary school teachers need in this area. This problem impacts elementary schools because there is a lack of research on the professional development that educators need to effectively teach computer science at the elementary school level. There are many possible factors contributing to this problem, among which are the newness of computer science initiatives in schools. Additionally, it has only been adapted in recent years at the elementary levels, specifically. This study contributes to the body of knowledge needed to address this problem by researching the professional development needed for elementary school teachers to effectively teach computer science and digital game-based learning.

Purpose of the Study

The purpose of this qualitative case study research is to understand the professional development needed for elementary school (Grades K–6) educators to effectively teach computer science as part of the Computer Science for All initiative. The professional development examined encompasses skills in both computer science resources as well as digital game-based learning tools. While the standards have been created for Florida teachers to follow, there has not been research conducted on the professional development needed for educators to teach these standards. This has an effect on student outcomes as well. Research has shown that professional development of teachers has an impact on student achievement (Rahmatullah, 2016). If teachers are trained effectively, students will be able to master the standards that have been created.

I examined the perspectives of elementary educators for professional development in computer science and digital game-based learning. A qualitative case study will be the most effective approach to answer the research questions. Participating teachers were able to express their thoughts on these topics. Learning and understanding of the needed professional development and the current usage of computer science and digital game-based learning took place through interviews, observations, and examining artifacts that relate to the study. Interviews allowed teachers to discuss their views on computer science and digital game-based learning from a pedagogical lens, what they believe are the benefits, discuss professional development experiences, as well as discuss their recommendations on effective professional development trainings in these content areas. Observations allowed me to see in real-time how teachers are using technology in general, and more specifically their uses in computer science and digital game-based learning, if any is occurring. After interviewing the teachers, it gave me an opportunity to view how teachers are using the technology tools they have and see any of the barriers to implementing computer science and digital game-based learning that they discussed in their interviews. Artifacts were collected in the form of professional development plans for participating schools in the charter school network. This gave me an opportunity to understand how the school where the teachers currently work, and other network schools, are training teachers in technology, computer science, and digital game-based learning.

Research Questions

Two research questions guided this study: What professional development training is needed for Florida elementary school educators to effectively teach the topics in the Computer Science for All initiative? How do Florida elementary school educators use digital game-based learning to effectively teach the topics in the Computer Science for All initiative?

Rationale, Relevance, and Significance of the Study

The topic of professional development for elementary school educators in computer science and digital game-based learning is significant because of the standards that have been created for students to achieve mastery of computer science at this level. When standards have been created by the state, in this case Florida, there is an expectation that it is taught at public schools, such as the one where this research will be conducted. The results of this study may provide education administrators an understanding of the professional development needed for implementing a computer science program at their elementary school. As this comes from the perspective of teachers, it is important to understand the needs of the teachers and how they believe they need to be effectively trained in order to understand the content, create resources to use in the classroom, and efficiently teach their students the instructional content.

In order for educators to effectively teach their students the content, it is important that the professional development meets their needs as learners. This is especially critical as the teacher is the main factor in the educational process (Malik, 2015; Rahmatullah, 2016). Teacher effectiveness has been shown to have a direct impact on student achievement (Skourdoumbis, 2014; Green, 2015). While the focus of the study is on professional development on computer science and digital game-based learning, there are commonalities in how teachers would prefer professional development training in these topics as well as all topics that teachers are trained on. Concepts that are critical to professional development such as setting, pedagogy, teaching style, and resources are able to be transferred to any professional development that a given teacher may be attending.

The potential benefits of the research are a deeper understanding of the professional development that is necessary for elementary school teachers to teach computer science and implement digital game-based learning in their instructional practices. During interviews, we discussed the implementation of computer science and digital game-based learning in schools, past experiences, as well as directions for the future. This also included the different challenges that occur if they are unable to effectively and consistently implement computer science and digital game-based learning in their instructional practice. Being able to understand that barriers that are in place preventing teachers from implementing these instructional strategies is critical to problem solving and ultimately creating a plan for consistent implementation. I believe that these conversations will help teachers understand why it is important, listen to what teachers believe is needed, and what resources are available to them.

Additionally, a benefit to the educational community is information from teachers at an elementary school on what professional development is necessary to effectively implement computer science and digital game-based learning in their daily practices. This benefits teachers by allowing them the opportunity to learn about resources and professional development opportunities, as well as to ask questions about topics in these areas. Currently there are deficiencies in the literature specifically about the professional development in computer science for elementary school teachers, and this study aims to address this issue.

Definition of Terms

Although most of the following critical terms are familiar to educators, a glossary is provided to clarify their definitions as used in this study.

Charter school: Refers to a publicly supported school governed by a private board under performance contract with a "charter authorizer" for a defined term. Although charter schools are public institutions and thus responsive to the democratic processes offered by public institutions, they are free from many of the regulations that traditional public schools face (Berends et al., 2017, p. 14).

Community Model: Refers to a learning style of classroom instruction that differs from the traditional classroom model. In the community model, all students within the grade level are placed in one large classroom, typically holding 30-50 students with smaller breakout rooms that support small group instruction, typically 10-15 students. In this model, all teachers within the grade-level work together in the same room and teach all of the students.

Digital game-based learning: Refers to using digital games to serve an educational purpose containing two important elements: entertainment and an educational component (All, 2015, p. 91). Digital games can refer to a multitude of types and genres of games played on different platforms using digital technologies. Digital games of all types are enjoyed by millions of people and can be played alone, in groups, or against machines. A digital game is a creative, aesthetic, and technological product, and digital gaming is the practice of game use and consumption, in this case for educational purposes (Stewart, 2013, p. 18).

Instructional Software: Refers to digital content that is used in an educational setting. This could include mathematics, English Language Arts, and science programs that students use. This software could also include assessment programs, new content and lessons, as well as diagnostic and review tools.

New Teacher Introduction (NTI): Refers specifically to pre-service professional development training for teachers who are either in their first year of teaching or if they are new to the charter school company. The school where this study took place conducted an NTI professional development program for all staff members since the school was brand new and in it's first year of opening.

One to One Technology Model: Refers to the ratio of the technology tools within a given classroom to the amount of students. In a one to one technology model, there is the availability of one device or more per student (Chan et al., 2006). This could include iPads, laptops, or other technology devices.

Professional development: Refers specifically to training for educators. For teachers, professional development is defined as structured professional learning that results in changes in teacher practices and improvements in student learning outcomes. This includes content-focused material, active learning, collaboration, modeling of effective practice, coaching, feedback, and reflection (Darling-Hammond, Hyler, & Gardner, 2017).

State Standards: Refers to the learning goals for what students should know and be able to do at each grade level. They act as guidelines for the knowledge and skills that students should be learning at each grade level. Each state sets its own standards and benchmarks for core curriculum areas such as English Language Arts, mathematics, physical education, science, etc.

S.T.E.M.: An interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise, enabling the development of STEM literacy and with it the ability to compete in the new economy. (Tsupros, 2009)

SMART boards: Refers to an interactive whiteboard developed by SMART Technologies. It is a large touch-sensitive whiteboard that uses a sensor for detecting user input that are equivalent to normal PC input devices, such as mice or keyboards. The SMART board comes with writing utensils that create digital ink for the teacher to write on top of the content that is displayed on the screen.

Title 1 school: Refers to a school that is receiving funds as part of the Title 1 LEA Grants. Title I, Part A (Title I) of the Elementary and Secondary Education Act, as amended by the Every Student Succeeds Act (ESEA) provides financial assistance to local educational agencies (LEAs) and schools with high numbers or high percentages of children from low-income families to help ensure that all children meet challenging state academic standards (U.S. Department of Education, 2018).

Assumptions, Limitations, Delimitations

As in all scholarly research, this study has restrictions caused by assumptions that were out of the researchers' control. During this process, I assumed that all participants provided data that truthfully represented their experiences during the interviews. I also assumed that their answers might need follow-up or clarification, which is why semistructured interviews were used (Barbour & Schostak, 2005; Patton, 2001). I assumed that all participants' interest in the study was genuine, as no compensation was given. Because this was a case study with 15 participants (Creswell, 2007), the findings cannot be generalized (Creswell, 2007; Stake, 1995). I provide the results so that readers can choose when it would be appropriate to apply the findings to other areas of research or contexts in education (Stake, 1995).

Limitations and delimitations are aspects of a study that represent weaknesses in the research (Creswell, 2017). The design of this study, case study research, has several limitations, including the sample size and the subjective nature of the qualitative research analysis. For this study, limitations include time, personal biases, sample size, and setting. To reduce the amount of personal bias, I did my best to ensure that any personal feelings or influences are kept out of the research and conclusions by ensuring that I examined through a logical, objective and rational lens (Herr & Anderson, 2015; Stake, 2010; Stringer, 2014). The sample size was a limitation since I only had access to the teachers in one school, restricting the number of teachers that I was able to have participate in the study. With roughly 50 teachers total at the school, I was allowed to interview 15 classroom teachers. This does not allow me to generalize to a larger population.

The setting is also a limitation because I only had access to the one elementary charter school in Florida at the time the research was conducted. I chose this site for both convenience and need. This limited the possibility of studying different demographic groups. Additionally, since there were only female classroom teachers at the school, each of my participants were female. I was unable to interview male teachers since the only two male teachers at the school are in a different role such as physical education. Due to the nature of the work day schedule, time constraints were a limitation on both the teacher interviews and the observations. Since the teachers had a 30-minute instructional block that is built into their daily schedules, my observations also reflected a 30-minute timeframe.

Delimitations refer to the limits that the researcher chooses to put on the study. They set the scope and parameters of the study and allow for a focus of certain research questions. For this study, the delimitations were the boundaries of study as well as the selection of participants. The boundaries include the professional development of teachers in both computer science and digital game-based learning. I chose these specific parameters to target the research questions that I would like to address through this case study research design. It allows me to pinpoint and focus on specific themes and questions that I am able to address by the end of the study. Additionally, purposeful sampling was used to select participants from the teacher pool at an elementary school in Florida. At this school, I was not in an administrative or evaluative role. I had previously established rapport and connects with the teachers at this school. Teachers felt comfortable to volunteer for the study and expressed their beliefs and suggestions in the areas of professional development, technology, computer science, and digital game-based learning without the fear of administrative or evaluative repercussions.

Summary

The purpose of this case study research is to understand the professional development needed to effectively teach computer science using digital game-based learning. Computer science has become a trending topic in education that has received attention at the federal and state levels. This had included a push to ensure that computer science education is available at schools across the country, and across different grade levels (Kastrenakes, 2016; Nager & Atkinson, 2016; “State of the Union,” 2016). The inclusion of digital game-based learning as a tool to teach has additionally grown in a similar manner. This had led to a combination of teaching computer science using digital game-based learning and many companies have created educational software and resources for teachers to use in the classroom (Burke, 2016; Martens & Lemmens, 2014; Stewart, 2012). However in-order for educators to teach computer science using digital game-based learning, it is important that they are provided with effective professional development (Darling-Hammond, 2009; Green, 2015; Ladd, 2011; Rahmatullah, 2016; Shakman, 2016; Skourdoumbis, 2014). Teachers’ prior educational experience in academic and professional settings must be considered when determining the type of professional development that is provided in both of these areas (Darling-Hammond, 2009; Green, 2015; Malik, 2015; Shakman, 2016).

Chapter 1 began with an introduction to the study and an in-depth background section to which the foundation of the study was built on. Professional development in computer science and digital game-based learning, the focus of the study, was defined to provide clarity throughout the dissertation proposal. I explained the problem and purpose of the study and the deficiencies in the research regarding the problem. I also described how the research questions will add to the educational research that currently exist. The qualitative case study was explained and aligned with constructivism as the conceptual framework to guide the study. Chapter 1 included the rationale, relevance, and significance of the study, definitions of terms, and assumptions, delimitations, and limitations.

In Chapter 2, I present a thorough and detailed literature review with research studies in related issues of computer science, technology, education, digital game-based learning, and professional development. In Chapter 3, I explain in detail how the study was conducted. This includes the explained of the choice of research design, procedures, and measures that were used to collect data such as interviews, observations, and professional development artifacts. In Chapter 4, I explain the process that was used for data analysis. Additionally, the results of the study are shared along with the data analysis and findings. In the concluding Chapter 5, I share the conclusions of the research study and the meaning. I present and discuss the results of my research with personal insight and interpretations. I also detail the implications for the educational community and recommendations for further research.

Chapter 2: Literature Review

Introduction

In the fall of 2015, New York City Mayor Bill de Blasio and Chancellor Carmen Farina announced a set of goals for New York City schools. One of these goals, which constitutes the Equity and Excellence agenda, is the Computer Science for All initiative. One of the main focuses of this initiative is that by 2025, all New York City public school students will receive meaningful, high-quality computer science education at each school level. This includes elementary, middle, and high school. This program will include teacher training over the next 10 years to allow teachers to effectively instruct their students in areas of computer science.

In Florida, while there is no state government initiative that is similar to the Computer Science for All initiative in New York City, there is a state-wide push to provide high-quality computer science training and instruction to students and teachers. Florida does have computer science state standards, as well as a certification track for teachers to become certified in this computer science.

Today's students grow up in an age where technology is evolving at an exponential rate. Educators inside of the classroom are having to adapt to this technological wave in order to effectively reach the students they teach. One of the growing uses of technology at home is the use of digital video games to teach different skills such as computer science. Popular educational programs such as Code.Org, Scratch MIT, and Code Monkey, examples of software that are now using educational games as a means to teacher computer science. According to the Pew Research Center (2015), 59% of girls and 94% of boys ages 13-17 play video games (Lenhart, Duggan, Perrin, Stepler, Rainie, & Parker, 2015, p.1). This trend of using digital video games as a tool for learning has also made its way into educational classrooms. For this reason, the study focuses on two initiatives. The first is initiative is if and how teachers are prepared to teach computer science in the elementary school classroom. Additionally, because many of these programs use digital educational video games, the study also examined the way teachers are trained and prepared to use digital educational games to effectively instruct their students on different skills, such as computer coding.

This literature review begins with a discussion of the conceptual framework, followed by an examination of research regarding the current use of computer science and educational games. This will also lead into a discussion of the impact on student achievement. Teacher training and preparedness to use technology in the classroom is also discussed. This is followed by a further examination of current computer science knowledge of teachers, as well as teacher training in digital educational games at an elementary charter school in Florida. The review ends with a discussion of the benefits of effectively implementing computer science and digital educational games in classrooms.

Conceptual Framework

The pedagogical framework that drove the study is the constructivism theory of learning. According to Creswell (1998), "individuals seek understanding of the world in which they live and work" (p. 8). Students and adult learners learn information through the previous knowledge that they have obtained in life. This type of learning is an active, contextualized process of learning new information, rather than simply acquiring it through simple direction and instruction. These personal experiences, such as previous knowledge and culture, help shape the understanding of the learner. Crotty (1998) identified several assumptions when discussing constructivism. One is that the meanings are constructed by people as they engage with the world. Another assumption is that people will use their cultural and social perspective to shape their understanding. Finally, Crotty (1998) believed that “the basic generation of meaning is always social, arising in and out of interaction with a human community” (Creswell, 2013, p. 8). The goal is “to come as close as possible to understanding the true ‘is’ of our participants’ experience from their subjective point of view” (Seidman, 2012, p. 17). The subject’s point of view assists with our analysis of the experience.

When discussing constructivism, it is important to focus on the role of the learner. As described by Davis, Maher, and Noddings (1990), “it is assumed that learners have to construct their own knowledge—individually and collectively. Each learner has a tool kit of concepts and sills with which he or she must construct knowledge to solve problems presented by the environment” (p. 3). In the instances of educators, this would be acquiring the skills necessary to effectively teach a particular subject. The experiences of the learner are still the essential key in understanding and comprehending the information. Von Glasersfeld (1995) continued this constructivist definition by explaining that “the thinking subject has no alternative but to construct what he or she knows on the basis of his or her own experience” (p. 18). This definition can be connected to the experiences of teachers and how they learn.

With this understanding of constructivism in mind, it is important for the researcher to address the interaction of teachers in their current position, as well as other positions that the teachers may have held at other educational institutions. Experiences teaching other content areas, working in different capacities (e.g., substitute role, administration, specials/fine arts teacher), or working in schools with different demographics will have an impact on the way a particular teacher understands information and is able to teach that to their students. It is the researcher’s responsibility to effectively interpret the meanings and experiences that teachers have about education to understand why a certain viewpoint is held. The first step in this process is to listen to the teachers and understand their viewpoint. The follow-up procedure is to allow them the opportunity to express why they have these viewpoints with evidence from their experiences (Creswell, 1998). Open-ended questions allow the participant to discuss personal feelings and experiences to the researcher to allow for contextual background information.

This study was designed to address the implementation of computer science and digital educational games to improve student learning and understanding. The constructivist theory of learning was used at two levels within education. First, constructivism was used to understand how students learn with digital video games through their own life experiences. Additionally, the researcher sought to understand how teachers interpret computer science and digital video games and how they are able to learn the pedagogical skills necessary to effectively use digital games as an instructional tool in their practice.

Review of Research Literature and Methodological Literature

Search Strategy

This literature search focused on the implementation of the Computer Science for All initiative, beginning at the federal level and moving down to the state and local levels. More specifically, the search focused on the benefits of using computer science in the classroom. Additionally, the literature search also focused on the ways that digital media and gaming have been used in the classroom and also the benefits for students. Teacher training and professional development in both of these areas was researched and reviewed to determine current and best practices. The search was conducted using ProQuest, ERIC, Wiley Online Library, as well as Google Scholar. Keywords included *computers, technology, gaming, educational games, computer science, computer science for all, video games, professional development, constructivism, elementary,* and *students.*

Federal Computer Science for All Initiative

In the January 2016 State of the Union Address, President Barack Obama discussed the ways that computer science should be at the forefront of education for students across the country. He discussed the need for students to begin learning computer science in all states and across all grade levels, beginning in elementary school. In his speech, President Obama suggested building on the initial progress by, “offering every students the hands-on computer science and math classes that make them job-ready on day one” (“State of the Union,” 2016). Shortly after the address, initiatives were rolled out to increase funding for programs in computer science education. In January 2016, the following Federal agencies announced new actions in support of Computer Science for All (CS4All):

- National Science Foundation (NSF): Twenty million dollars in planned investment for the *Computer Science for All: Researcher Practitioner Partnerships* program. The program aimed to better understand research and develop K–12 teachers with the professional development to teach computational thinking and computer science courses (Office of the Press Secretary, 2016).
- National Science and Technology Council (NSTC): Planned to develop a CSforAll strategic framework for the 2016 year. This counsel would develop a strategic framework to guide Federal efforts to support the integration of computer science into K–12 education. (Office of the Press Secretary, 2016).
- U.S. Department of Education (ED): Expanding its STEM partnerships with NASA, National Parks Service (NPS), Institute of Museum and Library Services (IMLS), and National Oceanic and Atmospheric Administration (NOAA) (Office of the Press Secretary, 2016).

The initiatives that were planned during this CS4All movement also trickled down to the local levels. At the time, 250 different organizations announced new commitments to computer science education. These organizations include Intrepid Museum Foundation, American Modeling Teachers Association, Bootstrap, Center for Advancing Women in Technology, as well as many others. Larger industry leaders such as Google, Microsoft, and Intel also got behind the push for computer science education. In all, roughly 500 organizations responded in 2016 with programs for computer science in education.

While not all initiatives were eventually pushed through Congress due to the changing of presidents, a number of programs that would allow for increased funding in the computer science education fields began. The National Science Foundation further addressed the need for computational thinking, workforce development, computer science in schools, and expanding access to those computer science resources (National Science Foundation, 2018) This also pushed state governments to begin their own projects and programs in computer science. One such state is New York, where the NYC Department of Education currently leads initiatives with their own Computer Science for All program.

New York City Computer Science for All

According to the New York City Department of Education (NYCDOE) website, it is the largest school district in the United States, serving 1.1 million students in over 1,800 schools ("About CS4All", 2018). In the fall of 2015, Mayor Bill de Blasio and Chancellor Carmen Farina introduced the Equity and Excellence Initiative. The goal of this over-arching initiative is for all students to "receive a world-class education and have the opportunity to reach their full potential" ("About CS4All," 2018). This includes having 80% of students graduate high school on time and two-thirds of students being college ready by the year 2026. Computer Science for All is included as one of the Equity and Excellence Initiatives.

One of the goals of the Computer Science for All program is that by 2025, all NYC public school students will receive meaningful, high-quality computer science education at each school level. This program includes training for teachers as well. Over the next 10 years, the NYCDOE will train nearly 5,000 teachers in this growing field. This private-public partnership has funders in companies such as CSNYC, Robin Hood, AOL, Code.Org, Math for America, and many more. These companies partner with the NYCDOE through donations, computer science programs, as well as available internships at these different companies allowing students to get hands-on learning experience in the workforce.

The vision of the Computer Science for All initiative is to have a computer science course at every school. This could be a semester-long course, multi-year sequence, or incorporated into other subject areas such as science, math, or art. Students will learn skills in problem solving, writing and troubleshooting code, building with the design process, using online resources, and introducing the fundamentals of computer science at the lower levels such as elementary school ("About CS4All," 2018). With the continued push for skills in computer science, it is important for school building leaders, teachers, and students to understand the benefits and the necessary requirements at each level to successfully push this program across New York City and the rest of the country. This includes building leaders understanding why there is such a strong push and teacher professional development to roll out the program at every level.

Florida Computer Science for All

While Florida does not have a specific Computer Science for All statewide initiative, there are state standards for computer science in grades K–12. All secondary schools offer computer science and allow computer science to count for a core graduation requirement. At the professional level, there are clear certification pathways for computer science teachers, as well as a dedicated computer science position in the state education agency (“Standards and Instructional Support,” 2018). Additionally, Florida has a dedicated computer science position in the state education agency. Florida also requires that all secondary schools offer computer science and allow computer science to count for a core graduation requirement

Code.org has collected data on computer science education from the following list of sources: the Conference Board for job demand, the Bureau of Labor Statistics for state salary and national job projections data, the College Board for AP exam data, the National Center for Education Statistics for university graduate data, the Gallup and Google research study Education Trends in the State of Computer Science in U.S. K–12 Schools for parent demand, the 2018 Computer Science Access Report for schools that offer computer science, and Code.org for its own courses, professional learning programs, and participation data. According to their sources, they detail the following information about computer science in Florida:

- Florida currently has 18,272 open computing jobs (2.7 times the average demand rate in Florida) (Code.org state advocacy sheet, 2018).
- Florida had only 2,986 computer science graduates in 2017; only 18% were female (Code.org state advocacy sheet, 2018).
- In Florida, only 19% of all public high schools teach computer science (Code.org state advocacy sheet, 2018).

- Only 10,617 exams were taken in AP Computer Science by high school students in Florida in 2018 (Code.org state advocacy sheet, 2018).
- Only 315 schools in Florida (29% of Florida schools with AP programs) offered an AP Computer Science course in 2017–2018 (15% offered AP CS A and 24% offered AP CSP), which is 74 more than the previous year (Code.org state advocacy sheet, 2018).
- According to a representative survey from Google/Gallup, school administrators in Florida support expanding computer science education opportunities: 67% of principals surveyed think CS is just as or more important than required core classes (Code.org state advocacy sheet, 2018).

This information is important when discussing the significance of computer science education, and specifically how that impacts elementary school teachers in Florida who would eventually be designated to begin the introductory level of computer science. Another alarming statistic that was provided by Code.org was that “Universities in Florida did not graduate a single new teacher prepared to teach computer science in 2016” (Code.org state advocacy sheet, 2018). While this statistic would need to be further vetted to determine what are the credentials and parameters to be determined to be effectively prepared to teach computer science, and at what level, it is interesting to note that there is a severe lack of educators that are prepared to teach computer science, even if that number is not zero.

On their information page, Code.org also lists some ways in which Florida can adopt policy frameworks to provide all students with access to computer science (Code.org state advocacy sheet, 2018). The recommendations are a “menu” of best practices that states can use based on the company’s nationwide experience in supporting and expanding computer science.

Code.org recommends creating a state plan for K–12 computer science that articulate the goals in computer science, strategies for accomplishing these goals, and timelines for carrying out the strategies. Another policy recommendation is to provide dedicated funding for rigorous computer science professional development and course support. This would include strengthening computer science programs by creating specific opportunities to bring computer science to school districts, such as matching fund programs. Another recommendation to address the computer science teacher shortage can be to expose more preservice teachers to computer science coursework during their educational pathways. To address the lack of computer science as a core admission requirement at institutions of higher education, state leaders could work with institutions to ensure credit and articulation policies align with secondary school graduation requirements (Code.org state advocacy sheet, 2018).

Technology Education Research in Florida

Recent research in Florida has helped build on the nationwide focus in computer science and technology education. At the high school level, Stubbs and Myers (2015) integrated science, technology, engineering, and mathematics (STEM) in agriculture programs at three different rural schools in Florida and found that the integration has a positive effect on student achievement, positive teacher perceptions of STEM can positively influence students' perceptions of STEM, and teachers with more STEM-related professional development are more likely to incorporate STEM at higher levels (p. 199).

As mobile devices have grown in K–12 classrooms, research has been done in the areas of pre-Kindergarten as well. In a study conducted by Reeves, Gunter, and Lacey (2017), pre-Kindergarten students were given the Florida VPK Assessment test at the beginning and the end of the study. The students in the experimental group consisting of 28 students were given guided instruction in literacy and math using iPads, while the control group did not have access to iPads. According to the researchers, “Results of the ANCOVA revealed significantly higher Phonological Awareness and Mathematics measures for the iPad class, suggesting that integrating mobile learning in content-specific areas using informal student feedback effectively increases early childhood education students’ academic achievement” (p. 37). Similarly, with pre-Kindergarten students, research conducted by Shamir et al. (2018) suggested that computer-assisted instruction leads to academic achievement. Florida school district pre-Kindergarten students were assigned computer-assisted instruction and were assessed with the Florida Voluntary Pre-Kindergarten (VPK) Assessment at the beginning and the end of the year. According to the researchers, students who were given computer-assisted instruction had better learning outcomes than students who did not. In another study that looked at technology and student achievement, Farrell et al. (2017) examined the relationship between a teacher’s TPACK (technological pedagogical content knowledge) on in-service teachers and student achievement measured with each individual teacher’s VAM (value-added model) score. Results showed that there was no significant relationship between a teacher’s VAM score and the TPACK survey overall or its individual constructs.

At the college level, it is important to understand what technological skills employers are searching for in-order to prepare students to be career-ready after graduation. Hollister et al. (2017) conducted interviews with IT employers in North Florida to understand their perceptions of IT program graduates’ workplace readiness. Results showed that while employers valued technical and general skills, they also sought professionals who understood computer programming to assist with problem-solving, with the belief that computer programming skills are aligned with problem-solving skills. In the area of collegiate education, the Department of

Mathematics at the University of Central Florida developed an innovative teaching method that incorporated computers and MyLabsPlus software with application sessions for large calculus classes. This instructional method combines group with computer technology usage for calculus. However, Vajravelu and Muhs (2016) believed this technique could be used for all STEM disciplines as well.

In the area of professional development, Dieker et al (2015) created TLE TeachLive, a virtual reality application designed to serve as a classroom simulation to support teachers and administrators to practice skills for instruction and management. Essentially, this playground for teachers allows them to work with artificial intelligence avatar students and practice different skills that they would use in the real-life classroom. This includes mathematics content, science content, teacher behaviors, as well as high level questioning. Similarly, in professional development, Schmidt et al. (2015) used the University of Florida's Restructuring and Improving Teacher Education 325T grant project to assist with teacher professional development using iPad Minis. This prototype specifically targets teachers in rural settings in Florida, where 20% of the elementary schools are located. The program allows supervisors to provide feedback to teacher interns even if a supervisor is not on site at the location, which is a common occurrence at rural schools where supervisors cannot attend due to costs, location, and time. Understanding of how to create effective distance supervision systems and professional development is still emerging (Routier & Otis-Wilborn 2013). Pittman and Gains (2015) investigated the nature of technology usage among third, fourth and fifth grade teachers in a Florida school district. Results showed that only 18.7% of teachers who responded to the survey met the requirements to be considered high-level technology integrators. The strongest barrier to technology integration was a lack of available computers/hardware, followed by factors relating to the time required to develop and implement lesson plans that incorporate technology.

Combining technology and professional development resources, STEM TIPS is a mobile-ready support platform that gives institutions and school districts the ability to provide professional development to teachers. Jones et al. (2016) partnered with 18 Florida school districts to pilot this program to provide instructional and support services in the fields of science, technology, engineering, and mathematics in middle and high schools. In another study related to technology and student learning, the University of Florida's Lastinger Center for Learning and Study Edge developed an online teaching and learning system for algebra teachers and students called Algebra Nation. This was launched throughout Florida in the spring of 2013. As described by Schackow and Cugini (2016), "Algebra Nation created videos of master teachers effectively incorporating one mathematical practice standard in their classroom and then reflecting on the standard and their instructional practices, as well as students' perceptions of the lesson, instructional strategies, and their own learning" (p. 36). Schools in Florida that were frequent users of Algebra Nation during the 2014–2015 school year scored an average of 20 points higher on the end-of-course Algebra exam than did schools with a low usage rate.

Current State of Computer Science in Education

As schools prepare students to become successful college and career ready individuals, the current trends reflect the growing need for students to be proficient in computer sciences. According to the Bureau of Labor Statistics Employment Projections, there will be approximately 597,100 new computing jobs from 2016–2026 (Bureau of Labor Statistics, 2017). Additionally, according to an analysis by the National Association of Colleges and Employers, graduates with computer science degrees are expected to command the highest starting salaries at the bachelor's degree level (National Association of Colleges and Employers, 2017). Computer Science graduates also enjoyed the highest full-time employment rate at 76%. These nationwide trends are also prominent and reflective of computer science in New York State. New York currently has 21,438 open computing jobs with an average salary for a computer occupation of $100,813 (Bureau of Labor Statistics, 2016).

Within the schools, despite the growing trends of technology in the social and economic sectors, there is still a gap in-terms of students choosing computer science as their focus, gender discrepancies, as well the amount of schools offering computer science programs. In the United States, 40% of U.S. schools offer Computer Science classes with computer programming, according to Gallup (Google Inc. & Gallup Inc., 2016).

There is also a major difference between men and women entering the Computer Science field. According to DuBow (2016), the percentage of first-year college students intending to declare a computer science major for females was roughly 2% in 2015, while males were over 3 times that percentage at 6%. Additionally, only 26% of computer technology field jobs were held by women (DuBow, 2016). This also applies to the major technology companies, where only 17% of Google's engineering workforce, 21% of Pinterest's technical team, 15% of Facebook's workforce, and 20% of Apple's global engineering workforce are women (Lien, 2016). These statistics show why there is a current need for increased computer science courses in schools across the United States.

Educational Benefits of Computer Science with Computational Thinking

At the heart of computer science is computational thinking (CT), which is not only required for computer scientists but required for all students. The ability to process algorithms, think in a logical manner, and compute the step-by-step logarithmic thinking are some of the many important skills that students focus on when working in computer science. Programming platforms such as Code.org and Scratch use block-based coding initially to introduce these skills to young learners. Eventually, they are moved to more advanced skills in which the students write the actual code for themselves instead of placing code blocks that are prewritten.

The Carnegie Mellon Center for Computational Thinking defines this method of understanding as a "a way of solving problems, designing systems, and understanding human behavior that draws on concepts fundamental to computer science" (Mellon, 2014, n.p). To excel in today's world, students need problem-solving skills to become college and career ready. Computational thinking allows students to work and think in an efficient manner, while thinking at multiple levels of abstraction and combing mathematical and engineering thinking (Sanford, 2016, p. 23). It can augment, facilitate, and expand the realm of thinking, logic, and mathematics. This does not only apply to mathematics or computer science, but is often used in biology, chemistry, physics, medicine, and other fields that can use computers for mathematical modeling (Sanford, 2016, p. 24). Additionally, as technology advances, the requirements and definition for computational thinking will evolve as well.

According to Denner, Werner, and Ortiz (2012), "algorithmic thinking involves defining a problem, breaking it into smaller yet solvable parts, and identifying the steps for solving the problem" (p. 241). In order to cover the skills necessary for computational thinking, Grover and Pea (2013) created a standard list of learning objectives or computational constructs that should be covered for instructional designs of entry-level computing based on a review of the field. The learning objectives are as follows: abstractions and pattern generalizations (including models and simulations), systematic processing of information (proceduralization), symbol systems and representations, structured problem decomposition (modularizing), iterative, recursive, and parallel thinking, conditional logic, debugging, and systematic error detection (pp. 39-40).

Using these learning objectives as a framework, developers could theoretically design their instructional material to incorporate each of these computational thinking skills. While not incorporating all, software companies and game developers have used many of these skills in their games to teach students. As described by Jenson & Droumeva (2016), there is no specific curriculum provision regarding what 21st century learning should entail and how that should inform K–12 schooling. However, it is accepted that digital games should be incorporated somewhere (Gee 2005; Salen 2007; Squire 2011). Combining the need for students to learn computational thinking skills and the motivation and engagement factor with digital games, computer science online resources have become more popular in schools.

Educational Gaming and Digital Game-Based Learning

There is a rising trend of using information and communication technologies at home and in school consistently (Martín-Párraga & Marín-Díaz, 2014). The growth of new technologies in private homes, educational institutions, and businesses has allowed greater access to software and devices that were unavailable as early as a few years ago. Of all of the new fast-growing technologies, video games appear as the most popular among the classroom population across different educational levels (Martín-Párraga & Marín-Díaz, 2014). In addition to the traditional use of games in education, more and more educators are using games for teaching complex concepts in K–12 schools (Novak, 2016). Game-based learning is making the information and skills that students learn more engaging, appealing, and informative than traditional context.

In-order to understand the trend of educational games in the classroom, one must first understand what game-based learning (GBL) encompasses. According to Qian and Clark (2016), “Game-based learning (GBL) describes an environment where game content and game play enhance knowledge and skills acquisition, and where game activities involve problem solving spaces and challenges that provide learners with a sense of achievement” (p. 51). Additionally, Pho and Dinscore (2015) defined game-based learning as the “borrowing of certain gaming principles and applying them to real-life settings to engage users” (p. 1). In an ideal educational game setting, students learn how to solve complex problems. As skill levels increase, so does the difficulty of the game, further pushing the player to grow and adapt (Hamari & Shernoff, 2016, p. 1).

Adding the digital aspect to game-based learning incorporates technology into the instruction. Digital game-based learning (DGBL) refers to using digital games to serve an educational purpose containing two important elements: entertainment and an educational component (All et al., 2015, p. 91). Digital games can refer to a multitude of types and genres of games, played on different platforms using digital technologies. Digital games of all types are enjoyed by millions of people and can be played alone, in groups, or against machines. A digital game is a creative, aesthetic, and technological product, and digital gaming is the practice of game use and consumption, in this case for educational purposes (Stewart, 2013, p. 18). While playing digital games may be entertaining to children and young learners, there must be an educational benefit to these games or they will be seen more as a novelty instead of an instructional tool. Research has shown that digital game-based learning can have benefits for students and teachers in the classroom through a range of different criteria.

Benefits of Digital Game-Based Learning for Students

While many may look at the movement of digital game-based learning as a tool purely for entertainment, the benefits for students has been researched and documented. Critics would point out that students are simply playing, and not actually learning the content that is being presented to them in the different platforms. However, studies have been conducted that can refute these claims. Studies have shown that digital game-based learning can benefit students in different aspects of learning and understanding. These benefits include increases in motivation, engagement, and content knowledge.

One impact that digital game-based learning can have on students is an increase in motivation and engagement. Freeman (2014) defined engagement as relating to students' inclination and effort to comprehend and learn academic topics, self-regulate his or her actions, and exhibit academic strategies (p. 123). As discussed by Nelson-Walker and Doabler (2013), gaming technologies can provide a foundation to increase instructional intensity and serve as a motivational component for students who have had difficulties through the traditional means of learning. In this study, researchers observed through the use of the NumberShire instructional game that "second grade participants enjoyed playing NumberShire, were engaged in game activities…were excited about the game, believed it targeted important math skills, and expressed interest in obtaining student performance data and customized instructional recommendations" (p. 4). Furthermore, this point was confirmed by Novak (2016), who agreed that digital game-based learning can facilitate active learning by doing that not only affects learning outcomes, but keeps the learner engaged and motivated (p. 2). Specifically, for disinterested students as well, Stewart (2013), also explained the use of games in a formal learning context leads to an increase in motivation and self-confidence (p. 58).

Motivation and engagement can lead to other educational benefits within the classroom. As students are more motivated different skills can progress through an increase in engagement in the content in which the students are learning about. This was confirmed through a study conducted by Reinders and Wattana (2014). The researchers looked at the benefits of digital games for language learning. This includes lowering affective barriers in learning, encouraging foreign or second language interaction, and the experience of the students when playing these digital games. In the study conducted by Reinders and Wattana (2014), the researchers investigated the experiences of five students who had participated in a 15-week game-based learning program at a university in Thailand. They conducted six interviews with each student (for a total of 30 interviews) to identify what impact gameplay had in particular on their willingness to communicate in English. The results showed that. “gameplay had a number of benefits for the participants in this study, in particular in terms of lowering their affective barriers to learning and increasing their willingness to communicate” (p. 38). When relating this study back to the overall benefits of digital game-based learning in the classroom, it is important to note that students can improve communication, cooperation, and language skills.

While motivation and engagement would seem as an obvious benefit of the increase in digital game-based learning, another benefit is the impact on student achievement. Many studies have shown that the incorporation and implementation of digital game-based learning, when done effectively with an appropriate platform, can have a positive effect on student achievement and skill-building. In a study conducted by Novak (2016), students who were exposed to digital game-based learning in a statistics course that incorporated storylines in the program showed “a positive effect of simulation-based learning on statistics knowledge and skills acquisition for graduate students” (p. 10). Additionally, in a virtual-world digital game-based learning study conducted, Freeman (2014) explained that student’s pre- and posttests showed that students acquired content knowledge from working in the virtual world (p. 134). Additionally, in this study, engagement was shown to be very high in both students and teachers. Dourda (2014) looked at language and content skills through the use of digital game-based learning. In this study, students worked with a game called “whodunit,” where students act as detectives when learning about geography and language. In comparative pretests and posttests, results showed that “students’ content knowledge was considerably improved . . . the average percentage of students’ positive progress in the knowledge tests was approximately 30%” (p. 252). This positive impact on skill building, student achievement, motivation, and engagement through digital game-based learning can push administrators and teachers to look at this tool as a vital source of instruction. However, as with any new tool, professional development must be provided to teachers and leaders for it to be conducted effectively.

Teacher Effectiveness and Professional Development

While the benefits to students of implementing digital game-based learning are wide-ranging, as always, it takes a teacher to facilitate the experience for learners to receive these benefits. Without an effective teacher, students may not have the background information, instructional guidance, or understand the real-world applications to effectively synthesize and apply the information being given to them. Gaming becomes more and more like critics envision: students playing games purely for entertainment. The role of the teacher is critical for this to be successful. With that in mind, it is important to look at how teacher effectiveness, training, and professional development impact student achievement in any program such as computer science and digital game-based learning.

Rahmatullah (2016) explained that the teacher is the main factor in the educational process. Even though factors such as a good educational facilities impact learning, they do not exist without the teacher (p. 170). Further citing sources, the researcher explained that 76.6% of students learning outcomes are influenced by teacher performance. Skourdoumbis (2014) further emphasized the impact of teacher effectiveness on student achievement. The researcher stated that, “the emphasis is on what teachers do—specifically, their pedagogies—which have more impact on student outcomes than do whole-school effects; and particular classroom practices are linked to high-quality student performance” (p. 112). Teacher effectiveness makes the difference to student achievement. This is particularly important when examining student achievement and teacher effectiveness in low-income schools, where economically disadvantaged students are far more likely than their peers to have inexperienced teachers (Ladd, 2011).

However, for teachers to be effective, they must be trained properly by means of professional development. Professional development refers to skills and information attain for both personal and job development. This is an in-service instruction to upgrade the content knowledge and educational skills of teachers (Malik, 2015, p. 169). National studies identify effective professional learning as a critical component of school success (Darling-Hammond., 2009). Studies have shown that teachers who are involved in impactful and effective professional development are more effective teachers. One such study conducted by Shakman (2016) showed that more teachers who participated in professional development activities of any type related to instruction-based standards received at least a proficient rating in that standard on their subsequent summative evaluation compared to those who did not participate in the activities (p. 13). Furthermore, research conducted by Green (2015) showed that “high quality professional development served a key factor in improving teacher quality, and subsequent student assessment scores” (p. 70). Teacher quality includes classroom management, lesson planning, data analysis, as well as instructional strategies, which could have an effect on student assessment scores.

As described previously, in-order for teachers to effectively deliver the content and skills that encompass the Computer Science for All Initiative, it is imperative for them to be trained properly with effective and efficient professional development opportunities. This would ultimately have a trickle-down effect, where teachers would be more effective in delivering the content, thus resulting in higher student achievement in these particular computer science skills.

Review of Methodical Issues

A variety of research methods are used to effectively ensure that the appropriate information is obtained and interpreted efficiently, including qualitative, quantitative, or mixed-method designs. While each has its own strengths and weaknesses with respect to design feasibility, limitations, ethical protections, and the manner in which information is obtained, the researcher must understand each type and choose the appropriate methodology.

Qualitative studies, such as the study conducted by Dietrich (2014), use interviews as the primary source of data. In Dietrich's study, students were interviewed to determine their understanding of being engaged in learning, improvements to teaching, and successful and unsuccessful lessons. All et al. (2015) interviewed participants over a 2-month period. The interviews were transcribed and analyzed using the qualitative analysis software package nVivo. As described by these previous two research designs, as well as the study by Zheng (2014), interview data are commonly analyzed and decoded for similarities in-order to be understood by researchers. This also allows the researchers to view trends and commonalities in the participants' responses.

In quantitative studies, such as Malik (2015), research is conducted through the use of survey questionnaires to educators. According to Kerlinger (2000), the quantitative review is the most appropriate method for examining correlations between some variables. The teachers were drawn from the National University of Modern Languages, which also became a limitation of the study. Green (2015) used a quantitative approach when presenting the teachers in the study with a 60-question self-administered questionnaire to determine their demographics as well as their self-perceptions of instructional skills and professional development. Similarly, Shakman (2016), used both survey data as well as interview data to understand teacher effectiveness in relation to the professional development they received. Survey data was taken to understand demographic information, while interview data was used to understand administrative and teacher perceptions. Scales such as the Likert scale in Ratmatullah (2016) allow the researcher to use and analyze data based on an instrument that has already been proven reliable and valid.

Another use of quantitative data is a pre- and posttest to determine knowledge, skills, or perceptions that have changed through the course of a study. In the research of Dourda (2014), students were given a pretest, were introduced to a digital game, went through the defined program designed by the researcher, and were ultimately given a posttest to determine the skills that were learned through the process. The pretest and posttest process is also displayed in Novak (2014), Jenson and Droumeva (2016), and Smith (2014), the latter of which used the test to understand student learning and engagement with the use of a virtual world environment game. This case study allowed the researchers to analyze data directly correlated to students and the use of the digital game and make assumptions of understanding based on the pre- and posttests.

A mixed methods approach is also common when multiple areas of understanding are sought. This is the case in Nelson-Walker (2013), where the researcher used interviews, observations, as well as data taken from game-play to analyze both perceptions and learned skills. However, each of these methods also has their limitations that could affect the data and results. When conducting interviews for a qualitative study, it is possible that participants could be untruthful and deceive the researcher. Additionally, what they perceive to be true and what is actually occurring may not be the same. The researcher must pose the correct questions in-order for the participant to understand what is being asked of them. The presence of the researcher alone may affect the overall outcome, as the natural environment has changed. In quantitative studies, validity and reliability are important concerns. If a particular tool, such as NumberShire in Nelson-Walker and Doabler (2013), is used, there may not be a definitive way to prove that the tool was the direct cause of the result. Lastly, the personal views of the researcher can affect the way the methodology is created, and the results are perceived. For that reason, any bias should be described at the beginning of the research process (Creswell, 2013).

Synthesis of Past Research Findings

Federal and state initiatives have pushed K–12 educational institutions to offer more courses in computer science (About CS4All, 2018). To prepare students for the careers they will eventually inherit, cognitive skills such as computational thinking are more important than ever. Research has identified computational thinking as an ability to think in an algorithmic and logical manner, while using and applying this applicative problem-solving process to a specific task (Denner, Wener, & Ortiz, 2011; Sanford, 2016).

Even though there is a push for computer science to be taught in K–12 educational institutions, the manner in which it is taught must be addressed. K–12 schools have offered computer science courses that use a digital game-based learning platform (such as Code.Org), where students become engaged in learning through a gaming software. These educational games have two important elements: entertainment and an educational component (All et al., 2015; Stewart, 2013). Teaching computational thinking skills in a fun, engaging learning environment has been the approach of many new software programs, including Code.org, Scratch MIT, and Code Monkey. This new learning environment challenges learners to engage in problem solving activities, enhances knowledge and skills acquisition, and provides users with a sense of achievement (Qian & Clarke, 2016).

While much of the current literature surround the need for increased instruction in computer science in K–12 education, there are limitations in the literature as to how this will be rolled out, what most effective instructional techniques for computer science are, and how educators and building leaders will be trained on effectively teaching this new content area. Research has shown that teacher effectiveness is an important factor in student achievement (Rahnatullah 2016; Skourdoumbis, 2014). However, in order for a teacher to be effective, there must be professional development that trains educators to effectively instruct the students to use higher order thinking skills in a specific subject area (Darling-Hammond, 2009; Green 2015); Shakman, 2016). Similarly, with computer science initiatives, teachers must be properly trained and developed in the skills that they must teach to their students.

Critique of Previous Research

While there is research conducted on technology courses being taught to students (Dieker et al., 2015; Farrell et al., 2017; Hollister et al. 2017; Pittman and Gains, 2015; Stubbs & Myers 2015; Reeves, Gunter, & Lacey, 2017; Shamir et al., 2018) and separately how digital game-based learning is should be implemented in classroom instruction (All et al., 2015; Dourda, 2014; Freeman, 2014; Martín-Párraga & Marín-Díaz, 2014; Nelson-Walker & Doabler 2013; Novak, 2016; Pho & Dinscore, 2015; Stewart, 2013), there seems to be a lack of research in the areas of teacher professional development for computer science using digital game-based learning. The review of the literature was critical in understanding the growth of the computer science field, and how educational institutions are beginning to implement the new mandates

(Bureau of Labor Statistics, 2017; Code.org state advocacy sheet, 2018; DuBow, 2016; Google Inc. & Gallup Inc., 2016; National Association of Colleges and Employers, 2017). However the review of the literature does not effectively capture the element of teacher professional development training in the field of computer science and digital game-based learning at the K–6 level in Florida that I seek to understand through interviews, observations of teachers, and the collection of professional development artifacts in a qualitative research study approach.

Chapter 2 Summary

Educators are instructed to create college and career-ready individuals who will be successful in the 21st century technological world. New initiatives at both the federal and state levels have demanded that schools at the K–12 level begin implementing computer science courses at each grade level to teach students computation and logical thinking skills in order to compete in a demanding and growing workforce.

Many computer science programs are moving toward a digital game-based learning approach to critical and computational thinking that has been shown to be effective in reaching students. Digital game-based learning allows students of all ages to work in an environment that promotes engagement, motivation, critical thinking, and ultimately leads to the understanding of content skills.

In order for educators to effectively roll out the new computer science courses using digital game-based learning, they must first be trained on how to teach the material. Professional development and teacher training in computer science must first be created and implemented at the K–12 levels before this can be understood by our students. For this reason, I have chosen to research the teacher professional development that is needed to effectively instruct students in the areas of computer science using digital game-based learning.

Chapter 3: Methodology

Introduction

The purpose of this qualitative case study research was to understand the professional development needed for elementary school (grades K–6) educators to effectively teach computer science as part of the Computer Science for All initiative. The professional development examined encompassed skills in both computer science resources and digital game-based learning tools. A case study involves conducting an empirical investigation of a contemporary phenomenon within its natural setting using multiple sources of evidence (Hancock, 2017, p. 31). The subjects in a case study could include programs, persons, and events. Research in this case study involved artifacts and documents as well as observations of and interviews with teachers, in elementary schools. The case study researcher seeked to identify themes, behaviors, and events rather than prove hypotheses (Hancock, 2017 p. 31). The strength of the case study is its ability to use a wide range of evidence including documents, artifacts, interviews, and observations (Yin, 2017, p. 8).

Research Questions

The focus of this study was the training and skills needed in the areas of computer science and digital game-based learning for teachers to effectively teach the concepts and programs for the Computer Science for All initiative for elementary school teachers in a Florida K–6 elementary school. The research questions that guided this study were:

1. What professional development training is needed for Florida elementary school educators to effectively teach the topics in the Computer Science for All initiative?
2. How do Florida elementary school educators use digital game-based learning to effectively teach the topics in the Computer Science for All initiative?

Purpose and Design of Study

The purpose of this case study was to understand the professional development training that is needed for elementary school educators in Florida to effectively teach the topics in the federal Computer Science for All initiative, including using digital game-based learning. Best practices for teaching computer science and digital game-based learning was based on information from researchers such as Hazzan (2015), Yadav (2016), Hartveld (2016), as well as my own experience as a certified New York State instructional technology specialist and professional developer. Teacher training in the United States is one of the most cited reasons for lack of technology implementation in the classroom (Birch, 2008). In this case study, qualitative data was collected through interviews, observations, and documents to understand professional development and educational experiences of teachers in computer science and digital game-based learning. Interviews were conducted and observational notes were collected to understand the teachers' collegiate and professional training in computer science, as well as teacher perceptions on what future professional development in computer science is needed to effectively teach computer science at the elementary school level. Artifacts and documents from the school and other schools in the company network were collected to understand the current state of technology training at the institution. The focus was on teachers who are currently in the elementary school classroom, ranging from kindergarten to sixth grade in Florida. The sources of information were school artifacts, teacher interviews, and observational studies, which were analyzed and reviewed for common themes.

Related research in the literature has been both quantitative and qualitative. Quantitative studies have looked at how computer science and digital game-based learning have affected student achievement and content knowledge (Nelson-Walker & Doabler, 2013; Novak, 2014;

Smith, 2014). Qualitative studies focused on teacher professional development (Green, 2015; Rahmatullah, 2016) and the benefits in student achievement (Skourdoumbis, 2014). I conducted a collective case study to understand both elementary teachers' perceptions of professional development in computer science and digital game-based learning.

Case study is defined by Yin (1994) in terms of the research process as an "empirical inquiry that investigates a contemporary phenomenon within its real-life context" (p. 18). While Yin focused more on the research process, Stake (1995) focused on the unit of study. Stake believed a case study is "both the process of learning about the case and the product of our learning" (p. 237). Additionally, Merriam (1988, 1998) defined case study in terms of the end product by stating that "a qualitative case study is an intensive, holistic description and analysis of a single instance, phenomenon, or social unit" (p. 21). Each definition gives a unique outlook on what defines a case study, but allows the researcher to understand the parameters and focus on what should define the study. The study must have boundaries to define what will and will not be studied and allow the researcher to focus. I defined the participants as a group of teachers from a specific school. I interviewed and observed their beliefs on professional development on computer science and digital game-based learning and made inferences and recommendations based on those results. As this is a qualitative case study, it was more descriptive in nature.

Research Population

The population in this study are elementary teachers from a Florida charter school. All teachers live in Florida. Some teachers had knowledge of teaching computer science and digital game-based learning at the elementary level at the school, while others did not. All teachers had at least one year of teaching experience in an elementary classroom. The characteristics of the population include their experience, grade level, location, technology/computer science/digital game-based learning familiarity, as well as the type of class they teach. Teachers were willing to participate in interviews and observations.

Sampling Method

To identify teachers whose experience will address the research problem and questions, I used purposeful sampling (Creswell, 2014). Palinkis (2015) explained that purposeful sampling is a technique used for the identification and selection of information-rich cases. This involves selecting individuals who are knowledge about the experience, which in this case is education in general and, more specifically, computer science and digital game-based learning. Teachers needed to hold an elementary classroom teaching position (nonspecial), as well as at least one year of teaching experience. Teacher recruitment happened through online surveys and email. The sample size was 15 teachers, and each teacher was interviewed and observed. The sample size was determined based on the amount of time available to both the researcher and the participants. Teachers selected were from the same Florida elementary charter school who volunteered to participate. This sampling procedure was used due to convenience as I was employed as a teacher in Florida; however, I was not in a supervisory or evaluative role for any of the participants.

Sources of Data

In order to effectively understand the perceptions and experiences of teachers working with computer science and digital game-based learning, I conducted observations and structured interviews, as well as collected artifacts from the school that relate to technology use, computer science, digital game-based learning, and other documents that helped me understand the vision for the school. During the interviews, I recorded the conversations and took notes on the teachers’ responses. As described by Hatch (2002), principal data are gathered by qualitative researchers directly through field notes from observations, transcripts of interviews, and data from artifacts from research sites or social phenomena (p. 7). This allows the researchers to make sense of the social aspects and essentially quantify the information into data that can be proceeded for trends and understanding. Field notes were used during observations to effectively capture the events inside of the classroom. Each source of data allowed for efficient and accurate review for analysis.

Data Collection

Before observational and interview data collection began, I obtained approval from the Concordia University Institutional Review Board (CU-IRB) and the school where the study took place. Data collection followed the guidelines and procedures established in the initial recruitment letter. Observations and interviews were recorded with an audio recording device for accuracy, reliability, and validity. All audio and video recordings were deleted immediately following the transcription and completion of the research as per the CU-IRB. Different instrumentation tools were used to effectively capture the research experience, including a technology observation checklist and an interview question form.

Artifacts

Artifacts were collected from the school and other schools in the company network to understand different aspects of professional development, school vision, and curriculum with respect to computer science and digital game-based learning. Artifacts included official professional development plans and documents from the charter schools. According to Merriam (2015), documents and artifacts are ready-made sources of data easily accessible to the researcher. Similar to interviews and observational data, artifacts and documents from the environment were also coded to analyze trends (Merriam, 2015).

Observations

Observations were used to gauge teachers' perceptions, reactions, and instructional strategies. An observation checklist was be used (see Appendix B). The observation checklist was derived from the International Society for Technology in Education (ISTE), similarly used in research conducted by Bielefeldt (2012). Additionally, field notes during observations provided background information as well as context for different points that are made during the teacher observations. These notes were documented during observations. Each of these sources of data were analyzed for trends. Teachers were observed in the areas of technology usage, computer science, and digital game-based learning. Attention was paid to instructional techniques, comfortability, attitudes, perceptions, as well content knowledge for each observed area.

Interviews

Structured interviews were conducted to understand the teachers' experiences and perceptions regarding computer science and digital game-based learning. A list of questions was created to facilitate the discussion about these two main concepts (see Appendix A). Interview questions were based on the survey questions by Gray, Thomas, and Lewis (2010) that are included in the Teachers' Use of Educational Technology in U.S. Public Schools form the National Center for Education Statistics. The questions were modified from this report to help answer the research questions. Interviews were held in a one-on-one setting that lasted approximately 30 minutes. While all questions were predetermined, any follow up questions were be structured based on interviewee responses. Certain questions elicited background information to establish the teachers' demographics and to build strong relationships (Hatch, 2002). Additionally, teachers were asked to state recommendations for teacher professional development in the areas of both computer science and digital game-based learning.

Identification of Attributes

The attributes that defined and guided this case study are computer science, digital game-based learning, professional development, technology integration, teaching experiences, pedagogical techniques, perceptions, elementary teachers, and elementary students. The experiences of each teacher were based on their prior knowledge, training, perceptions, and attitudes toward the teaching of computer science and digital game-based learning in an elementary classroom. The goal of this process was to understand what professional development is needed for elementary school educators to teach computer science and digital game-based learning.

The perceptions and experiences of elementary school teachers in Florida were the focus of this study. The participating teachers shared perceptions and experiences in the areas of computer science and digital game-based learning, and the professional development they received and/or would like to receive in these areas. Teachers discussed how they integrate technology into their pedagogical techniques. Each teacher had experience in the teaching field, and all had some background with integrating technology in their classrooms. Each attribute discussed contributed to the overall understanding of the teacher experience in the classroom, as well as the professional development they received or what they believe teachers should be trained on in the areas of computer science and digital game-based learning (Thiele, Mai, & Post, 2014).

Data Analysis Procedures

This case study research is a qualitative study. According to Harding (2013), qualitative data analysis involves gathering a data set, dissecting the data, and reassembling the data in a manner that is relevant and meaningful to the study. For this case study, interviews and observations were analyzed to identify common themes and trends. The data analysis procedures that were used in this study are focused on results from interviews and observations as well as the collection of professional development documents.

Interviews

Structured interviews were conducted to understand the teachers' experiences and perceptions regarding computer science and digital game-based learning. A list of questions was created to help facilitate the discussion around these two main concepts. Participants were able to express their ideas, thoughts, and concerns during their interview sessions. I used a list of questions to guide the interview questions that are found in Appendix A. As responses were given, I asked impromptu follow-up questions. These questions were open ended in nature and contained unplanned probes based on responses (Harding, 2013).

Conversations were recorded through software and transcribed for coding after the interviews are complete. Recording only occurred with the consent of the interviewee (Harding, 2013). After the initial summaries were created, the coding process for data analytics began. Codes are labels that assign symbolic meaning to the descriptive or inferential information complied during a study (Saldaña, 2013). This involved short phrases or words that symbolically assign an attribute to the data. This could be as small as single word or as large as a paragraph. Codes are primarily used to retrieve and categorize similar data chunks to quickly find and cluster information that relates to a particular research question or theme (Saldaña, 2014). I first created the list of codes, analyzed the transcripts for each code, and used the NVivo software to organize. Codes were analyzed for patterns and trends related to the themes and research questions for final analysis, which was created in narrative form.

Observations

Observations were used to gauge teachers' perceptions, reactions, and instructional strategies. An observation checklist was used (see Appendix B). Additionally, field notes during observations provided background information as well as context for different ideas that emerged during the teacher observations (Harding, 2013). These observations were recorded with the teachers' permission. The concepts and themes of the checklist were derived from the codes created during the initial teacher interviews. The date and time was coordinated ahead of time with the teachers. Any observational data was incorporated into the coding process that began in the first interview and was included in the final narrative (Harding, 2013; Stake, 2010; Stringer, 2014).

Artifacts

Artifacts were collected from the school and other schools in the company network to understand different aspects of professional development, school vision, and curriculum with respect to computer science and digital game-based learning. Artifacts included school-year professional development plans, new teacher introduction plans as well as other various documents that come from the charter school organization. As described by Marshall (2014), analyzing artifacts entails interpretation by the researcher. Similar to the interview and observational data, artifacts were coded to understand trends.

Limitations and Delimitations of the Research Design

Limitations and delimitations are aspects of a study that represent weaknesses in the research (Creswell, 2017). This could affect credibility and reliability for future researchers including sample size, recruitment, and settings as some examples. Limitations are matters that arise in a study but are out of the researcher's control (Simon, 2011). This could affect the results, discussion, and conclusions that are ultimately drawn as a result of the study. For this study limitations and delimitations included the setting, sample size, time constraints, transferability, and self-reporting. This section provides information about possible limitations and delimitations within this study and my plan to minimalize these limitations.

Limitations

Influences that cannot be controlled by the researcher that place restrictions on the research and conclusions. For this study, limitations included time, personal biases, sample size, and setting.

Time constraints. Due to the nature of the work day schedule, time constraints were a limitation on both the teacher interviews and the observations. At this particular school, teachers were given a 45-minute prep periods as well as a 45-minute lunch. My interviews took place out of these time periods as to not interrupt teacher planning or lunch. Observations of teachers took place during the school day, roughly 8am to 4pm. Each instructional period was roughly 30 minutes, which was the length of the observation period.

Personal bias. Personal bias refers to the preconceived notions and thoughts based on experiences of the researcher and how that may affect the interpretations and conclusions of the study. According to Kaptchuk (2003), "Unbiased interpretation of data is as important as performing rigorous experiments. This evaluative process is never totally objective or completely independent of scientists' convictions or theoretical apparatus" (p. 1453). For this reason, I did my best to ensure that any personal feelings of influences are kept out of the research and ultimate conclusions by looking at the research through an objective, logical, and rational lens. To ensure credibility, I was careful not to allow my own ideas or biases influence the study (Herr & Anderson, 2015; Stake, 2010; Stringer, 2014). Researcher reflections allowed me to analyze my own bias during the process to ensure that I did not influence the results.

Sample size. Because I only had access to one school, the sample size of possible teachers that I can interview was restricted. The research site has approximately 50 teachers total, and with the time constraints, I was allowed to interview 15 teachers. For this reason, I was not be able to generalize to the larger population.

Setting. In this study, the setting was a limitation. This case study research study took place in an elementary charter school in Florida. I choose the site for both convenience and need. This limited the possibility of studying different demographic groups and schools comparatively.

Delimitations

Delimitations refer to the limits that the researcher chooses to put on the study. This sets the scope and parameters of the experiment and allow for a focus of certain research questions. For this study, the delimitations were the boundaries of study as well as the selection of participants.

Boundaries of study. The boundaries of the study are the choices that I had made that target the specific research questions that I addressed. These boundaries included the professional development of teachers in both computer science and digital game-based learning. While this limited the amount of information and conclusions that I was able to draw from the research, it allowed me to pinpoint and focus on specific themes and questions that I address at the end of the study.

Sampling. Purposeful sampling was used to select participants from the teacher pool at an elementary school in Florida. I had previously established rapport and connections with the teachers in this setting. I believe this made them more comfortable in expressing their beliefs and suggestions in the areas of professional development in computer science and digital game-based learning.

Validation

Validation refers to the objectivity, dependability, and credibility of a study. According to Silverman (2016), “the validity of research concerns the interpretation of observations: whether or not ‘the researcher is calling what is measured by the right name’” (p. 414). In this case study, validation was ensured by the extent that the actions deemed appropriate to meet research goals are addressed and how these actions led to a possible resolution of the research purpose. In general, the researchers’ interpretations of observations are valid when they are in a credible and demonstrable way based on the information and data that are obtained during the case study (Silverman, 2016, p. 415).

To ensure that this case study is valid, triangulation was used for collecting data. Triangulation means to use more than one method to collect data in the same study. According to Carter (2014), “triangulation refers to the use of multiple methods or data sources in qualitative research to develop a comprehensive understanding of phenomena. Triangulation also has been viewed as a qualitative research strategy to test validity through the convergence of information from different sources” (p. 1). This helps ensure validity and credibility. The triangulation process for this study included collecting and analyzing information from interviews, observations, and professional development artifacts that were collected. The data obtained was then coded to understand emergent and common themes. The consistency of the findings generated by the different data collection methods were then analyzed (Patton, 2001).

I further provided validity through member checking. According to Birt (2016), "member checking, also known as participant or respondent validation, is a technique for exploring the credibility of results. Data or results are returned to participants to check for accuracy and resonance with their experiences" (p. 1). Teacher participants were provided with the transcripts from the interviews by email one week after the interviews were concluded to ensure accuracy and legitimacy (Stringer, 2014).

Credibility

Credibility refers to the quality of being believable or worthy of trust. In a qualitative study, this means that the findings of the researcher accurately represent the reality of the participants in the study (Lincoln, 2001). In this case study, interviews, observational data, as well as self-reflection was used and collected to further support the credibility of this study.

I will keep all data collected and audio recordings. According to federal regulations, research data must be kept at least five years ("Research Records," 2017). Additionally, I clarified any personal biases at the beginning of the study and ensured that when analyzing data, I did not interject personal preferences (Creswell, 2014).

Dependability

Dependability refers to quality of the data collection techniques, data analysis, as well as the procedures and methods of the study. Trustworthiness, part of dependability, were established through the consistency of data collection and representation. To ensure dependability, research procedures were clearly defined and opened for review (Stringer, 2014).

Expected Findings

The purpose of this case study is to contribute to the existing research findings on the professional development needed for educators to teach computer science and digital game-based learning effectively. Based on the information found in the literature review, I have identified results that I expected to uncover from the beginning to the end through each method of data analysis. The methods for this study were interviews, artifacts and classroom observations.

Interviews

Questions during individual interview sessions with educators allowed the participants to express their thoughts and feelings regarding the purpose of this case study (Creswell, 2014). I expected that participants had not been trained how to teach computer science and digital game-based learning, despite the initiatives that ask classroom teachers to incorporate both into their daily lessons. I believed they would explain that most of their training has been focused on either the specific content that they teach (e.g., math, science, reading, writing) or general pedagogy and instructional practices for the classroom. As STEM (science, technology, engineering, and mathematics) education has become a focus for many schools and districts, the required training to teach computer science had not been provided. I believed teachers would feel that digital game-based learning is more of a passive instructional tool in which teachers give students a game, let them play, and have little interaction during this process. Many would believe that this is more intended for entertainment than to teach students a specific skill or standard.

Similarly to computer science, teachers would feel that they are not equipped with the proper training to use digital game-based learning in a way that is both educational and entertaining for students on a regular basis. I believed that during their college or teacher training courses, computer science and digital game-based learning were not covered, and thus they will feel unprepared to use computer science and digital game-based learning on a regular basis. I also believed that there will be a significant difference in the comfortability of teachers using computer science and digital game-based learning in the classroom based on age. I believed that older teachers who are not as tech savvy will feel less confident in using both of these educational tools in their classrooms.

Observations

Observations in the classrooms allowed me to observe phenomenon relation to the purpose of this case study (Creswell, 2014). A checklist was created to use during each observation (Appendix B). I believed that teachers who do not feel comfortable using computer science and digital game-based learning will also use less technology in the classroom overall during their lessons.

Artifacts

Artifacts taken from the school and other schools in the company network would allow me to understand the curriculum, vision, and current expectations of teachers in the areas of computer science and digital game-based learning. Artifacts such as professional development plans and new teacher introduction professional development plans for new and existing schools were coded to analyze trends in the environment. I believed that there would be a lack of instructional resources and training materials for the professional development of teachers in both computer science and digital game-based learning.

Ethical Issues of the Study

For all research, it is important that ethical issues be reviewed. This is a case study research design and working in the field involves ethical dilemmas that are different from survey research and cannot always be addressed at the outset (Silverman, 2015, p.6). Informed consent was obtained when participants initially volunteered to be a part of the study. All participants signed the informed consent document during initial signups. The location for each of the interview was in a classroom that was in a quiet and secure location to ensure privacy and confidentiality. Before the interview began, teachers signed the consent form and were given a copy for their records. All information was stored on a password-protected computer, and all documents are secured in a locked container.

The Belmont Report helped guide me in ensuring that all procedures and actions taken during this case study research were ethical and that no participants were harmed during the course of this study (National Commission for the Protection of Human Subjects of Biomed Behavior, 1978). The principals of the Belmont report refer to respect for persons, beneficence, and justice for the ethical conduct of research involving human subjects. To respect persons involved in the study, all participants were informed of any possible risks and benefits prior to the study. Additionally, participants were not identified by their names, as aliases will be used. Beneficence refers to the principal of minimizing possible harm and maximizing possible benefits. There was no harm to participants as their confidentiality was not violated, nor were there identities revealed. The benefits for participants of this study were the potential to gain a deeper understanding of computer science and digital game-based learning, as well as growing as educators. The last principle of the Belmont Report is justice, which refers to who will benefit from the study. Again, this was addressed by teachers understanding the two focus areas.

Conflict of Interest Assessment

Prior to conducting the study, I obtained approval from Concordia University's Institutional Review Board. Permission was obtained by the school's administrative staff located in Florida. This consent form provided a transparent summary of the case study research study (Creswell, 2014; Stringer, 2014). Participants demonstrated that they are participating in the study voluntary based on their signatures on the consent forms (Creswell, 2014; Stringer, 2014). Participants were recruited voluntarily by email as well as personal recruitment of staff members. The sample recruitment letter and sign-up sheets are located in Appendix C. Interviews were audio recorded and transcribed using the online transcription service Rev. The transcripts were sent to the participants for them to review and make changes as necessary. When correct, the participant approved the transcript. Participant confidentiality was maintained in all documentation (Creswell, 2014).

Researcher's Position

I conducted and transcribed all interviews with participants. Participating educators had the flexibility to choose which time we would meet for the interviews if the created schedule did not work for them. As a certified instructional technology specialist in New York, I have expert knowledge and experience on how to effectively teach computer science and implement digital game-based learning in elementary school classrooms. As a nonevaluative technology administrator, having knowledge of the research setting and related experience allowed participants to view me as a credible researcher. Additionally, because I am not an evaluative administrator, participants were more likely to respond honestly and truthfully in both interviews and reflections without the possibility of repercussions from administration (Creswell, 2014; Hatch, 2002). Teachers received no financial compensation for participating.

Additional Ethical Issues

Potential ethical issues that I needed to address included how the data is analyzed and reported. I remembered to report multiple perspectives to maintain the credibility of the study

(Creswell, 2014). Clear and concise language was used to communicate the findings of this case study research design (Creswell, 2014).

Chapter 3 Summary

Chapter 3 described the methodology and the case study research design for this study. In this section, I provided the research questions, setting, participants, data analysis, limitations, and delimitations. Validity, dependability, and credibility were also discussed in this section. To conclude, I discussed my role as a researcher in this case study research design. Chapter 4 will document the results of the study.

Chapter 4: Data Analysis and Results

Introduction

This qualitative case study was designed to explore the professional development of elementary school teachers in the areas of computer science and digital game-based learning. By using the case study design, researchers are able to examine the issues, experiences, and relationships that exist within a given case (Hatch, 2002). In this case study, I examined elementary school teachers at a Florida elementary school with two research questions in mind: What professional development training is needed for Florida elementary school educators to effectively teach the topics in the Computer Science for All initiative? How do Florida elementary school educators use digital game-based learning to effectively teach the topics in the Computer Science for All initiative?

In this chapter, I present a description of the participants, the research method, and the analysis of the data collected from structured interviews, classroom observations, and professional development artifacts. The findings are summarized before data and results are presented. The chapter concludes with a summary after a presentation of the data and results.

Description of the Sample

Recruitment of participants was initially done through emails that were sent out to all classroom teachers at the same Florida elementary school where I was employed. Teachers responded through email that they were interested in participating in the study, and I followed up in-person to ensure that those teachers were willing to participate and to make sure that they were aware of the requirements of the study. I was able to secure 15 participants that were all current classroom teachers in grades K–6. Each grade level teacher-captain was chosen in addition to eight other teachers.

The school from which participants were chosen was a new school in its first year of opening. Because of that, each participant was in their first year of teaching at the school. Every classroom teacher at this school was female (excluding specials teachers, special education, and support staff), therefore all participants were female. All of the participants have been given a coded pseudonym to protect their identity and maintain confidentiality.

The number of teachers who have taught each grade level at some point in their careers and what they currently teach is shown in Table 1. Experience levels ranged from one year of teaching to the 13th year of teaching. Table 2 depicts the experience level range of the 15 participants.

Table 1

Grade-level Teaching Experience Overview

Grade Level	Taught Previously	Teach Currently
Kindergarten	2	1
1st Grade	4	1
2nd Grade	5	3
3rd Grade	4	2
4th Grade	5	1
5th Grade	2	4
6th Grade	0	3

Table 2

Overall Teaching Experience Overview

Years of Teaching Experience	Number of Participants
1–3 years	5
4–10 years	8
>10 years	2

Description of Participants

Briana. Briana has one year of teaching experience and was teaching third grade at the time of the interview. She has previously taught third grade. She was a member of the third grade team and not the grade-level captain. She described herself as comfortable with technology and had educational technology courses in her academic career. She said that “I’m not a techie person. I know I’m a millennial and I feel like I should, but I don’t get it right away always.” She felt that she was more comfortable with using technology inside of the classroom than she was using technology in her personal life.

Cathy. Cathy had three years of elementary school experience and was teaching fifth grade at the time of the interview. She was also the grade team captain for fifth grade. She previously taught third and fourth grade. She described herself as “pretty comfortable” with technology and stated that “I would say out of a 10, like a seven or eight. I’m not one for reading the directions to do it, I like to just figure it out and mess with it.” She did not have experience in technology education courses in her academic career, as her bachelor’s degree was in an unrelated field. The only course she took was on how to create a class website as part of her teaching certification.

Carol. Carol was a second grade teacher and the captain for the second grade. She had four years of teaching experience in kindergarten and as a third grade teacher. She stated, "I went to the University of Anywhere and I had no technical classes at all." Carol felt "pretty adequate" with technology despite not having any undergraduate requirements to take technology courses in her academic career.

Christine. Christine was a fifth grade teacher but she was not the captain for the grade. At the time of the interview, she was in her 11th year teaching between two different states. She stated that she was "not comfortable at all [with technology]. I just use my laptop for basic necessities. I don't really know much, I'm not a techy type person." She did not take any technology courses at all in either her undergraduate or graduate academic career.

Faith. Faith was a sixth grade teacher and she was not the captain for the grade. She had been a teacher for eight years consisting of second grade, fifth grade, sixth grade, seventh grade, and eighth grade. Faith did not have a lot of experience using technology, and she mentioned she only started using her iPhone recently. She also had experience teaching oversees in Boliva, Costa Rica, and the Dominican Republic. In total she had spent 13 years overseas in and out of education. Describing her technology experience in college, she said "None, no. We didn't really have technology in my master's program either because we were just using the computer for research and stuff." She did not have any technology in college in her undergraduate program, and her master's program consisted of only using a computer to type papers.

Felicia. Felicia was a first grade teacher and the team captain for the grade level. She had taught elementary school for eight years and taught first grade for all of them. When describing her comfortability with technology, she stated that she was "somewhat comfortable. Not extremely comfortable. I know how to use the basics." She also did not have any technology education courses during her undergraduate or graduate career.

Gina. Gina was a fifth grade teacher and had been teaching for three years. She had previously taught fourth grade and second grade. Describing her technology courses in college, she claimed that most of the courses that she took required her to use technology instead of teaching how to use it. Gina stated, "Most of the courses that I took weren't specifically how to teach technology. It was more like the course required me to use a certain program, so then I learned about it through that and then implemented it in my teaching." Additionally she stated, "I just learn to accept it and I try to learn as much as I can so that I can use it." She was "pretty comfortable" in using technology in her personal and professional life.

Gabby. Gabby had five years of teaching experience and was teaching second grade. She had previously taught first and fourth grades in addition to second grade. Describing her comfortability in using technology in her personal and professional life, "My phone? I'm good. Some of the stuff on the computer and iPad, not so much." Gabby had taken a computer programming course in college; however technology courses were limited in the rest of her academic career.

Gwen. Gwen was a sixth grade teacher and the team captain for the grade. She had worked as an elementary school teacher for five years, teaching sixth, fourth, and second grade. She explained that despite always researching about technology on her own, she had never taken a technology-related course in college. Gwen stated, "Especially with my education courses, none were really technology courses and how to use technology in classes." In describing her comfortability using technology at home in her personal life, she stated, "We're a very technology family. I'm not one of those parents who my kids are not on technology. They are because personally for me, I see the hand-eye coordination, I see their problem-solving skills, I see their critical thinking skills." Despite that lack of experience, she was extremely comfortable using technology.

Hazel. Hazel has taught elementary school for five years and was the fourth grade team captain at the time of the interview. She had previously taught fifth, fourth, third, and first grades. She also had teaching experience out of the state of Florida. Hazel did take technology courses in college and had a background in STEM education. Hazel said,

> So, in college, I don't remember the classes that they were, but they were part of the education program, so they had us where we went in and we learned about the whole, like, PowerPoint program to get kids to build presentations and things like that. Different software programs that we could use for students when we build lesson plans.

She also stated, "I feel pretty confident about it, I mean a lot of the teachers or even in my community or in the other schools that I've taught, most people come to me to fix technology issues." In describing her comfortability in using technology, Hazel felt comfortable in her personal life, as well as troubleshooting for computers.

Jessica. Jessica was a second grade teacher and was in her second year of teaching. She had previously taught fourth grade. She had not taken any technology courses in her undergraduate or graduate academic career. Jessica stated, "I think the closest I've gotten to actually taking a technology kind of course is just doing courses online." She explained that, "I did a lot of office work before I started teaching, so I got most of that through there. But professionally in the classroom, a lot, I don't feel super comfortable with it." In describing her comfortability in using technology, she stated that she was "super comfortable" with the basics.

Janet. Janet was the captain for kindergarten and had been teaching for six years. She had previously taught kindergarten, preschool, second grade, and fifth grade. She stated that she was comfortable with technology in her personal life. She explained that, "I feel comfortable using it in my personal life. I prefer Apple products, so the more Apple products that are in my life, the happier I become." She stated,

> The only technology class I had to take as an undergrad that had to do with teaching was for smart board/promethean board training, and because that was the only big new technology that existed at the time. This is before really iPads were in the schools, or that was just starting to become a thing.

She did have some technology classes in her undergraduate program dealing with SMART boards.

Lisa. Lisa was in her 13th year of teaching and was a fifth grade teacher. She had previously taught kindergarten, first, second, third, fourth, and fifth grade. She did have some technology courses in college and stated, "During college, we had to take a course, and all the programs that teachers would use, even Word and PowerPoint, and it was hands-on. You had to produce something, so I think that helped me not be scared of it." She stated that, "I don't really use technology in my personal life except as a mom; pictures, and digital stuff." While she described her comfortability in her professional life, she did not use technology too much in her personal life.

Melissa. Melissa was the captain for the third grade and had seven years of teaching experience. She had previously taught first grade and third grade. Melissa stated that, "We didn't have any technology specific courses. I went to University of Anywhere. So all the courses integrated technology into the course." She also explained that she was "pretty comfortable" with technology and added, “I do everything from my cell phone in my personal life… I mean I don’t have any problem using it. My professional career, I think obviously it’s increased each year.” In describing her technology education courses in her undergraduate and graduate programs, she explained that she did not have any that were focused on technology specifically.

Rachelle. Rachelle was a sixth-grade teacher and had been teaching for two years. She had previously taught fifth grade as well. She had taken technology courses in her undergraduate and graduate career in multimedia software, such as Adobe Suite, Dreamweaver, and computer science coding software. Rachelle stated, “I might need some more training and stuff like how can I incorporate that into, say math or teaching?” In her personal life, she felt comfortable using technology, but felt that she needed more training in her professional life.

Research Methodology and Analysis

In this qualitative study, I used a case study design to understand the experiences that elementary level teachers had in their academic and professional careers in the areas of professional development of technology, specifically in the areas of computer science and digital game-based learning. Two research questions were used to guide the study: What professional development training is needed for Florida elementary school educators to effectively teach the topics in the Computer Science for All initiative? How do Florida elementary school educators use digital game-based learning to effectively teach the topics in the Computer Science for All initiative? The case study was intrinsic to gain a deeper understanding of the teachers’ experiences in both of these areas (Stake, 1995). The data from this case study were comprised of responses from structured interviews, classroom observations, and professional development artifacts obtained from the participating school, as well as from other schools in the charter network.

The collection of artifacts differed from the initial data collection procedures described in the methodology, which explained that professional development artifacts would be collected from the teachers. After conferencing with the teachers, it was found that most of the teachers would not be able to provide professional development artifacts that they have collected throughout their academic and professional careers. The most common issue was because many of them had not had any professional development experience and therefore were not able to provide any artifacts. After discovering this, I decided to use the 2018–2019 professional development calendar plans from the school from which the teachers were selected.

Additionally, I was able to get the professional development calendars from five other schools in the same charter school company, making a total of six schools. This allowed me to analyze and understand the ways that teachers were trained at the current school, as well as at other schools in the same charter school company. Another set of artifacts that was collected and analyzed was the New Teacher Introduction (NTI) professional development plans that were used. These artifacts contained the plans for the summer preservice professional development plans that were to be used by all schools in this company, including the school from where the teachers were selected. This is also broken down into two separate types of NTI documents: preservice professional development plans for new schools and preservice professional development plans for existing schools. NTI preservice professional development plans were collected for the 2015, 2016, 2017, and 2018 school years.

In the following section, I explain the coding steps I followed in detail. I conducted face-to-face interviews at the school where the teachers worked. Each interview was recorded using the Easy Voice Recorder app and transcribed using Rev.com. Observations of a lesson using technology was conducted on each participant in the weeks following the interview. Observation data was collected using the Technology Observation Checklist (see Appendix B). Finally, professional development documents were collected from the participating school as well as five other schools in the charter school network. All data collected were then coded using the NVivo software to analyze trends and themes.

Data Collection

I collected data in three phases. First, I conducted structured interviews with the participants during a one-week period. Second, I conducted classroom observations of technology lessons with each of the participants during a two-week period. Third, I collected professional development artifacts from the school where the teachers worked, as well as five other schools in the charter school company network.

Structured Interviews

I conducted interviews with each of the 15 participants over a one-week period. I collected interview data from each participant during prescheduled, 40-minute interview sessions. Each interview was conducted during a time when teachers were in the classroom, so as to not take away from their planning or personal lunch time. Substitute teachers were provided to relieve the teachers for the time-slot. The location for each of the interview was in a classroom that was in a quiet and secure location to ensure privacy and confidentiality. Before the interview began, teachers signed the consent form and were given a copy for their records.

The same procedure was followed for each of the 15 participants. I recorded each interview using the Easy Voice Recorder app on my cellphone. I also took notes on my own notepad for anything that I wanted to note or follow-up with. As the interview progressed, I added follow up questions in addition to the set of 24 questions that are shown in the Teacher Interview Questions document in Appendix A. Questions one through seven focused on teacher experience and general technology usage. Questions eight through 15 focus on computer science and professional development. Questions 16 through 24 focused on digital game-based learning and professional development. Follow up questions were asked as needed based on participant responses. After the interview, I transcribed each of the interviews using Rev.com. Transcripts were emailed to the respective participants and checked for accuracy. Data from the interviews were then coded using the NVivo software.

Observations

Following the interviews, observations were set up during a two-week period. Teachers were observed for a 30-minute block that consisted of a lesson using technology. I conducted the observation using the Technology Observation Checklist (see Appendix B). This allowed me to understand how teachers are using technology in the classroom. Teachers were given a copy of the observation checklist to check for accuracy. Data from the observation checklist was then coded using NVivo software.

Professional Development Artifacts

Professional development artifacts were collected from school administrators at the school, as well as five other participating schools. An administrator at the participating school was able to send me NTI documents from the previous four years, as well as the professional development calendar for the current school year. Upon receiving these documents, the administrator directed me to five other schools that might be willing to participate. I reached out to the curriculum resource teachers at each of these five schools by email. The curriculum resource teachers sent me back their current school year’s professional development calendar over the course of a four-week period. Documents from the six total participating schools were then coded using the NVivo software.

Member Checking

I conducted member checking with each participant over a period of three weeks. Member checking was conducted with each participant after the interview and observation portion of the research and confirmed that all information was accurate and valid. Interview transcripts were sent to each participant the following week after the interview was conducted. The observation checklists were sent to each participant the following week after the observation was conducted. Each document was sent to the respective participants through email.

Data Analysis

I used the inductive analysis steps as modeled by Hatch (2002) to analyze the data from the interviews, observations, and professional development artifacts. To code the information, I began with more specific information to general ideas (Hatch, 2002). I used the initial coding model as described by Saldaña (2016) and broke the codes into three different cycles. In the first cycle, I analyzed the initial data into 154 codes. Those 154 codes were then analyzed and compared with codes that had similarities and differences. I used pattern coding (Saldaña, 2016) to then collapse those 154 codes into 22 clear and concise codes. I was able to then reorganize and regroup those 22 codes into five emergent themes. The coding process was completed with the two research questions in mind.

Interview Data

After collecting the interview data, transcribing the information, and checking for accuracy and validity, I began the coding process. To analyze the data from the interviews, I used Hatch's (2002) inductive analysis model. I began with an initial reading of each transcription to understand and refresh myself on the information that was presented. By using the NVivo software, I was able to create codes where I discovered a main idea or concept during each interview question that was asked. Each individual question resulted in statements and ideas made by the teachers that would eventually create a set of 154 codes using Saldaña's (2016) initial coding process. Reanalyzing the data provided me an opportunity to find any ideas or concepts that were missed during the initial reading and place them in the appropriate code. After noticing common themes and concepts within those 154 codes, I was able to collapse those codes into 22 codes using the pattern coding method. The initial 154 codes and collapsed 22 codes can be seen in Appendix C.

Observation Data

After completing the interviews and the data analysis, I moved on to the observations and data analysis. Over a two-week period, I was able to conduct the 15 observations for each teacher that participated in the interviews. Observations were conducted on a technology lesson taught by the teacher using the Technology Observation Checklist in Appendix B. After checking the data for accuracy and validity, I began to analyze the results of the observations. After noticing that not all the sections on the checklist would help me answer the research questions, I focused on specific aspects of the checklist to add to list of codes that was created during the interviews.

A typological approach, as described by Hatch (2002), was used to analyze the observational data. The observation checklist data was able to help me understand how teachers were using technology in the classroom. More specifically, I was able to focus on six main typologies of the observation checklist that would help me answer the research questions. The six sections that I focused on were: student groupings, teacher role, learning activity, technology used by the teacher, technology used by the students, and the technology standards that were addressed in the lesson. I was then able to review my set of created codes and identify existing patterns between the information. I noticed the main concepts and uses of technology that were able to be added to the existing codes. A final review of the information from the observations was conducted and data was both added to existing codes, and new codes were created if needed.

Professional Development Artifacts

After reaching out to six different schools within the charter school company network through email, I was able to get professional development plans from all six of the schools (including the school where the teachers worked). I was able to get the current school year's professional development plans for all six schools as well as NTI documents from the current school year as well as the previous three years. This included the NTI professional development plans for new schools and existing schools. There was a difference in the professional development plans made between the new and existing schools because existing schools only were required to do a five-day professional development plan, while new schools were required to do a 10-day professional development plan. In total, 11 professional development documents were collected and analyzed with the research questions and existing codes in mind.

The professional development documents were analyzed to understand how teachers at the current school and across the charter school company network were being trained in the areas of technology, computer science, and digital game-based learning. Hatch's (2002) typological analysis model was used to understand the topics that teachers were being trained in. A first reading of the documents created codes based on the specific technology program or software that the teachers were being trained on. The second round of analyzing the data collapsed the information into more general concepts of technology that either fit into existing codes or created new codes as needed. The final set of typologies were as follows: admin/operational software training, Apple software training, computer science software training, instructional software training, SMART software training, and Tech 101 training. This information was coded under the “Technology Professional Development Experience” code that already existed from the interviews and observational data.

Summary of the Findings

The findings of the study revealed that although the participating teachers understood the importance of technology, computer science, and digital game-based learning, they have not been properly trained through professional development to implement the concepts and strategies in the Computer Science for All Initiative. Despite many participants not being able to accurately describe and define computer science and digital game-based learning, they still believed that it was important enough to be included in many different standard strands such as English language arts, mathematics, and science. Teachers would like to have more professional development in these specific areas to help them implement strategies in their classrooms throughout the grade levels; however, the training and development that they have received in their academic and professional careers have not effectively prepared them to do so. Teachers understood that the future is in technology and the implementation of computer science, however they felt that many barriers and challenges discourage them from doing so.

Participants detailed several challenges that prevent them from implementing computer science into their instructional practice. A common challenge described by many of the teachers was the lack of time in professional development opportunities, as well as the restricted time to implement the common core state standards. As the standards take priority and are the focus of instruction, they must be taught with high priority. Because computer science is not specifically listed as an indicator in the state standards, they do not have the time to teach it. Additionally, the lack of knowledge in computer science as well as the lack of resources in computer science was described as a common barrier. Similarly, the implementation of digital game-based learning was challenging because of the lack of resources, time, and professional development on how to teach using this tool.

Teachers lacked effective and efficient training and development experience in both their academic and professional careers. Many teachers reported that they had little or no training in technology, computer science, or digital game-based learning through their college and professional careers. Despite that many teachers would welcome the opportunity to learn and implement these tools as part of the Computer Science for All Initiative, they were not trained in these areas. Examining the professional development plans at the current school and at other schools in the charter school company network also revealed a lack of training in these areas. Many technology trainings focused on the operational and administrative aspects of teaching including gradebooks, communication tools, SMARTboard usage, and taking attendance. The majority of the technology trainings for classroom usage focused on instructional software in mathematics, English language arts, and assessment and diagnostic testing software.

In examining the research questions and the professional development that would be needed to effectively teach the topics from the Computer Science for All Initiative, teachers requested different areas to be improved or implemented into their trainings. To be trained effectively in computer science instruction, teachers wanted to first understand the background and foundational understanding of computer science and why it is important for it to be taught to elementary school students. Additionally, the most common form of professional development that the teachers requested was a hands-on training with instructional modeling in a group setting. In countering one of the common challenges, the teachers requested the time to create lessons and try them out in a classroom setting to increase their level of comfortability. The professional development requested for digital game-based learning followed the same model as the professional development training that was requested for computer science. Some teachers also felt that supplemental training online in a webinar-type format would also be useful. As a follow up to the hands-on modeling, teachers believed that having an online video to reference afterwards would be beneficial to their learning.

Overall, the data revealed five themes that support the research question of the professional development necessary for elementary school teachers to teach the concepts of the Computer Science for All Initiative using digital game-based learning. The following themes were created from the initial codes and the 22 collapsed codes as detailed in Appendix C.

1. Teachers have not been properly trained to implement computer science into their instructional practice.
2. Teachers need effective professional development training in-order to implement computer science into their instructional practice.
3. Teachers have not been properly trained to implement digital-game based learning into their instructional practice.
4. Teachers need effective professional Development training in-order to implement digital game-based learning into their instructional practice.
5. Teachers have not been properly trained in basic instructional technology skills in their academic or professional careers.

Presentation of the Data and Results

I analyzed the interviews using the inductive analysis model. I analyzed the observations and professional development artifacts using typological analysis (Hatch, 2002). Throughout the process of analyzing the data from these sources, patterns began to emerge and were sectioned into codes. I was able to reference Saldaña’s (2016) initial and pattern coding models to better understand the data. As a result, 22 codes emerged resulting in five themes, which are presented in this section.

Code: Computer Science Challenges

When asked about the challenges that teachers face in implementing computer science into their instructional practice. Many teachers pointed to a lack of knowledge on what computer science is. Felicia stated that her biggest challenge is, "how comfortable I am with it, because if I'm not comfortable with it I tend to not bring it out in front of the kids, because then I feel if I don't know the answers." This was similar to other teacher responses on their lack of knowledge. Rachelle also agreed that one of her barriers is her knowledge of the subject area, stating that "It would be the confidence level that, yeah, that I can teach this or this will work." Teachers felt that if they are unable to understand the concepts and ideas around computer science, it will deter them from attempting to teach it.

Another common challenge that teachers described was the lack of time. This was caused by the lessons that they had to implement in the core subjects of math, English language arts, social studies, and science. Briana stated,

> The only barrier I would say is how do you implement it when you're also trying to teach ELA and math. What time of the school day are you going to be using that, solely for that? Right now, it's usually if we have any free time, or recess-type things, if they have extra time then they can do that. We don't have a set time where they can do this computer science type thing.

Since the standards essentially dictate what teachers are doing on a day-to-day basis, they are limited in how much time they could spend on computer science. Similarly, Faith stated that the lack of time was a significant barrier. She stated, "We have 50 minutes in class to get those standard taught. In addition, at this school they want you doing small groups, and this group, and that group, and all kinds of extra help here and there. Data this, and data that, and so time." The lack of appropriate time to instruct was a common theme throughout teachers responses.

While these were the two most common challenges, there were other challenges that were discussed by the teachers. Melissa stated that, "We have the state test and computer science isn't on it. So we're pretty restricted to the standards. As unfortunate as that is, it's the reality." Other areas of challenges in implementing computer science in their practice was the lack of resources, the fact that computer science is not directly listed in a standard that they are required to teach, and student behavior and engagement.

Code: Computer Science Comprehension

Teachers were asked to describe their understanding of computer science and what they believe the subject is. Despite understanding and explaining the importance of it, many could not describe what computer science actual was. Based on their answers, many of the teachers had no understanding or only a partial understanding of what computer science actual entailed. Many teachers, such as Christine, stated that they just did not know what computer science was. She said that, "I am not familiar at all with computer science. I know that I hear the word STEM thrown around a lot and having the students incorporate real worlds. I don't know much, no." Similarly Gwen stated that "I don't know what falls under the term computer science." Some teachers did have a partial understanding of computer science by aligning the topic with computers and technology in general. Cathy stated,

> For myself, the understanding of computers and how they work, but also for my students because that's gonna be so crucial for them, so getting that knowledge to them at the

same time. Applying their standards, but through that technology so they're learning the same thing.

Only four of the participants could accurately and confidently describe what computer science was and how it can be used in the classroom. For example, Melissa stated that "So when I think of computer science, I think of designing apps. I think of coding." Melissa's statement was an effective description of computer science, however other teachers correlated computer science to technology in general, or any type of instructional technology.

Code: Computer Science Instruction

Participants were asked to describe their use of computer science in their daily instruction. Ten of the participants stated that they have never used computer science in instruction, as was the case with Christine, who was asked if she had used computer science in instruction at the current school or previous schools. She responded, "None, not at all. Ever." Lisa, Janet, Hazel, and Gabby also similarly stated that they had not used computer science in instruction at their current school or previous schools.

Four teachers did state that they used computer science with the Code.org platform in their classroom. Because each student has access to a Code.Org account through their Clever software accounts, Briana, Faith, Lisa, and Melissa stated that they will use Code.Org in their practice to allow students the opportunity to learn computer science. Melissa stated that "So right now for the kids, it's the Code.org." The Code.org platform was the most commonly used computer science program at the school.

Another common code that came up when asking teachers about whether they used computer science in their instructional practice was that many teachers began to describe their instructional mathematics and English language arts software that the students use as a form of computer science. Gina stated, “Okay, so I use the computer or internet or instructional software, I guess, to create my lessons, to make it easier, to make the lessons more student centered.” Similarly, Jessica stated that “At previous schools, it was just instructional software honestly.” They mentioned this in the same area of computer science because the students used the software on their iPads, making it more technology and computer science based.

Code: Computer Science Professional Development Experience

Many of the teachers noted that they have not had any professional development in computer science in their careers. Nine of the participants said that they have never had a computer science professional development training, including Gina, who stated, “No, not for technology or computer science.” Similarly, Felicia stated, “At this school? None. Or in previous schools, none.” For the teachers who stated that they did have computer science professional development training in their careers, the only response was a training on the Code.Org platform. It is worth noting that a Code.Org professional development training was offered at this school during the beginning of the school year. In describing her professional development experience with the Code.Org training, Gwen explained,

> That was just showing us was coding was, how their program works, and how coding really connected to that problem solving aspect of life, and how it doesn’t have to just be a student who’s interested in creating software programs, but that technology and coding translates to other aspects of life.

Hazel also attended the training, but stated “I mean, I know we did have a professional development on coding, but I think that we could go more in depth with that.” The Code.org training was an optional professional development choice, and teachers were not required to attend or train the rest of their teammates.

Code: Computer Science Professional Development Wanted

Teachers were asked to describe the professional development that they would ideally want in a computer science training for them to effectively teach the subject to their students. This code was particularly important as it has a direct impact on the first research question which asks what professional development is needed for teachers to effectively implement the concepts of the Computer Science for All Initiative. Two of the common characteristics that teachers wanted in a computer science training were hands-on training and modeling of a lesson that teachers could use in their classroom with their students. Carol detailed the need for a hands-on training experience that would be ideal for her:

> So, I think that professional development that, one, teaches the advancements in computer science, right? We've moved beyond just being able to get on the internet, right? I think that would be really helpful. I think hands-on training is really important… adults and teachers, they need to be able to manipulate it and use it in order to effectively be able to teach it.

This was also confirmed in statements made by Gabby. She stated,

> But, if I had my option I would like more hands-on. Give us a chance to ... Instead of saying, again, "Oh, here it is," or watching over your kids' shoulders on, oh, well, what happens next? Having that full capacity of knowing, okay, there's, I don't know, 12 stages. Once you get to the fifth stage then it bounces you up or ... Really know what to expect of the game and what to expect for the kids and their progress. I would say a lot of hands-on.

A hands-on approach to computer science professional development was described as necessary by eight of the participants.

Modeling of a lesson was also a common factor in the professional development experience that was wanted by the participants. Seven participants discussed modeling as an important area of training that they would like to have. Lisa stated,

> I want someone else to do it, and then teach me how to teach them, not teach me what it is and then me have to go reinvent the wheel. If there's good programs and there's a good way to do this, teach me how to teach them, and I will teach them.

Rachelle also confirmed the need for instructor and participant modeling when she stated that "with the instructor and activities that I can do and show the instructor how to accomplish this so that more in a classroom environment where I'm doing and creating it and yeah, presenting it." Rachelle felt this would add a visual element to the training that would allow the participants to copy what they see into their own practice.

Teachers described other aspects of effective professional development training that they would find effective in learning computer science. These include having the background and foundational knowledge of computer science, creating lessons to use in the classroom, conducting the training in a group setting, adding webinars and online tools as a supplemental training resource, and being given access to computer science resources that they could use in their classroom. All of this information is critical to understanding the professional development experience that is needed for elementary school educators to effectively teach computer science as part of the Computer Science for All Initiative.

Code: Computer Science Resources

Teachers were asked to describe and name any computer science resources they were aware of. The majority of the participants said that they were unaware of any computer science resources to use for instruction at the time of the interview. Christine, Faith, Felicia, Gabby, Hazel, Jessica, Lisa, and Rachelle all stated that they did not know of any computer science resources to use for instruction. Carol stated "Kahoot" and "Quizlet" as computer science resources; however, they would both best be described as online assessment tools. Similarly, Gina stated, "Our textbooks are online . . . we have the Reading Plus and Imagine Math of course." These would not be considered computer science instructional resources. The only computer science resource that participants were able to name was Code.Org, which was mentioned by Briana, Janet, and Melissa, who also mentioned Google's coding tool:

> Honestly, Code.org. I also know, only because at my previous school, it was a private school, but at my prior school we had a coding club after school and Google has a coding program as well. So I had some exposure. That's what I'm aware of, Google's computer programming, material that they have for teachers to teach coding and then what Code.org provides.

Additionally, when asked specifically about computer science resources, some of the participants named resources that they believed were computer science related, but in fact were not.

Code: Computer Science Standard Implementation

Despite many of the teachers not having a foundational understanding of computer science or having used it in their instruction, many teachers felt that computer science could fit into many different strands if listed on a state standard. Every teacher felt that computer science could be incorporated into one of the four major strands including mathematics, English language arts, social studies, and science. Carol believed it should be in all standards: "I think it really should be in all subjects, personally. Because then, if you limit what standards the technology is introduced to, then you limit the understanding that kids are gonna get of other ways to use it." Hazel believed it should be in all subjects as well when she stated that "I think it would be embedded throughout all, because we teach everything, and we pretty much embed the science, social studies across the curriculum. So, I feel like it would be embedded throughout everything." Other participants believed it should be in one or multiple standards. None of the participants believed that it should not be included in any of the state standards.

Code: Digital Game-Based Learning Challenges

Similar to implementing computer science, teachers described many of the same challenges when discussing the use of digital game-based learning in their instructional practice. Two common issues in implementing digital game-based learning are the lack of time and the lack of resources that are available to them. When describing the lack of time, Melissa stated that "it's that planning piece of finding the time for when they can play the game." Similarly, in discussing the work-life balance that teachers often find challenging, Faith stated,

> I don't have the time, I've got six kids, I have five at home. I don't have the time, I'm mom when I get home, and I'm wife when I get home. School comes much later in the evening and that's that.

Even with time available, many of the teachers who were interviewed did not know what resources were out there for them to use. Janet echoed this feeling of the teachers when she stated,

> I would say continually expanding the toolbox of what digital game-based you use, like what else can I use besides PBS Kids? I use those two a lot, but there's other things out there, but then, what are they?

Other challenges included student issues such as behavior while playing games, lack of digital game-based learning on the state standards, the lack of knowledge of how to use games in their instruction.

Code: Digital Game-Based Learning Comprehension

Teachers understood what digital game-based learning was in an instructional sense and how it should be used in the classroom. Christine described digital game-based learning as "when the students are playing a game but the purpose of it is educational. It's the outcome where they're learning something while having fun." Jessica built on this concept of learning in an entertaining way:

> I believe, as far as my experience, that digital game-based learning is learning skills while not realizing that you're learning skills or having a different kind of gratification for those learned skills. So if it's on the screen, and they're playing a game, they know that they have to learn these things in order to finish the game, so it's incentivized in a different way."

Additionally, Gwen described her understanding of digital game-based learning:

> Game-based learning for me is that they're learning in a way that's a game, that there's an objective, and they have to answer these questions, and they win, they lose. Or if they're competing with people, that's what I see it as.

The comprehension level of digital game-based learning seemed to be higher than that of computer science and how both are used in instruction.

Code: Digital Game-Based Learning Frequency

Teachers described their frequency in using digital games in their personal and professional lives. In their personal lives, some teachers described that they do not play video games. Briana, Christine, Jessica, Melissa, and Rachelle claimed that video games were not something that they do frequently. Jessica stated, "Personal, it is pretty null, almost none. I do a lot of reading." This was split almost evenly, as some of the teachers such as Cathy and Carol stated that they do play video games in their personal time. Gina stated,

> Yeah, I play a lot of . . . Not a lot, but I play frequently games on my phone. I have like word games and just like . . . I don't know how to describe it, like those . . . You know, like the Candy Crush type of game.

The divide was roughly half and half on teachers who play video games and those who do not.

In their professional lives, the frequency of using digital game-based learning in the classroom was ranging from no use at this or previous schools to almost an everyday occurrence in their current school. Cathy stated, "Very rarely would we do one where it's graded as a game, so that's more for them to practice or it can be a center or a station that they do on their own." Similarly, Melissa stated,

> So at previous schools, we were not one to one. We only have one iPad cart per floor. So typically the floor I was on, the iPads were being used by the older grades, fourth and fifth grade. So my students didn't have access to it as much.

Some teachers responded that they do use digital games more frequently in their instructional practice with mathematics and English language arts software. Jessica described her frequency in using games with her students:

> I use them a lot with the kids. I do a lot aside from the instructional software that they are already assigned. I always use it to kind of further their learning. So after the lesson, after their independent work, it just embeds it more because they see it on a different platform. I would say at least once or twice a day.

Hazel also explained that playing digital games is a frequent occurrence in her class: "Digital games for the students is pretty much every day." This was noted through classroom observations as well as examining the instructional software applications that the students were using on daily basis.

Code: Digital Game-Based Learning Instruction

Teachers explained that most of the time when they are using digital game-based learning during instruction, it is with the mathematics and English language arts software that the students have on the iPads. This includes programs such as Imagine Math, Math Seeds, Lexia, and Reading Plus. In explaining her usage of Imagine Math, Gina stated,

> We let them do Imagine Math. There's a game that they can play and they're learning something through it. It might not be specifically what we're working on at that time, but we know that it's not a waste of their time, like if they were sitting at home on, I don't know, Fortnite.

Melissa also stated, "we do use games and digital games in ELA and in math for student engagement." Seven of the participants claimed that this was the main usage of digital game-based learning.

Another common response of participants was the use of digital assessment games in their instruction. This included Hello SMART, Quizzizz, Jeopardy, and Kahoot. Rachelle explained her use of assessment games in her class: "In this school we use digital games on the SMART Exchange. We've used that one. I use jeopardy. Game base was also Quizzizz and Kahoot!, those. Previous school was Kahoot! and Jeopardy, that's the only two we used." Similar to using digital games as assessments, Melissa stated that games were also used as a review tool: "But typically when it's used, it's more for review purposes. That's what we in 3rd grade do, the gaming component, when they're reviewing material."

Only two of the participants described using a computer science program as part of their digital game-based learning practice. Felicia stated, “At other schools, not really, because I never really had technology at my previous schools.” Ten of the participants described not using digital game-based learning tools at all in their previous schools.

Code: Digital Game-Based Learning Professional Development Experience

Many of the participants stated that they had not have any professional development training in the area of digital game-based learning. Only three of the teachers stated that they had a training in this area. Melissa said, “no research based understanding of game based application in the classroom.” Many of the teachers said “none” or “not at either school” when discussing any trainings that they had at previous schools or their current school. Carol stated, “Zero at both. Never received training on how to use a game. It sounds cool.” Professional development artifacts confirmed that there was no specific training on digital game-based learning and its components throughout the school and other schools in the network.

Code: Digital Game-Based Learning Professional Development Wanted

Similar to the trainings that they would want in computer science, participants stated that they would like professional development in digital game-based learning to be hands-on, incorporate modeling of instruction, as well as the opportunity to learn about resources that are available for them. When discussing the need for hands-on training, Cathy stated,

> But yeah, where it’s hands on, where it’s gonna show you how to create things and you can actually try it and then if you have a question, you can pop that in there. But maybe everyone’s working at their own pace, ‘cause everyone’s gonna be at a totally different point in technology.

Similarly, Christine said,

> I would prefer if it was more hands on. You guys showed us how to do it now you guys check out this website. What do you think? You know, what sort of students maybe make a list of students who'd benefit from certain websites and just leave there with a plan instead of leaving there with a bunch of papers. Okay, now I'm going to use this. At least try one thing, when you leave you're going to try. When you get to see your kids again, what are you going to use again, and that would be helpful.

Teachers also discussed the need for modeling of instruction in an effective professional development experience. Faith stated, "That modeling and follow up is really important. You can sit in a workshop and we've had a bunch of those this year, especially in NTI. That doesn't mean you're equipped to carry it out in the classroom." Gina echoed this statement as she said,

> Showing me ways that I can use it as a resource in the classroom. Maybe I can have it replace something that I'm already doing as far as a time slot, helping me figure out a way to use it as a resource during one of the time slots that I'm using something else.

Other areas of professional development training that the participants said would help them effectively use digital game-based learning in their instruction are understanding the background and foundational reasoning behind digital game-based learning, creating lessons, participating in a group setting, and having online webinar follow-up trainings. Janet said,

> I think just for me a lot of it is, something quick, like, hey, here's this cool digital gaming. Here's how you do it. If it's something we create, okay, cool. Give me some time to create, or if it's something where everything is just pre-made, give us a little bit to go click around, like actually play the games, but it's more of just I feel like for me just more of the resources.

Participants such as Janet had similar concerns about the lack of time and the need to create lesson plans for them to effectively teach their students.

Code: Digital Game-Based Learning Resources

Teachers were asked what, if any, digital game-based learning resources they were aware of. Teachers described assessment and review games, mathematics and English language arts instructional software games, and other internet platform games such as ABCYa. Six of the participants stated that they either did not have any knowledge of any instructional resources in digital game-based learning or that it was a superficial understanding. Briana stated, “The ones that we use now I’m very familiar with. I know that there are probably some out there in addition to that, but I’m not sure. Again, Reading Plus, Imagine Math, code.org, iReady, Nearpod, Kahoot, just tons.” Melissa said, “Well, all of our instructional resources in our community have gaming built into them. So even Wonders, Envision, they all have games in them.” None of the teachers responded that they use computer science software such as Code.Org as a digital game-based learning resource in their instruction.

Code: Grade Levels Taught

Teachers were asked what grade levels they are currently teaching, and what grade levels they have taught in the past. This helped determine if all elementary grades are being represented in this study. Based on teacher responses, it was determined that all grade levels are represented. The breakdown of each teacher grade-level experience was detailed previously in this chapter in Table 1.

Code: Teaching Experience

Teachers were asked how many years of teaching experience they had. This helped if there is a wide range of experiences are being represented in this study. Based on teacher responses, there was a range from one year of experience to 13 years of experience. The breakdown of experience was detailed previously in this chapter in Table 2.

Code: Technology Comfortability

Twelve out of 15 of the participants stated that they were comfortable using technology in their personal and professional lives. The comfortability of each participant with respect to technology usage was detailed previously in this chapter in the description of each of the participants.

Code: Technology Education Academic Experience

When discussing their academic experience in technology education courses, nine of the participants stated that they had not taken courses in technology during their undergraduate or graduate academic programs. The academic experience of each participant with respect to technology courses was detailed previously in this chapter in the description of each of the participants.

Code: Technology Instructional Frequency

Participants stated that they frequently use technology in their instructional practice. Each of the 15 participants stated that they use technology each week, and none of the participants stated that they do not use technology in their instructional practice at their current school. Briana stated,

> I would definitely say every day, multiple times a day. We use Nearpod a lot for instruction. They have Paper-Lite. They have it on their iPads. I have it on my screen so they can see it here and there. That's how we do a lot of our instruction and a lot of their independent work as well. They're doing it on the iPads, whether it's Nearpod or through another app, they use it almost constantly.

Similarly, Cathy said,

> All the time. Most of my lessons are gonna be using the iPad, pretty much the whole time. Unless we're doing a comprehension check or something that I need them to mark the text on paper, but otherwise, even if they're working on the table, they're gonna be submitting it somehow with their iPad.

This school had one to one access for iPads at the third, fourth, fifth, and sixth grade levels. Kindergarten, first grade, and second grade had a ratio at roughly two students per one device.

Code: Technology Professional Development Experience

I analyzed the data from the professional development artifacts that I received from the participating school as well as other schools in the charter school company network using typological analysis model by Hatch (2002). Table 3 illustrates an overview of the typologies, the themes that emerged through the typologies, and supporting data from the professional development artifacts.

Table 3.

A Typology of Professional Development Artifacts in Elementary Schools.

Codes	Professional Development Trainings Offered	Emergent Theme from Professional Development Artifacts
Administrative / Operational Usage Training	[19 references] Powerschool, Chalk, TapApp, Edmodo	Teachers have not been properly trained in basic instructional technology skills, computer science, and digital game-based learning in their professional careers.
Apple Education Training	[6 references] Apple Classroom, Pages, Keynote,	

Table 4 (continued)

Codes	Professional Development Trainings Offered	Emergent Theme from Professional Development Artifacts
	Garage Band, Numbers, Clips, Camera, Vanguard	
Computer Science Instructional Training	[2 references] Makerspace/STEAM, Code.Org	
Instructional Software Training	[26 references] Lexia, Reading Plus, Imagine Math, Mathseeds, Math Facts, I-Ready, Nearpod, Classlab, Padlet, Flip Grid	
SMART Training	[10 references] SMARTboard, SMART software, SMART Exchange.	
"Technology 101" Training	[7 references] IT Training, iPad usage, IBM Watson, troubleshooting, safe usage, email, basic computer skills and applications.	

Code: Technology Professional Development Wanted

Teachers stated that they would like more hands-on trainings for technology instruction professional developments. Briana stated,

> It would definitely have to be more hands on, because again, I feel like I need that in order to understand something new. It took me a very long time to understand Nearpod. Even Imagine Math or Reading Plus, I had to sit down with it and have someone show me even just to figure it out. I feel it needs to be hands on with some kind of instructor there to guide me.

Christine similarly said, “Anyone learns best by doing so I guess in the future it would be easier if they taught us something like, ‘Alright, now you guys try it. Get into this.’ That would be more helpful in my opinion.” This technology professional development was referring to basic technology skills such as word processing, emails, troubleshooting, or other basic Tech 101 skills.

Code: Classroom Technology Usage

I analyzed the data from the teacher observations that I conducted using the Technology Observation Checklist in Appendix B using typological analysis model by Hatch (2002). Table 4 illustrates an overview of the typologies, the amount of references of each code seen in the observations, the themes that emerged through the typologies, and supporting data from the teacher observations.

Table 5

A Typology of Technology Observations in Elementary Schools.

Teacher Observation Category	Observation Evidence	Number of References
Learning Activities	Creating Presentations	2
	Digital Games	3
	Drill and Practice	2
	Information Analysis	4
	Research	5
	Skill Training	3
	Test Taking	5
	Writing	6
Standards Implemented	Communication and Collaboration	7
	Creativity and Innovation	2
	Critical Thinking	9
	Digital Citizenship	0
	Research and Informational Fluency	5
	Technology Operations and Concepts	2
Student Grouping	Individual	14
	Small Group	6
	Student Pairs	6
	Whole Class	2

Table 4 (continued)

Teacher Observation Category	Observation Evidence	Number of References
Teacher Role	Discussion	3
	Facilitating	15
	Interactive Direction	10
Technologies Used	Assessment/Review Software	3
	Code.Org	1
	iPad	12
	Math/ELA Instr. Software	3
	Nearpod	3
	SMARTboard	15
	Video Software	2

Note. Emergent theme—Teachers have not been properly trained in instructional technology skills, computer science, and digital game-based learning in their professional careers.

Themes from Across the Data

Several overarching patterns emerged from the data. The main theme was the lack of professional development in the areas of computer science, digital game-based learning, and instructional technology. During the interviews, many of the participants noted that they did not feel they had effective professional development training in these areas and, as a result, were not using them consistently in their instructional practice. The observation data displayed that teachers were using technology in their instructional practice; however, they were not using computer science or digital game-based learning effectively and consistently. The professional development artifacts showed that teachers had not been trained properly in computer science, digital game-based learning, or instructional technology. As a result, the following themes emerged from the data:

1. Teachers have not been properly trained to implement computer science into their instructional practice.
2. Teachers need effective professional development training in order to implement computer science into their instructional practice.
3. Teachers have not been properly trained to implement digital-game based learning into their instructional practice.
4. Teachers need effective professional Development training in order to implement digital game-based learning into their instructional practice.
5. Teachers have not been properly trained in basic instructional technology skills in their academic or professional careers.

Summary

In this chapter, I revisited the purpose of the study and the research question behind this qualitative case study, and I included a detailed description of each participants current grade level, teaching experience, academic background, and comfortability with respect to instructional technology. The methodology was presented in a step-by-step account of how the data were collected and analyzed. The data and results were organized by the initial codes, collapsed codes, and the resulting emergent themes. The collapsed codes were described in detail using evidence from the participants, observation checklist data, and professional development artifacts that supported each code. The results of the study revealed that teachers have not been properly trained to implement computer science and digital game-based learning into their instructional practice. In addition, the results showed that teachers need effective professional development training in computer science, digital game-based learning, and instructional technology.

Chapter 5: Discussion and Conclusion

The purpose of this chapter is to present an overall discussion of the of the study, the conclusions, and future implications of the study. I present the key findings in relation to the literature discussed in Chapter 2 and additional supporting literature through the lens of constructivism, the conceptual framework that guided this study. I conclude Chapter 5 with recommendations for future research, practice, and policy.

Summary of the Results

This study was guided by two central research questions:

1. What professional development training is needed for Florida elementary school educators to effectively teach the topics in the Computer Science for All initiative?
2. How do Florida elementary school educators use digital game-based learning to effectively teach the topics in the Computer Science for All initiative?

These questions were created to address the topic of professional development for elementary school educators in the areas of computer science and digital game-based learning. The interviews provided rich and descriptive information about the experiences, perceptions, and recommendations of the participants. The observations that were conducted on the participants provided data on how teachers currently use technology within their classrooms. The professional development documents from the participating school and other schools in the network gave more information on how teachers are trained in computer science, digital game-based learning, and instructional technology.

The results indicated that the teachers who participated in the study have not been trained properly in computer science, digital game-based learning, and instructional technology. The participating teachers felt that they were not equipped with the proper training to implement these skills in their daily instructional practice. This is due to various reasons including a lack of professional development, limited knowledge of the resources that are available within each field, and the planning time required to efficiently learn and implement these skills in their practice. The participants also discussed the aspects of effective professional development that they would need to implement computer science and digital game-based learning. The teachers discussed the need for hands-on training that would allow them to work the software and tools that they would be teaching. Additionally, the teachers suggested the need for modeling of instruction in both areas to allow them to see how it should look in a classroom. The results also suggested that the teachers would need to be made aware of the resources that exist in computer science and digital game-based learning.

Discussion of the Results

Results: Research Question 1

The first research question was: What professional development training is needed for Florida elementary school educators to effectively teach the topics in the Computer Science for All initiative? The participants in the study believed that to effectively teach computer science at the elementary school level, there must be effective professional development training. Because most of the participants stated that they had not had computer science professional development training in the past and limited training in the collegiate careers, it was important to have this effective training. Each of the participants described what the ideal professional development training should entail to prepare them to teach the content to their students. The most common answer from the participants was that they would need a training that used a hands-on learning style. They explained that they would like to take part in the learning and use the software that they would be using in the classroom. Seven of the participants also stated that they would like modeling within their professional development training. Participants stated that this should come from the instructor of the training, as well as from their peers. Modeling of the computer science content would allow them to see the lesson in real time, and the participants felt that this would prepare them adequately.

Common responses from the participants also revealed that they would want to be told of the resources that are available to use in the classroom and understand the pedagogy and background information of why computer science education is important. Participants also stated that they would like online training material as a supplemental resource, as well as conducting the professional development trainings in a group setting so that they can interact and learn with their peers. Due to the lack of previous computer science professional development training, lack of academic instruction in past undergraduate and graduate courses, as well as the current low usage of computer science instruction in their current classrooms, most participants believed that these characteristics of professional development trainings were essential in order for them to teach the topics in the Computer Science for All Initiative.

Results: Research Question 2

The second research question was: How do Florida elementary school educators use digital game-based learning to effectively teach the topics in the Computer Science for All initiative? Five of the participants stated that they use some digital game-based learning in the classroom, but not for computer science content. Seven of the participants stated that their use of digital game-based learning in the classroom centered around students using instructional software in the areas of mathematics and English language arts. Five participants stated that they also were able to use digital game-based learning in the form of assessment or review. However, results showed that most of the participants had not received professional development training in the area of digital game-based learning and used the content that was built into the instructional software. Results from the classroom observations showed this to be true. All of the 15 participants stated that they had not had undergraduate or graduate academic courses on digital game-based learning. Results from the classroom observations showed that, while most participants stated that they would like to use digital game-based learning in their classroom, they were unsure of the resources that were available to them.

All of the 15 participating teachers stated that they would like professional development training on digital game-based learning to use in the classroom. Similar to the professional development on computer science instruction, participants described the components of an effective training in digital game-based learning that they would like. Twelve of the participants stated that they would like a hands-on training where they are able to play the digital games they would use in their instruction. Similarly, seven of the participants stated that they would like to see the instructional use of digital games modeled for them by the instructor or their peers. Four of the participants also stated that they would want to learn about the pedagogical background of digital game-based learning, the resources that are available to them, the time needed to create lessons to use in the classroom, and a group setting that would allow them to collaborate with their peers. Participants also described the need for an online supplemental webinar that would allow them to continue their professional development.

It is interesting to note that, despite 11 of the participants' stating that they were not trained in digital game-based learning, were unaware of what digital game-based learning is, or did not use it in their instructional practice, many of the observations did have elements of digital game-based learning. Despite many of the teachers stating that they did use digital game-based learning, introductory and surface level implementation of the strategy was evident in the observations. Teachers used elements of digital game-based learning with their assessment reviews, instructional software, as well as some other content area instruction. However, many did not believe they were using this instructional strategy. This shows that teachers are unaware of the background instructional pedagogies of digital game-based learning, and when they use some elements of it, they are unable to recognize it in their instructional practice. This may have been caused by the lack of training to recognize digital game-based learning as well as the lack of understanding of the teacher's role when students participate in digital game-based learning.

Overall, the participants understood the need for computer science and digital game-based learning within the classroom but felt unprepared to teach it. Their lack of training at the academic or professional level left them unready to use either content in an effective manner. The teachers explained the desire to take part in computer science and digital game-based learning professional development. The teachers also explained that they would like both trainings to contain a hands-on component, modeling of the instruction, as well as the understanding of the resources and background pedagogical knowledge that go into both computer science and digital game-based learning. Despite teachers not using computer science or digital game-based learning in their classroom consistently or effectively, most learn more about it and implement it in their instructional practice if given the proper professional development training.

Discussion of the Results in Relation to the Literature

For teachers to be effective, they must be trained properly by means of professional development. Professional development refers to skills and information attained for both personal and job development. This is an in-service instruction to upgrade the content knowledge and educational skills of teachers (Malik, 2015, p. 169). National studies have identified effective professional learning as a critical component of school success (Darling-Hammond., 2009). Research conducted by Shakman (2016) and Green (2015) further emphasized that professional development improved teacher quality and effectiveness. The participants of the study explained that they would feel more comfortable teaching computer science and using digital game-based learning as a tool if more professional development training opportunities were available to them in these areas. Many of the participants also stated that they have not had professional development in these areas or the proper coursework in their academic experiences to effectively teach computer science and use digital game-based learning on a consistent basis. The participants also described their ideal learning environment and training characteristics that would help them use both components in their instructional practice. When examining the professional development plans of the participating school as well as the professional development plans from other schools in the charter school company network, it was evident that there was a lack of training in both computer science and professional development.

Teachers in other studies such as Pittman & Gaines (2015) have showed a low percentage of teachers who met the requirements of high0level technology integrators. The strongest barrier to technology integration was a lack of available computers/hardware, followed by factors relating to the time required to develop and implement lesson plans that incorporate technology (Pittman & Gaines, 2015). Data from the teacher interviews showed common barriers and challenges relating to lack of time, lack of effective professional development opportunities, implementation of computer science in the standards, as well as the lack of instructional resources. The lack of available computers and hardware were not found as a common barrier at the current school where the teachers worked, however it was mentioned that other schools where teachers had taught previously lacked the effective technology tools to implement computer science and digital game-based learning.

The ability to teach computational thinking skills in a fun, engaging learning environment has been the approach of many new software programs, including Code.org, Scratch MIT, and Code Monkey. This new learning environment challenges learners to engage in problem solving activities, enhance knowledge and skills acquisition, and provide users with a sense of achievement (Qian & Clarke, 2016). While many teachers did not fully understand what computer science was or how digital game-based learning is used, all 15 of the participants understood that it is important for students to learn. Participants described that computer science should be incorporated into many different standards such as English language arts, mathematics, and science. Research has identified computational thinking as an ability to think in an algorithmic and logical manner, while using and applying this applicative problem-solving process to a specific task (Denner, Wener, & Ortiz, 2011; Sanford, 2016). During interviews teachers discussed the need for implementation of computer science into English language arts, mathematics, and science standards because the skills that are required for computer science, such as computational and logarithmic thinking,

Participants understood the benefits of computer science and how the logarithmic and computational thinking can benefit students across all subjects. As discussed by Nelson-Walker and Doabler (2013), gaming technologies can provide a foundation to increased instructional intensity and serve as a motivational component for students who have had difficulties with the traditional means of learning. This was confirmed by Novak (2016), who agreed that research shows digital game-based learning can facilitate active learning by doing that not only affects learning outcomes but keeps the learner engaged and motivated (p. 2). Specifically for disinterested students, Stewart (2013), also discussed the use of games in a formal learning context leads to an increase in motivation and self-confidence (p. 58). Observational data showed that participants were engaged and motivated when the participants used technology in the classroom, and teachers described that this was a main factor in their choice to use technology in-general, and more specifically computer science and digital game-based learning.

Of all of the new fast-growing technologies, video games appear as one of the fast-growing and popular technologies among the classroom population across different educational levels (Martín-Párraga & Marín-Díaz, 2014). More educators are using games for teaching complex concepts in K–12 schools (Novak, 2016). Game-based learning is making the information and skills that students learn more engaging, appealing, and informative than traditional context. Interview and observational data showed that teachers are using digital game-based learning within their instructional practices. However, some teachers are unaware that they are using digital game-based learning. Teachers in observations also predominately used digital game-based learning as an assessment, diagnostic, or independent instructional tool. Teachers did believe that digital game-based learning is an effective instructional tool and would like to implement it more in their practice. They did believe however that they would need more effective professional development training to use digital game-based learning consistently. The popularity described in the research such as Martín-Párraga and Marín-Díaz (2014), was evident in both the interview and observational data. Teachers felt that the entertainment value of digital game-based learning for the students helped them understand the information and concepts that were being taught through that program. There is no specific curriculum provision regarding what 21st century learning should entail and how that should inform K–12 schooling (Jenson & Droumeva, 2016). However, it is accepted that digital games should be incorporated somewhere

(Gee 2005; Salen 2007; Squire 2011). Teachers did describe the need for combining the requirement for students to learn computational thinking skills and the motivation and engagement factor with digital games to teach computer science

Limitations

Limitations refer to conditions or events that may affect the study. They may be shortcomings, conditions, or influences that cannot be controlled by the researcher but place restrictions on the research and conclusions. Limitations and delimitations are aspects of a study that represent weaknesses in the research (Creswell, 2017). This could affect credibility and reliability for future researchers including sample size, recruitment, and settings as some examples. Limitations are matters that arise in a study but are out of the researcher's control (Simon, 2011). For this study, limitations included time, personal biases, sample size, and setting.

Time Constraints

Due to the nature of the workday schedule, time constraints were a limitation on both the teacher interviews and the observations. At this school, teachers were given a 45-minute prep period as well as a 45-minute lunch. My interviews took place out of these time periods as to not interrupt teacher planning or lunch. Observations of teachers took place during the school day, roughly 8:00 am to 4:00 pm. Each instructional period was roughly 30 minutes, which was the length of the observation period.

Personal Bias

Personal bias refers to preconceived notions and thoughts based on experiences of the researcher and how they may affect the interpretations and conclusions of the study (Kaptchuk, 2003). I did my best to ensure that any personal feelings were kept out of the research and ultimate conclusions by looking at the research through an objective, logical, and rational lens. To ensure credibility, I was careful not to allow my own ideas or biases to influence the study (Herr & Anderson, 2015; Stake, 2010; Stringer, 2014). Researcher reflections allowed me to analyze my own bias during the process to ensure that I did not influence the results.

Sample

Because I only had access to one school, the sample size of teachers that I could interview was restricted. The research site had approximately 50 teachers total, and with the time constraints, I was allowed to interview 15 teachers. For this reason, I was not be able to generalize to the larger population. The information gathered from the interviews and member checking reflect each participant's experiences, and not those of all elementary school teachers.

Setting

In this study, the setting was a limitation. This case study took place in an elementary charter school in Florida. I choose the site for both convenience and need. This limited the possibility of studying different demographic groups and schools comparatively.

Implications of the Results for Practice, Policy, and Theory

In this section, I discuss the implications of the results in context of practice, policy, and theory. I relate the results to constructivism, which is the conceptual framework of this study. I also explain and describe the implications of this study in relation to practice and policy with connections to the literature.

While research has shown that high quality professional development serves a key factor in improving teacher quality, the results of the study indicate that teachers in this Florida elementary charter school are not receiving effective professional development in these areas (Darling-Hammond, 2009; Green, 2015; Shakman 2016; Skourdoumbis, 2014). Teachers at the participating school as well as other schools in the charter school network have access to limited trainings on computer science that would allow them to effectively implement these subjects in their daily practice. Additionally, results also showed that many teachers had not been trained in these practices during their academic careers. Digital game-based learning has been shown to increase student engagement and motivation as well as increase student inclination and effort to comprehend and learn academic topics, self-regulate actions, and exhibit academic strategies. This type of learning also can provide a foundation to increase instructional intensity, especially for students who have had difficulties with traditional means (Freeman, 2014; Nelson-Walker & Doabler, 2013).

Practice

The gap in practice explored in this study is displayed in the lack of effective professional development trainings from the participants in both computer science and digital game-based learning. Educational leaders should consider making computer science a focus of instructional practice and create professional development opportunities for teachers. While teachers understood the importance of computer science, there were barriers in their own practice that would have to be removed, such as the lack of professional development, lack of time, and the fact that computer science is currently not implemented in many of the standards teachers are required to teach.

The lack of professional development can be remedied by a variety of professional development opportunities that teachers could choose from. This should include school building leaders creating opportunities during NTI at the beginning of the instructional school year. Follow up professional development trainings in computer science and digital game-based learning should continue during the school year on designated professional development days, as well off-site locations where these types of trainings are offered by other schools or outside companies. Furthermore, the professional development opportunities would need to be advertised by the school to inform teachers. This could include flyers for any trainings such as Code.org, which offers different professional development opportunities at colleges, local K–12 schools, and other off-campus locations. For teachers who are unable to attend face-to-face trainings, webinars for outside companies should also be advertised to give another platform for teachers to continue their professional growth.

Based on the recommendations from the teachers during the study, the practice within these professional development opportunities should also include a variety of instructional methods. This should include the modeling of instruction from both the trainers that are conducting the sessions, as well as the modeling of instruction from their peers. This will give them an opportunity to see the use of computer science and digital game-based learning in real-time. Additionally, the trainings should include a hands-on element where the teachers are able to use the computer science and digital game-based software and explore how the programs work. Other recommendations include adding in locations of resources in these areas, explaining the pedagogical benefit, as well as explaining the background knowledge on computer science and digital game-based learning. Based on the results from the study, educational leaders should consider making digital game-based learning a focus of instructional practice and provide the necessary effective professional development opportunities for elementary school teachers. This may assist teachers with using computer science and digital game-based learning as a tool to teach the concepts from the Computer Science for All Initiative.

Policy

To attempt to remedy this problem, educational leaders need to make a conscious effort to effectively train teachers in both computer science and digital game-based learning. Professional development programs in this charter school network, such as New Teacher Introduction for both new and existing schools, as well as year-long professional development trainings, need to have time set aside for teachers to be trained in technology education (where a gap was also noticed from the professional development artifacts from other schools in the network), computer science, and digital game-based learning. One of the goals of the New York City Computer Science for All Initiative is that, by 2025, all NYC public school students will receive meaningful, high-quality computer science education at each school level. For this to be possible at this specific Florida school, educational leaders must ensure that there are professional development training opportunities to help teachers understand the pedagogical framework behind computer science, have access to the resources needed for effective instruction, and see the instruction modeled in a hands-on training environment.

In addition to the educational leadership changes at the school-wide and network-wide levels, a change at the state level of education is needed as well. Results from the participants showed that one of the major factors contributing to the lack of professional development and instruction in computer science and digital game-based learning is the state standards of Florida not incorporating both. Teachers explained that their time in instructional concepts is guided, and sometimes restricted, by what they are supposed to teach according to the standards. However, many of the participants explained that they felt that computer science should be incorporated into one or more of the standards, including English language arts, mathematics, and science. Educational policymakers and lawmakers would need to ensure that computer science is incorporated into one of more of the standards at the elementary level specifically to ensure that administrators understand the importance, which would trickle down into the instructional practice of the teachers.

Certification of teachers in computer science is also a policy that would need to be adjusted. As it currently stands in Florida at the professional level, there are clear certification pathways for computer science teachers, as well as a dedicated computer science position in the state education agency (“Standards and Instructional Support,” 2018). However, this is applicable to certifications in Grades 6 through 12. At the elementary level, there is not a specific pathway for computer science certification. This limits the amount of trained computer science teachers who are available in the elementary grades, which is shown in the results of the study. Many teachers expressed that they have not taught computer science at all in their professional careers.

Constructivist Theory

The results of this study suggested that teachers build knowledge based on the learning and perceptions that they have acquired through their academic and professional careers. For this study, the teachers’ learning and perceptions of professional development trainings were the focus. In relation to the conceptual framework of the study, constructivist theory, teachers make meaning of the instructional practices regarding training and professional development based on their own experiences.

Constructivist theory emphasizes that individuals seek understanding where they live and work (Creswell, 1998). Students and adult learners learn information through the previous knowledge that they have obtained in life. This type of learning is an active, contextualized process of learning new information, rather than simply acquiring it through direction and instruction. Meaning is constructed by people they engage with in the world. Their cultural and social perspectives help shape their understanding (Crotty, 1998). In this study, teachers' experiences regarding the professional development in computer science and digital game-based learning contributes to a more in-depth and detailed understanding of this concept as they interact in their natural setting.

The role of the learner is also important to focus on when discussing constructivism, it is assumed that learnings construct their own knowledge both individually and collectively. Learners have specific sets of concepts and skills that they use to construct knowledge and solve problems in their world. (Davis, Maher, & Noddings, 1990). The experiences of the learner are the essential element in understand and comprehending information. Teachers possess key information and experiences regarding computer science, digital game-based learning, technology education, and professional development. They use this knowledge to implement instructional practices to carry out ongoing self-evaluation on their learning in the context of their classrooms. The constructivist theory centers around the concepts that learners build knowledge from within their own perspective. This includes developing new outlooks, viewpoints, and opinions about their surroundings. As the results from this case study indicated, teachers continue to make meaning of their own experiences regarding computer science, digital game-based learning, technology education, and professional development. The results of this case study support the constructivism concept.

The findings of this study suggested that participating teachers were not effectively professionally developed in computer science and digital game-based learning due to such factors as the lack of training opportunities, resources, and school-wide focus on such concepts. Creating effective professional development training opportunities for teachers requires evaluating existing professional development focuses and plans and taking effective steps to address the gaps and challenges that exist to ensure that teachers are properly trained in computer science and digital game-based learning. The participating teachers expressed a desire to have effective professional development in these areas and incorporate these strategies into their instructional practice to teach concepts that are described in the Computer Science for All Initiative.

Recommendations for Further Research

Areas of Improvement

Areas of improvement of this study for future researchers include expanding the observations of the participants in their natural settings as a data collection method. The observations that were collected were on a unit that was technology based, but that lesson did not necessarily have to involve computer science or digital game-based learning. Although some of the observations did include one or both of these contents, it was not required due to the limited timeframe that was available for the observations and the study as a whole. To improve the data and gain a deeper understanding of how teachers use computer science and digital game-based learning specifically, it would be beneficial to ensure that every observation conducted on a participant used computer science with digital game-based learning as the prominent instructional method.

However, this was limited in this study due to time, standards that participants were mandated to teach for that day or week, as well as the comfortability of teachers being observed in a specific area where they may have never taught before. Additionally, this would have required the teachers to complete extended planning for a computer science lesson in which they may have had limited background knowledge, as the interview data suggested. To gain a more detailed, informative interpretation of the specific areas of instructional improvement in the areas of computer science and digital game-based learning, it is recommended that future researchers observe classroom lessons that involve both of these contents.

Participants

Expanding the number of participants in this case study from this school as well as other charter schools in the company's network could lead to outcomes that might benefit building leaders at the participating schools. This may lead to a richer and more detailed case study. The data from this study would add to the growing body of research regarding professional development, computer science, and digital game-based learning. This study was limited to 15 teachers; however, every participant happened to be female because the entire classroom teaching staff was female at this specific school. It may provide a more diverse data set if male teachers are also included in the set of participants in future research studies. Another set of participants that may be beneficial are technology teachers that are in the charter school network. They have a unique perspective because they have been trained specifically in technology. Future research could focus on how they have been trained and what they recommend is the best method for professional development to train elementary classroom teachers to teach computer science and digital game-based learning.

Additional Recommendations

To further expand this study, it may be more beneficial to expand on the professional development artifact documents that were collected. This case study focused on the professional development plans that were collected from the participating school as well as other charter schools in the company network. One area for future research is to expand the number of schools where professional development documents are collected from, both inside and outside of the charter school company network. Additionally, it would be beneficial to future researchers to understand how these professional development trainings are conducted**.** Collecting documents from the actual professional developments that were conducted or attending computer science and digital game-based learning professional development trainings for first-hand accounts would add to the body of research.

Another area in which to further expand this study is to understand how administrators and building leaders view computer science and digital game-based learning as instructional practices. One of the barriers that participants described was that neither of these content areas is directly listed in a standard nor are the participants instructed to teach either by the administration. Perspectives on computer science and digital game-based learning from principals, administrators, content specialists, and other educational leaders could take the study into a different direction, which would allow for a variety of information and perspectives to be examined from a greater sample.

Conclusion

In this chapter, I discussed the results of the case study in greater detail and in context of the central research question of the professional development training that is needed for Florida elementary school teachers to effectively teach the topics of the Computer Science for All Initiative using digital game-based learning. The educator participants indicated that many had not received effective professional development training in computer science or digital game-based learning in their academic or professional careers. Participants described many barriers that prevented them from incorporating computer science and digital game-based learning into their daily instruction, including a lack of time, a lack of inclusion of computer science and digital game-based learning in the standards, as well as a lack of knowledge and resources. The participants described the professional development training that is needed for them to effectively teach computer science as part of the Computer Science for All Initiative using digital game-based learning. The participants stated that they would need professional development trainings that were hands-on and allowed them to use the programs they were required to teach. They also stated that the trainings should involve modeling of instruction in which the teachers were able to witness how the programs should be incorporated into their daily practice by both a lead trainer and their peers. Participants also stated that they would need more information in the professional development trainings that includes foundational computer science and digital game-based learning information, the pedagogical background and benefits that goes into computer science and digital game-based learning, and knowledge of where to access resources in both of these areas.

This dissertation addressed the gap in practice, framed by constructivism, exploring the experiences of elementary school teachers regarding professional development in computer science and digital game-based learning as part of the Computer Science for All initiative. The methodology of this qualitative case study was designed to learn more about this set of elementary school teachers and to provide a rich, detailed story of their experiences.

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Appendix A: Teacher Interview Questions

The following questions will be asked to teachers during interview sessions. Questions will focus on technology usage, professional development, computer science, and digital game-based learning. Follow up questions will be asked based on responses, as well as rephrasing any questions for clarity.

General Technology Usage

1) What grades do you teach currently? What grades have you taught previously?

2) Including this school year, how many years have you worked as an elementary school year?

3) Describe your experience in technology education courses during your undergraduate, graduate or other educational institution program. What courses did you take in technology? Describe their effectiveness in training you to use technology in your instructional practice.

4) How comfortable do you feel in using technology in your personal life? In your professional career?

5) How frequently do you or your students use computers or other technology tools during instructional time?

6) In what ways do you use technology in the classroom? What instructional, operational, or administrative uses?

7) Describe your professional development experience in technology education in your educational career.

Computer Science and Professional Development

1) Please describe your understanding of computer science and its usage in elementary education.

2) Describe your usage of computer science in your instructional practice at this school. At previous schools?

3) How many trainings do you believe you have received in the area of computer science at this current school? At previous schools?

4) Please describe the professional development trainings in computer science you have received. Were they didactic, interactive, collaborative, and/or experimental?

5) Do you believe the professional development that you have received in your career has prepared you to teach computer science? Why or why not?

6) What instructional resources are you aware of in the area of computer science education?

7) What do you feel is your biggest barrier or challenge in implementing computer science in your instructional practice?

8) What professional development do you believe is needed for you to effectively teach and implement computer science in your classroom?

Digital Game-Based Learning and Professional Development

1) Please describe your frequency in using digital games in your personal and professional life.

2) Please describe your understanding of digital game-based learning and its usage in elementary education.

3) Describe your usage of digital game-based learning in your instructional practice at this school. At previous schools?

4) How many trainings do you believe you have received in the area of digital game-based learning at this current school? At previous schools?

5) Please describe the professional development trainings in digital game-based learning you have received. Were they didactic, interactive, collaborative, and/or experimental?

6) Do you believe the professional development that you have received in your career has prepared you to teach using digital game-based tools? Why or why not?

7) What instructional resources are you aware of in the area of digital game-based learning?

8) What do you feel is your biggest barrier or challenge in implementing digital game-based learning in your instructional practice?

9) What professional development do you believe is needed for you to effectively implement digital game-based learning in your classroom?

Appendix B: Classroom Observation Tool

ISTE Classroom Observation Tool (ICOT): Technology Checklist http://iste.org/icot

Teacher Code	**SCue5**	
1. Setting		
Date:	**Observation Start Time/End Time:**	**# Students:**

2. Room Description and Student Characteristics	
3. Student Groupings (check all observed during the period)	
☐ **Individual student work**	☐ **Small groups**
☐ **Student pairs**	☐ **Whole class**
☐ **Other (please comment):**	
4. Teacher roles (check all observed during the period)	
☐ **Lecturing**	☐ **Interactive direction**
☐ **Discussion**	☐ **Facilitating/coaching**
☐ **Modeling**	☐ **Other (please comment):**
5. Learning activities (check all observed during the period)	
☐ **Creating presentations**	☐ **Test taking**
☐ **Research**	☐ **Information analysis**
☐ **Writing**	☐ **Simulations**
☐ **Drill and practice**	☐ **Hands-on skill training**
☐ **Other (please comment):**	

6. How essential was technology to the teaching and learning activities?

☐ Not needed; other approaches would be better.	☐ Somewhat useful; other approaches would be as effective.
☐ Useful; other approaches would not be as effective.	☐ Essential; the lesson could not be done without it.
☐ Other (please comment):	
7. Technologies used by teacher	
8. Technologies used by students (check all observed during the period):	

9. NETS Technology Standards (choose all standards that apply):
☐ ET.1 Creativity and Innovation: Students demonstrate creative thinking and problem solving skills to develop innovative products and processes using (digital) technology. ☐ ET.2 Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, across the global community, to support individual learning and contribute to the learning of others. ☐ ET.3 Research and Information Fluency: Students select and apply digital tools to gather, evaluate, validate, and use information. ☐ ET.4 Critical Thinking, Problem Solving and Decision Making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. ☐ ET.5 Digital Citizenship: Students understand human, cultural, and societal issues related to digital technology and practice legal, ethical, and responsible behavior. ☐ ET.6 Technology Operations and Concepts: Students utilize technology concepts and tools to learn.
11. Estimated Time Technology Used (if 3-minute chart is not used)
Total minutes technology used by students: **Total minutes technology used by teacher:**
12. Lesson Outline

Appendix C: Initial Codes, Collapsed Codes, and Emergent Themes

Initial Codes	Collapsed Codes	Emergent Themes
Knowledge of Computer Science Resources of Computer Science Standards of Computer Science Student Issues of Computer Science Time of Computer Science	Computer Science Challenges	
Full Understanding of Computer Science No Understanding of Computer Science Partial Understanding of Computer Science	Computer Science Comprehension	Teachers have not been properly trained to implement computer science into their instructional practice.
Coding of Computer Science Math & ELA Apps No CS Instruction Other	Computer Science Instruction	
Code.Org No PD Experience	Computer Science Professional Development Experience	
Background-Foundation Information of Computer Science Creating Lessons of Computer Science		Teachers need effective professional development training in-order to implement computer science into their instructional practice.

Appendix C (continued)

Initial Codes	Collapsed Codes	Emergent Themes
Group Setting of Computer Science	Computer Science Professional Development Wanted	
Hands-On of Computer Science		
Modeling of Computer Science		
Online-Webinar of Computer Science		
Resources of Computer Science		
Code.Org		
No Resources of Computer Science	Computer Science Resources	
Other Online Resources		
All Standards		
ELA	Computer Science Standard Implementation	
Math		
Math and Science		
Math ELA Science		
Math or ELA		
Science		
Knowledge of Digital Game-Based Learning		
Resources of Digital Game-Based Learning	Digital Game-Based Learning Challenges	
Standards of Digital Game-Based Learning		
Student Issues of Digital Game-Based Learning		
Time of Digital Game-Based Learning		
Full Understanding of Digital Game-Based Learning		
No Understanding of Digital Game-Based Learning	Digital Game-Based Learning Comprehension	
Partial Understanding of Digital Game-Based Learning		
Frequent Use in Classroom		
Non-Gamer	Digital Game-Based Learning Frequency	
Appendix C (continued)		

Initial Codes	Collapsed Codes	Emergent Themes
Use Frequently Personal		
Assessment & Review Games		
Computer Science Games		
Math Games	Digital Game-Based Learning Instruction	
None		
Other Games		
Required Math & ELA Inst. Games		
Effective PD of Digital Game-Based Learning		Teachers have not been properly trained to implement digital-game based learning into their instructional practice.
No PD Experience of Digital Game-Based Learning	Digital Game-Based Learning Professional Development Experience	
Not Effective PD of Digital Game-Based Learning		
Background-Foundation Information of Digital Game-Based Learning		
Creating Lessons of Digital Game-Based Learning		
Group Setting of Digital Game-Based Learning	Digital Game-Based Learning Professional Development Wanted	
Hands-On of Digital Game-Based Learning		Teachers need effective professional development training in-order to implement digital game-based learning into their instructional practice.
Modeling Instruction of Digital Game-Based Learning		

Appendix C (Continued)

Initial Codes	Collapsed Codes	Emergent Themes
Online-Webinar of Digital Game-Based Learning		
Resources of Digital Game-Based Learning		
Assessment & Review Games	Digital Game-Based Learning Resources	
Math & ELA Required Apps		
No Resources		
Other Games		
1st Grade	Grade Levels Taught	
2nd Grade		
3rd Grade		
4th Grade		
5th Grade		
6th Grade		
Kinder		
1–3 Years of Experience	Teaching Experience	
4–10 Years of Experience		
More than 10 Years of Experience		
Comfortable with Tech	Technology Comfortability	
Not Comfortable with Tech		
Advanced Level Technology Courses	Technology Education Academic Experience	
Basic Level Technology Courses		
No Technology Courses		
Frequent Use of Tech	Technology Instructional Frequency	
Somewhat Frequent Use of Tech		
Instructional Software PD	Technology Professional Development Experience	
Admin-Ops Usage PD		
Apple PD		
Computer Science PD		
Appendix C (Continued)		

Initial Codes	Collapsed Codes	Emergent Themes
SMART PD		
Tech 101 PD		
Effective PD		
Limited PD		Teachers have not been properly trained in basic instructional technology skills in their academic or professional careers.
No PD Experience		
CSUSA Tech Outcomes		
Instructional Software	Technology Professional Development Wanted	
Operational-Admin Software		
Tech 101		
Hands-On		
Administrative Uses	Classroom Technology Usage	
Instructional Software		
Learning Activities		
Creating Presentations		
Digital Games		
Drill and Practice		
Information Analysis		
Research		
Skill Training		
Test Taking		
Writing		
Nearpod		
Review&Assessment Software		
SMARTboards		
Standards Implemented		
Communication and Collaboration		
Creativity and Innovation		
Critical Thinking		
Digital Citizenship		
Research and Information Fluency		
Technology Operations and Concepts		

Appendix C (continued)

Initial Codes	Collapsed Codes	Emergent Themes
Student Grouping		
Individual		
Small Group		
Student Pairs		
Whole Class		
Teacher Role		
Discussion		
Facilitating		
Interactive Direction		
Technologies Used		
Assessment-Review Software		
Code.org		
iPad		
Math-ELA Instructional Software		
Nearpod		
SMARTBoard		
Video Software		

Appendix D: Statement of Original Work

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

Statement of academic integrity.

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

Explanations:

What does "fraudulent" mean?

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

What is "unauthorized" assistance?

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

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

Statement of Original Work (Continued)

I attest that:

1. I have read, understood, and complied with all aspects of the Concordia University–Portland Academic Integrity Policy during the development and writing of this dissertation.

2. Where information and/or materials from outside sources has been used in the production of this dissertation, all information and/or materials from outside sources has been properly referenced and all permissions required for use of the information and/or materials have been obtained, in accordance with research standards outlined in the *Publication Manual of The American Psychological Association.*

Christopher Levy

Digital Signature

Christopher Levy

Name (Typed)

4/17/19

Date