USING ARTIFICIAL INTELLIGENCE TO CIRCUMVENT THE TEACHER SHORTAGE IN SPECIAL EDUCATION: A PHENOMENOLOGICAL INVESTIGATION

by

Kirt Elliot Hale

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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Abstract

The purpose of this hermeneutic phenomenological research study was to understand district technology leaders' receptivity to employing artificial co-teachers, based on their lived experiences with Artificial Intelligence (AI). Facing a problematic teacher shortage in special education, the Jade County School District was not readily employing available AI technologies such as IBM's WATSON and MIT Media Lab's TEGA, to aide in filling the instructional voids caused by special education teacher attrition. Veblen's theory of technological determinism provided the necessary framework for this study, which focused on how district technology leaders described their willingness or apprehension to employ autonomous machines to independently instruct students with disabilities in the classroom. This research study was carried out in a large public-school district with a high number of special education teacher vacancies. Purposeful sampling was used to recruit 11 district-level technology leaders who were responsible for developing and sharing a vision for how new technology could be employed to support the needs of students. The principal researcher applied hermeneutic phenomenology to interpret data from photo-elicitations, audio-recorded focus groups, and individual interviews.

Keywords: artificial intelligence, artificial intelligence in education, artificial co-teachers, cobots, computer assisted learning, intelligent tutoring systems, students with disabilities, special education, teacher turnover

Copyright Page

Dedication

The dissertation is dedicated to my three daughters, each of whom have first and middle name initials that begin with the letters D and R. I am very pleased to be an official member of your girls' club.

Acknowledgments

I would like to thank Dr. Jerry Woodbridge and Dr. Susan Quindag for their selfless commitments to ensuring the completion of this project. Their guidance carried me throughout all the stages of my research.

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List of Abbreviations

Artificial Intelligence (AI)

Artificial Intelligence in Education (AIED)

Fourth Industrial Revolution (FIR)

Individualized Education Program (IEP)

Intelligent Tutoring Systems (ITS)

National Center for Education Statistics (NCES)

CHAPTER ONE: INTRODUCTION

Overview

Empirical studies have identified high rates of attrition and turnover for special education teachers in the United States (Bettini et al., 2017; Hagaman & Casey, 2018; Robinson et al., 2019). In 2020, there were approximately 7.3 million students receiving special education services in the United States (NCES, 2021). Most of these students were educated in co-taught classrooms (Strogilos & King-Sears, 2019), and the absence of qualified special education teachers adversely impacted their student achievement and overextended the duties of general educators (Billingsley & Bettini, 2019). The first chapter of this study establishes the context for using artificially intelligent robots to aide in filling the instructional voids caused by special education teacher attrition (Billingsley & Bettini, 2019; Touretzky et al., 2019). There is a brief discussion on the background of the teacher shortage followed by a discussion on the subsequent growth of Artificial Intelligence (AI) in education. Veblen's (1919) theory of technological change and determinism is also introduced as a framework for defining the scope of the problem and the purpose of the study. Lastly, the significance of the research is explained, and the central question and sub-questions are identified.

Background

Forty-nine states reported shortages for special education teachers (NCPSSERS, 2021). Within the last decade, the special education workforce has declined by 20% (Samuels & Harwin, 2018), as stringent demands to teach and complete excessive paperwork have many special education teachers feeling as though they have two full-time jobs (Hale, 2015). While the bulk of special educator attrition is attributed to stress (Samuels & Harwin, 2018), it may be amenable to intervention if certain pedagogical responsibilities were tasked to autonomous machines (Whitney, 2017).

From an educational technology perspective, AI can perform many of the functional responsibilities assigned to special education teachers (Whitney, 2017). Although the roles of special educators vary from school to school, the essential duties would include: teaching academics and social skills, adapting learning materials to meet the individual needs of the student, co-planning and collaborating with stakeholders, and implementing/monitoring individualized educational programs or IEPs (Adera & Bullock, 2010). To this end, the professional capacity of an educator could be replicated by a machine (Renz & Hilbig, 2020), and with 54% (57 million) of K-12 students having access to school-issued, one-to-one computers (Molnar, 2015), it would be easier for a student with a disability to virtually connect to an artificially intelligent software program than it would be for them to physically connect with a special education teacher in the classroom.

Historical Context

Historically, AI in education (AIED) is wedged between enthusiasm and fear (Peters, 2017). Some researchers view AI as the long sought-after solution to academic challenges in education (Renz & Hilbig, 2020); others see it as a step towards the devolution of teacher pedagogy (Francom, 2020; Veblen, 1919). Both perspectives are equally exaggerated and dangerous, creating a tension between the traditional understanding of education and a futuristic idea of what knowledge transfer could be (Renz & Hilbig, 2020).

The first artificially intelligent computers appeared during the 1970s (Kulik & Fletcher, 2016). The retronym given to these machines is ITS or intelligent tutoring systems (Kulik &

Fletcher, 2016). ITS tools simulated human instruction by using individualized feedback to guide learners to problem solutions (Carbonell, 1970).

Research on ITS traditionally focused on student achievement (Kulik & Fletcher, 2016; McArthur et al., 2005; Serrano et al., 2018), and most of the studies showed an increase in performance for participants (Kulik & Fletcher, 2016; Serrano et al., 2018). As applications of ITS technology ensued, researchers began designing machines specifically for students with disabilities (Chatzara et al., 2016; Xin et al., 2017). The integration of ITS with intellectually disabled populations resulted in moderate gains in achievement from pre-to-posttests, as compared to conventional methods of specialized instruction (Kulik & Fletcher, 2016). The data show that AI could flourish with students with disabilities (Renz & Hilbig, 2020); nonetheless, most educators argue against AIED and its deterministic effects on the profession (Edwards & Ramirez, 2016; Humble & Mozelius, 2019; Korukonda, 2005; Thomsen, 2019).

The existence of AI in society has led educators to profile the technology based on speculation and not experience (Feifer, 2020). Most educators are unaware of AIED, and proponents of using the technology emphasize AI's ability to assume the workloads of absent teachers in the classroom (King, 1993; Humble & Mozelius, 2019), while opponents highlight job displacement by machines (Peters, 2017). Thus, district technology leaders—who are responsible for developing and sharing a vison of how technology could be employed to support the needs of students—may be more or less receptive to using robots to circumvent the shortage of special education teachers, depending on their presuppositions of AI.

Social Context

Western society generally favors technological advancement (Chen et al., 2017). The internet was a welcomed replacement of the printing press (Chen et al., 2017). Global positioning systems supplanted highway road maps, and paper money is slowly being deferred to digital currency (Bouri et al., 2019). Innovation is quintessential to America's modernization, yet it is slowed—sometimes altogether halted—in the country's educational institutions (Humble & Mozelius, 2019). One must question why school districts are lagging in the application of autonomous robots (Humble & Mozelius, 2019).

Because technology is understood to be a determinant for change (Veblen, 1919), it is reasonable for educators to assume that the employment of AI machines would alter the profession of education in some manner (Lima, 2020). Afterall, AI has irreversibly transformed hundreds of non-academic industries (Peters, 2017). Some scholars contend the tech has made industries better, while others contend it has made them worse (Humble & Mozelius, 2019; Peters, 2017). Notwithstanding, AI cannot be barred from education indefinitely, and educators should begin focusing on practical applications for robots in the classroom (Martínez-Córcoles et al., 2017).

The number of special education teachers has declined by 20% over the past decade (Samuels & Harwin, 2018). School districts in the United States spend millions of dollars on the recruitment of special educators—crippling their resources and the ability to promote effective change within the community (Carver-Thomas & Darling-Hammond, 2019). As districts continue to search for qualified special education teachers (Carver-Thomas & Darling-Hammond, 2019), educational technologists are calling for an examination of whether robots could be used to circumvent personnel issues in the classroom (Devedžić, 2004). Employing special education cobots or artificial co-teachers may be a viable solution for ensuring the needs of students with disabilities are met in the absence of a specialized instructor (Xin et al., 2017).

When district technology leaders veer away from conversations on using AI technologies such as IBM's WATSON and MIT's TEGA to aide in filling instructional voids, they are left in a continual parade of hiring inexperienced and ineffective personnel to occupy teaching positions (Adera & Bullock, 2010; du Boulay, 2016). Inadequate instruction undermines the quality and stability of a school district (Boe et al., 1997), and students with disabilities who participate in co-taught classrooms without the presence of qualified special education teachers to monitor and address their needs, do not progress toward their educational goals (Billingsley et al., 2020).

Theoretical Context

The argument for or against using AI in the classroom is centered on the technology's foreseeable impact on students and teachers (Humble & Mozelius, 2019). AI machines will augment instructional delivery, which may amend the student-teacher relationship, which may impact the role of teachers in the classroom, thus changing hiring practices for school districts (Humble & Mozelius, 2019; Veblen, 1919). This is a reductionist outlook on AIED that has its theoretical underpinnings in technological determinism (Veblen, 1919), as technology is thought to be a determinant of social and organizational structures (Feifer, 2020; Martínez-Córcoles et al., 2017).

Theoretically, societies function as biological systems, evolving through a course of natural selection and increasing in complexity through analogous processes (Gutek, 2011). Technological determinists assert that if AI can effectively fill the void of absent special education teachers, then AI will inevitably be used to replace special educators entirely (Feifer, 2020). Furthermore, if AI can replace special educators, general education teachers will likewise concede to its presence (Christensen et al., 2018; Veblen, 1919). The extent of free-will is ultimately challenged by the idea of using AI, suggesting that the receptivity of cobots such as

WATSON and TEGA would be grounded in deterministic attitudes toward AI technology (Humble & Mozelius, 2019; Veblen, 1919). It would be difficult to sustain in the face of AI's progression that human beings, not technology, affect the course of history (Humble & Mozelius, 2019; Veblen, 1919). When robotic teachers are integrated in the classroom, their reception will be dictated by how stakeholders perceive the intendment of the tech, namely the promises and threats robots pose to teachers and students (Humble & Mozelius, 2019; Veblen, 1919).

Problem Statement

The identified problem in this hermeneutic phenomenological research study was district technology leaders precluding the idea of employing available AI technologies to aide in filling instructional voids caused by special education teacher attrition (Billingsley & Bettini, 2019; Touretzky et al., 2019). Applications of AI outside the field of education were demonstrating how autonomous tech could be used to support issues that were relevant to the organizational goals of a school district (Devedžić, 2004). Hence, it was important to investigate school leaders' receptivity to using robots in an instructional role (Humble & Mozelius, 2019).

WATSON is poised to serve in the role of artificial co-teacher, as it—along with similar AI systems—can differentiate instruction, collect data, monitor student progress, manage student behavior, and effectively collaborate with educators far beyond the talents of a human instructor (Kulik & Fletcher, 2016; Touretzky et al., 2019). Technologies such as WATSON will not suffer from the limitations that plague their human counterparts (Whitney, 2017). They will not become frustrated or stressed by the workload; they will never be restricted by biology, succumbing to tiredness or sickness. They will repeatedly teach and reteach lessons until each student achieves mastery (Whitney, 2017), and soon AI will have the capacity to discern and respond to human emotion (Chatzara et al., 2016; Whitney, 2017).

Purpose Statement

The purpose of this hermeneutic phenomenological research study was to understand district technology leaders' receptivity to employing artificial co-teachers, based on their lived experiences with AI. Receptivity was defined as the willingness or apprehension to employ AI machines/software to independently instruct students with disabilities in the classroom (Renz & Hilbig, 2020). The theoretical framework of technological determinism (Veblen, 1919) provided the key concepts for identifying technophobia as a psychological constraint in the 11 participants.

Significance of the Study

Despite the long history of AIED (Kulik & Fletcher, 2016; Serrano et al., 2018), little to no research existed on autonomous machines functioning in the role of a special education teacher. This study was theoretically, empirically, and practically significant because it gave a voice to educators, allowing them to describe their attitudes toward employing artificial co-teachers in the classroom. Understanding district technology leaders' views on AI was essential because they were responsible for developing and sharing the vison for how technology could be employed to support the needs of students. They were also the primary decision-makers for the integration of AI in the schools. Thus, the willingness of district technology leaders to employ robots to teach was considered a prerequisite in preparation of AI being mainstreamed in education (Holmes et al., 2019).

Theoretical Significance

Technological determinists question the degree to which human thought and action are influenced by technology and assume that technology, in any given society, will ultimately define social structure (Veblen, 1919). Correlating technology to the evolution or de-evolution of a society is an extremely complex issue, and scholars generally take an ambivalent stance regarding technological determinism—arguing that humans govern technology, not the other way around (de la Cruz Paragas & Lin, 2016; Renz & Hilbig, 2020). Nonetheless, tenets of the theory outline the existential effect that technology has on the evolution of humankind (de la Cruz Paragas & Lin, 2016). Technological change is inevitable; robots in education are inevitable (Moustakas, 1994; Newton & Newton, 2019). Thus, there was a need to confront technological determinism in its reductionistic form and critique it as someone who could subscribe to simplistic notions of the theory (de la Cruz Paragas & Lin, 2016; Renz & Hilbig, 2020). To this end, this research study sought to investigate the fundamental relationship between technological change and fear. Specifically, I wanted to articulate the role of technophobia in district technology leaders' willingness to employ autonomous teachers (Moustakas, 1994, Veblen, 1919).

Empirical Significance

Big-tech companies are entering the education market with AI-based teaching and learning solutions, investing millions of dollars in personalized instruction (Holmes et al., 2019; Renz & Hilbig, 2020). Applications of AIED are growing exponentially and are expected to reach a market cap of nearly six billion dollars by the year 2024 (Holmes et al., 2019). Because the integration of AI was somewhat unobtrusive (Knox, 2020), school districts were being left out of central decision-making processes regarding AI's presence in education (Zawacki-Richter et al., 2019), namely the right to choose how the technology is incorporated. Moreover, most of the existing research on AIED is quantitative (Rienties et al., 2020; Zawacki-Richter et al., 2019), revolving around AI's causative effects in education (Knox, 2020). This qualitative study provided a naturalistic inquiry and in-depth understanding of why educators would preclude artificial co-teachers.

Practical Significance

AI is evolving at a rapid pace, and educational researchers are beginning to address the socio-political aspects of teacher-machine collaborations (du Boulay, 2016; Humble & Mozelius, 2019). Leaving AIED solely in the hands of big-tech companies would be detrimental to the field of education, as the race for autonomous innovation may result in a lack of accountability for educators and children (Hvistendahl, 2018; Renz & Hilbig, 2020). The district leaders in this study helped shape the conversation of robotic teachers in the classroom; they identified conditions for employing robots to teach. Conclusions drawn from this research could be used to shape AIED policy and design artificial co-teachers that are well-received by educators.

Research Questions

The following research questions were derived from the theoretical framework of technological determinism (Veblen, 1919). Additionally, Heideggar 's (1962) hermeneutic phenomenological design was used to structure questions that had intrinsic value to participants. These questions are also centered on both the problem and purpose statements.

Central Research Question

How do district technology leaders describe their willingness or apprehension to employ AI machines to independently instruct students with disabilities in the classroom (Renz & Hilbig, 2020)?

Sub-Question One

What motives or concerns do district leaders have for using robots to instruct students with disabilities?

Research in AIED identifies prerequisites for establishing new technology initiatives—with school leaders' dispositions toward AI being a key factor (Renz & Hilbig, 2020). Moreover, portrayals of AI's determinant presence in books, films, and other media may be the bellwether of AI receptivity (Korukonda, 2005; Saltman, 2016; Veblen, 1919).

Sub-Question Two

How does technophobia and technophilia contribute to the thoughts, opinions, and feelings of district technology leaders toward the idea of using artificial co-teachers?

This question allowed for an exploration into the psychological themes that emerged from participants' experiences with AI (Moustakas, 1994). Fear and optimism are emotions that undermine rationality, and research has shown that fear adversely affects the decision-making process by triggering avoidant behaviors in the presence of potential rewards (Pittig et al., 2014; Wagner & Morisi, 2019). To this end, technophobia would affect district leaders' receptivity to employing artificial co-teachers, even if the cause of the fear was contrary to the facts (Wagner & Morisi, 2019).

Sub-Question Three

What concessions are needed to strengthen district technology leaders' willingness to employ AI machines/software to independently instruct students with disabilities in the classroom?

Because technology influences the thoughts and actions of human beings (Veblen, 1919), it was important to identify yielding points for the consideration of using robotic teachers.

Definitions

1. *Artificial intelligence* - The branch of computer science concerned with building machines that engage in human-like processes such as learning, adapting, and synthesizing (Renz & Hilbig, 2020).

2. *Artificial co-teachers* – Specially designed machines used to teach students with disabilities (Chen et al., 2020).
3. *Cobot* – Collaborative robots designed for direct human interaction within a shared space (Veloso et al., 2015)
4. *Connectivism* - The theoretical framework for understanding learning in a digital age (Downes, 2012).
5. *Flipped learning* – An instructional strategy that requires students to individually explore and learn information within the lesson before the class meets and engages in discussions (Chao et al., 2015).
6. *Fourth Industrial Revolution* – The fusion of artificial intelligence, robotics, the internet, and genetic engineering, to automate traditional manufacturing and industrial practices (Peters, 2017).
7. *Hybrid intelligence* – The application of human and machine intelligence in combination to overcome the shortcomings of existing AI (Dellermann et al., 2019).
8. *Machine takeover* – The hypothetical scenario in which artificially intelligent machines effectively take control of the planet away from the human species (Chelliah, 2017).
9. *Neo-Luddism* – The appellation used to describe individuals who believe that applications of modern technology will have adverse effects on society (Merrit, 2019).
10. *Non-technological determinism* – The belief that technology has little to no effect on the development of a society (de la Cruz et al., 2016).
11. *Technological determinism* – The assumption that technology is an autonomous force shaping cultural values, social structure, and history (Veblen, 1919).

12. *Technology 4.0* – Digital technology designed to interconnect humans to real-time data and information through cyber-physical systems (Yang et al., 2021).
13. *Technophilia* – A strong enthusiasm for technology, especially new technologies (Lam, 2000).
14. *Technophobia* – The fear or dislike of advanced technology or complex devices (Lam, 2000).
15. *White-collar machines* – Autonomous machines that perform administrative and managerial duties in an office setting (Chelliah, 2017).

Summary

In this chapter, I discussed high rates of attrition and turnover for special educators and provided a context for using AI to circumvent special education teacher shortages (Carbonell, 1970; Humble & Mozelius, 2019; Kulik & Fletcher, 2016). Technological determinism (Veblen, 1919) was introduced as the theoretical framework, defining the scope of the problem and purpose of the study. The problem of district technology leaders precluding the idea of employing robotic teachers was explained and the significance of the research was discussed. This study gives a voice to educators who have experience with AI—in and out of the educational setting—allowing them to describe conditions for employing robots to teach. Lastly, research questions that were derived from the theoretical framework of technological determinism and structured upon Moustakas' (1994) hermeneutic phenomenological design were reviewed along with key terms and definitions that will be found throughout this research paper.

CHAPTER TWO: LITERATURE REVIEW

Overview

The purpose of this hermeneutic phenomenological research study was to understand district technology leaders' receptivity to employing artificial co-teachers, based on their lived experiences with AI. This chapter is a review of the existing literature on AI in education and in the broader community. The chapter begins with an examination of Veblen's (1919) theory of technological determinism, as it relates to technology being an exogenous force on human thought and action. Given the tenor of Veblen's (1919) theory to account for cumulative causation, this chapter draws attention to the social and psychological ramifications of innovation, which may have subsequently galvanized prejudices against machines in the workforce (Isaacs, 2012; Nestik et al., 2018). The chapter includes a synthesis of related literature on technophobia, technophilia, and luddism, all of which provide contexts for describing district leaders' receptivity towards autonomous machines. While there was little research on explicitly replacing human teachers with robots (Sharkey, 2016), ample literature was found on machines tutoring children in an educational setting (Chen et al., 2020). Finally, this chapter provides a discussion on identifiable gaps in the existing literature, thus presenting the need for this study.

Theoretical Framework

The theoretical framework strengthens the rationale for research—to include the research problem, the purpose, the significance, and questions for the investigation (Rocco & Plakhotnik, 2009). It provides a foundation for the literature review, which uses previous works to show connection (Osanloo & Grant, 2016). The theoretical framework applied to this study was technological determinism, a reductionist theory developed by Veblen (1919). Veblen's (1919) model qualifies the idea of technology being a catalyst for social, economic, and political change. With respect to employing robotic teachers to circumvent special educator attrition, technological determinism denotes an irreversible transformation to the system of education if robots are allowed to teach children in the classroom (Khasawneh, 2018).

Technological Determinism

School districts are both dynamic and unpredictable; nonetheless, they inevitably respond to technological forces within their communities (Laari-Salmela & Kinnula, 2014). Although the majority of educational robots are used outside of the school environment (Boyd & Holton, 2018), the existence of machines like MOXIE (Figure 1), which aids parents and therapists in teaching children's social skills and emotional competency, calls for an examination of the deterministic effects of robots in education (Martínez-Córcoles et al., 2017). If robots are finding success in promoting cognitive, emotional, and social learning for children outside of the classroom (Boyd & Holton, 2018), then in-school applications will ultimately take place (Lima, 2020).

Figure 1

MOXIE Robot by Embodied Inc.

Technological determinism (Veblen, 1919) serves as a conceptual model for understanding an educator's receptivity to using robots to offer specialized instruction to students with disabilities in the absence of a special education teacher. Veblen's (1919) postulate gives way to a convergence between technology, technological risks and rewards, as well as institutional decision-making (Feifer, 2020). Rather than following a single line of determinism for cause-and-effect, I sought to understand the interconnected pathways of AI's presence in society and district technology leaders' willingness or apprehension to use AI in the role of a co-teacher.

Technological determinism is described as the degree to which human thought and action are influenced by technology (Veblen, 1919). Veblen (1919), an American economist and sociologist, contended that people respond to technological advancements through impulse, thus conforming to thoughts that eventually give rise to institutional and social change (Lima, 2020). Accordingly, there are carryovers when implementing new technologies within an organization, especially a school district (Khasawneh, 2018). For example, smartboards redefined stakeholders' expectations for digital learning, which led to one-to-one technology initiatives for schools across the United States (Mun, 2019).

Veblen (1919) upheld the notion that humankind's desire to survive creates the need for technological innovation. Human existence revolves around modes of production and the distribution of material goods (Veblen, 1919). Technology assists in these efforts—eventually leading to the process of social change (de la Cruz Paragas, & Lin, 2016). For example, shortly after the American Civil War, isolated farmers in western parts of the United States encountered difficulties transporting perishable meats and produce across great distances (Bjornlund, 2015). In response to an identifiable problem, artificial refrigeration was developed in the 1800's to allow farmers to maintain foods long enough to ship across states. This transformed the regions of Texas, Arizona, and southern California into robust societies (Bjornlund, 2015).

Proponents of technological determinism generally ascribe to two facets: hard determinism and soft determinism (Laari-Salmela & Kinnula, 2014). Both hard and soft determinists reason that the human agency is diminished whenever new technologies are introduced (Martínez-Córcoles et al. 2017). However, hard determinists view technology as an omniscient force that governs humankind's social evolution (de la Cruz Paragas & Lin, 2016), whereas soft determinists argue that the opportunity to forgo new technologies will always be present—although resistance to tech may be detrimental to existing sociopolitical structures (Boyd, & Holton, 2018).

There are several examples of technology's determinant imprint on societies. The discovery of steam power led to the development of industrialized nations, and the introduction of computers led to the dawn of the information age (Boyd, & Holton, 2018). The invention of the gun changed how disputes were sorted out, which subsequently changed the face of combat and made nations more apt for war (Edwards & Ramirez, 2016). Prior to the introduction of cellular technology, people used fixed landlines to talk across far distances. Cellphones allowed people to speak remotely, thus regulating expectations for faster communication (Ward, 2017).

Veblen (1919) asserted that the convenience of using technology created an interdependency in which human beings act in accordance with technological forces. Technologies are developed to solve societal problems, and cultural changes occur as societies adapt to the tech (Pannabecker,1991). Each new discovery and innovation functions as a pre-cursor to social evolution (Edwards & Ramirez, 2016). People dictate how the technology is created and how it is employed, but the technology dictates the providence of societies that use it (Veblen, 1919).

Technological determinists reason that technology follows a chain of causality—juxtaposed to ideas of free will and human authority (Boyd & Holton, 2018; Laari-Salmela & Kinnula, 2014). A communal affair exists between human thought, technology, and social change (Veblen, 1919). Because human beings adapt to their environments through manners of natural selection (Veblen, 1919), any society adorned with technologies will add conditions that shape the morals, values, and philosophies of its inhabitants (Schatzberg, 2018). People will "…think in the terms in which the technological processes act" (Veblen, 1919, p. 598). Although technology may not have absolute power over humanity, it does determine how human beings think (Clarence, 1935), making it a factor in social evolution (Schatzberg, 2018).

Related Literature

Special education teacher shortages have existed since the Individuals with Disabilities Education Act was passed in 1975 (Samuels & Harwin, 2018). Sixty-seven percent of special educator attrition is voluntary and related to job stress; nonetheless, instructional voids left from absent special education teachers are amenable to intervention, as there are practical opportunities for AI to serve in an instructional role with educators in the classroom (Whitney, 2017; Renz & Hilbig, 2020).

Several technology companies specialize in AI-based teaching and learning solutions (Renz & Hilbig, 2020), yet there is very little evidence to support the groundwork for defining preconditions for employing robotic teachers in education—namely how instructional robots should look, talk, and operate in order to be accepted by educators. Traditionally, teachers have used AI technology within the context of a tool to supplement instruction rather than compliment the instructor (Rashid & Asghar, 2016). Nonetheless, intelligent machines can be granted a more prominent role in education (Garg & Sharma, 2020; Kulik & Fletcher, 2016).

Modern AI systems function more like software organisms rather than programs (Forbus, 2016), thus researchers and practitioners are growing increasingly interested in using AI-based robots as teachers of standardized curricula (Alcorn et al., 2019). AI has immense connections to internal and external databases, which may be modified or bypassed depending on an individual student's learning profile (Kulik & Fletcher, 2016). For instance, if a student has a deficit in reading, a robotic teacher could be programmed to substitute complex words with synonyms or illustrate terms that were difficult to read (Kulik & Fletcher, 2016). If a student has a diagnosis of attention deficit disorder, a robotic teacher could intermittently prompt him or her to remain on task or draw in his or her attention using specialized graphics (Greeff & Belpaeme, 2015).

Research on educators' receptivity for employing robots to teach is emerging (Alcorn et al., 2019). To gain a perspective on using cobots and robots in special education, Alcorn (2019) conducted semi-structured interviews and focus groups with 31 special education staff members in England. The participants represented a range of professional roles, which included teachers, paraprofessionals, and speech therapists. Alcorn (2019) explored participants' responsiveness to robotic teachers that were designed to teach children with Autism. Most participants showed an interest in the technology; however, they expressed concerns for the determinant effects of using robots in education (Alcorn et al., 2019). While the educators believed that autistic children would find robotic teachers more engaging than their human counterparts, they also supposed the presence of a robotic teacher in the classroom would prevent children from building appropriate interpersonal relationships with other human beings (Alcorn et al., 2019).

AI is a paradigm to the debate on the determinant presence of technology in society (Boyd & Holton, 2018; Chen et al. 2020). Technology enthusiasts and phobics both agree that conversations on the symbiotic relationship between man and machine must take place (Renz & Hilbig, 2020). Themes such as mass unemployment, robots skewing ideas of interpersonal connection, and machines becoming self-aware in an evolutionary doomsday scenario, outline presuppositions on the determinant nature of AI (Nimrod, 2018). In the face of such ominous forecasts regarding humankind and machine, district technology leaders may be swayed by melodramatic representations of AI's impact on society—resulting in their precluding the idea of employing available AI technologies (Khasawneh, 2018).

There are two analytical positions concerning technological determinism and AI (Korukonda, 2005). The first is: AI will be a non-determinant force in society (Haenlein & Kaplan, 2019). This position is centered on the notion that, much like any innovation, AI is advantageous to humanity but not transformative to human nature (Boyd & Holton, 2018). The second position is: AI will be deterministic (de la Cruz Paragas & Lin, 2016), and the continued presence of intelligent machines in society will spawn unbridled transformations to the thoughts and actions of human beings (Boyd & Holton, 2018).

Non-determinant AI

The position of AI as a non-determinant force in society is based on the notion of AI technologies failing to revolutionize western culture in a meaningful way (Haenlein & Kaplan, 2019). AI can be traced back over half of a century—with minimal induction into the general public (Haenlein & Kaplan, 2019). Most AI systems are used by private corporations; thus, applications of intelligent machinery have been largely unimpactful (Boyd & Holton, 2018). The average citizen does not ride to and from work in an autonomous vehicle; robotic assistants are not operating in the homes of everyday American citizens (Boyd & Holton, 2018). For the most part, AI remains a subservient entity of wealthier populations (Bruun & Duka, 2018). In fact, the technology has limited visibility and understanding amongst people in the United States (Haenlein & Kaplan, 2019).

The value of AI has varied between social groups, as socioeconomical statuses antecede the predispositions of middle, working, and lower-class persons who may only understand AI from a stance of science-fiction and not reality (Khasawneh, 2018). While one group may holistically welcome AI into their lives as the technology that drives their cars and monitors their health, another group may see AI as something that invades their privacy or coerces them into making decisions that result in adverse outcomes (Hvistendahl, 2018). This polarization emphasizes the belief that AI will never become a determinant force within society (Boyd & Holton, 2018).

Determinant AI

AI's determinant impact on society can be illustrated by instances of cause-and-effect involving technology and social change or technology and collective reasoning. For example, the threat of robot-induced unemployment is a real concern amongst economists who study labor-force cutbacks and the growing number of job roles that are being diminished by advancements in AI (Chomanski, 2018; Martínez-Córcoles et al. 2017). According to the Bureau of Labor Statistics (2020), manufacturing jobs have declined 30% over the last three decades, partly due to automations of industrial technology (Houseman, 2018). Employers in manufacturing have collectively realized that robots working in laborious positions enable manufacturers to produce significantly more with fewer workers (Atkinson, 2012). Moreover, economic researchers are also following a linear path of determinism by drawing a distinction between routine and nonroutine labor, citing routine jobs as highly suspectable to displacement by machines (Atkinson, 2012; Houseman, 2018; Peters, 2017).

Because AI can be employed to perform job labor, it holds provocative influence over societies' most important tenets (Thon, 2011). In the healthcare industry, the combination of AI and robotics is producing smart, precision machines that are irreversibly altering how medical surgeries are being performed, subsequently decreasing mortality rates for diseases, injuries, and deformities (Mirnezami & Ahmed, 2018). In the political realm, AI technologies were at the center of investigations involving election tampering and governmental disruptions in the United States during the 2016 elections, potentially transforming the nation's democracy (Polonski, 2017). Ultimately, the argument for AI's determinant impact on society can be made through a simple observation of the goals of computer science: to enhanced hybrid intelligence—infusing the cognitions of humans with machines; to participate in collective intelligence systems and share information with machines, humans, and networks; and to expand collective intelligence into society, physics, and cyber systems (Thon, 2011).

Technophobia

An individual's stance on AI's social imprint, rather it be determinant or non-determinant, serves as an audit of their predisposition for intelligent machines (Feifer, 2020; Khasawneh, 2018; McClure, 2018). By examining receptivity through a technologically determinant lens, it becomes apparent that the idea of the human agency being diminished at the hands of technology (Martínez-Córcoles et al. 2017) would impact one's attitude towards AI (Schleich et al., 2019). Although technophobia is identified as a psychological barrier (McClure, 2018), few studies attempt to explain how the sentiment could influence prejudice against intelligent machines in the workforce (Friend, 2018; Niehueser & Boak, 2020).

There is no consensus in literature on technophobia being linked to any particular form of technology. Rosen and Weil (1995) described technophobia as a negative attitude toward complex technologies and/or specific negative cognitions toward future technologies. Technophobia is a generalized disposition for various representations of automations and machines (Korukonda, 2005). AI-phobia is but one instance of technophobia, applicable solely to AI technologies, whereas chemophobia is technophobia characterized by the aversion of chemicals.

There are three classifications of technophobia: individualized fears (computer knowledge or a lack thereof), structuralized fears (fear of job loss or machine takeover), and interpersonal fears (fear of privacy invasion by technology) (McClure, 2018). Of the three, individualized technophobia is by far the most researched (Friend, 2018; McClure, 2018; Niehueser & Boak, 2020). However, the bulk of technophobic dispositions are classified as structuralized fears (McClure, 2018).

Technophobia can be traced back to the first Industrial Revolution—when the introduction of the power loom threatened the jobs of the Luddites, an organization of textile workers in Great Britain (Isaacs, 2012). Having the impression that the power loom would suppress their livelihoods, the workers physically destroyed the machines throughout Britain's factories (Isaacs, 2012). It is important to note that the Luddites protested the application of the power loom, rather than the mechanism itself (Merrit, 2019), suggesting that the receptivity of a particular form of technology would depend on its perceived value and whether the tech is designed to aid workers in the work process or replace the workers altogether (Isaacs, 2012).

The fear of being replaced or overthrown by machines is a uniquely Western viewpoint (Ito, 2018). Western society was constructed on principles of ownership, and the notion that anything—a tree, a dog, a lot of land, or a person—can belong to a human being is a likely antecedent to technophobia (Laari-Salmela & Kinnula, 2014). Machines are objects; they can be owned, but when machines are imparted with intelligence, they transcend positions of servitude and become pseudo-humans (Ito, 2018). Individuals who occupy positions of power feel threatened by pseudo-humans because power can shift, and power generally transfers to the stronger, more intelligent entity (Ito, 2018).

Technophobia would have a significant impact on the adoption and acceptance of robotic teachers because the procurement of AI technology would create a situation that threatens the power educators have in society, namely the power to transfer knowledge (Khasawneh, 2018). A.I. has already stripped away power from humans in many complex forms of work—ranging from assembling an automobile, performing paralegal activities, identifying fraudulent banking transactions, and transcribing audio for journalists (Chelliah, 2017). Though the link between AI and occupational power shifts is less established, correlations have been drawn between employers' willingness to employ robots and the fear of job displacement (Chelliah, 2017; Chomanski, 2018).

The adoption of new technologies places a great deal of stress on the employees of an organization, subsequently impacting their attitudes and influencing psychological orientations toward machines (Show-Hui & Wen-Kai, 2010). McClure (2018) examined the demography of technophobes and found that—on average—technophobia disproportionately effects non-White, married, females, between the ages of 50 and 55, who work and live in a metropolitan area. This implies that the proposed integration of artificial co-teachers would adversely impact the anxiety levels of district leaders who belong to this demographic (McClure, 2018). Additional factors such as educational level and whether the individual has children were also common characteristics of technophobes (McClure, 2018).

Technophilia

Technophilia is traditionally defined as a strong attraction or enthusiasm for technology, especially high-tech software, and gadgets (Martínez-Córcoles et al., 2017). Much like its counterpart, technophilia is not merely an attitude toward technology; it encompasses a psychological mindset, behaviors, and subsequent actions (Saltman, 2016). Research on technophilia shows that when individuals are aware of impeding technology and its application to a specific job function, they feel less threatened by the innovation (Brougham & Haar, 2018). Investigations on AI's integration into the workforce finds employees, who are technophilics, have a positive outlook towards using white-collar machines to circumvent routine labor (Chelliah, 2017). In fact, technophilics believe that automations vastly improve productivity (Martínez-Córcoles et al., 2017; Niehueser & Boak, 2020).

Technophilia can be as equally threatening to the adoption of new technologies as technophobia. This is because early adopters or pioneers of new technologies assume the most risks, and there are technological uncertainties associated with the integration of new tech (Fischer et al., 2019). Lower market shares are also associated with early adopters of technology (Fischer et al., 2019). Robots are not customary in the public school system, and technophilia would act as a barrier in district technology leaders who preclude the idea of employing robotic teachers because premature implementation could be rifled with consequences (Ito, 2018).

Artificial Intelligence in Education

The term artificial intelligence or AI was coined in 1956 by a group of professors who used the expression to describe machine automation (McCarthy et al., 2006). The group characterized the science of AI as an exploration of machine competence for solving problems in a manner similar to human cognition (McCarthy et al., 2006). Since its introduction, AI has branched into the areas of robotics, neurology, machine learning, gaming, e-commerce, and communications (Chen et al., 2020). Twenty-first century societies continue to evolve immensely with demands for an expansion of smart technologies for learning, resulting in explorations of AI in education (AIDE) (Renz & Hilbig, 2020).

It is not a matter of if autonomous machines will teach children, it is a matter of when (Chen et al., 2020; Veblen, 1919). School leaders will be faced with narrating the disruptive presence of AI (Christensen et al., 2018). Accordingly, districts must prepare to govern the integration of intelligent machines from the top-down—first establishing AI-based policies and curricula at the district level, then overseeing AI operations within school buildings. Otherwise, districts will face a multitude of unintended institutional changes stemming from a haphazard integration of AI technology (Ravizza et al., 2014). This is perfectly illustrated with the introduction of smartphones to the U.S. in the early 2000's. Smartphones became common sometime in 2010 (Sarwar, 2013), and because schools are microcosms of their surrounding communities, smartphones inadvertently began to enter classrooms at the hands of students and teachers. Before district-based policies governed the use of smartphones in the classroom, schools were faced with the issue of students using the internet for non-academic purposes, which consequently resulted in lower exam scores (Ravizza et al., 2014). Considering AI as disruptive technology means that it will inevitably enter our classrooms (Christensen et al., 2018; Veblen, 1919). Studies on top-down technology integration show school districts exerting better control over disruptive technologies (Christensen et al., 2018) when they diplomatically support and control the adoption of the new tech (Kouicem et al., 2018; Walsh, 2004).

Intelligent Tutoring Systems

The goal of AIED (whether it will lead to actualization or not) is the production of humanoid robots and internet chatbots that can effectively perform the instructional duties of a classroom teacher (Chen et al., 2020). Machines teaching students in the classroom designates the ushering in of a Fourth Industrial Revolution (FIR) (Peters, 2017). Educational technology developed in the FIR will highlight the shortcomings of human beings, as it relates to the transfer of knowledge (Humble & Mozelius, 2019).

The predecessors of AIED machines are Intelligent Tutoring Systems (ITS). ITS computer programs such as PLATO, shown below in figure 2, first appeared during the 1970s (Carbonell, 1970; Humble & Mozelius, 2019; Kulik & Fletcher, 2016). These programs simulated human instruction by guiding learners to problem solutions, using individualized feedback from an internal network of specialized databases (Carbonell, 1970). In their meta-analysis of the effectiveness of ITS, Kulik and Fletcher (2016) concluded that students who received intelligent tutoring outperformed their counterparts on post-tests in 46 of the 50 studies. Additionally, most the ITS programs successfully managed students' behaviors by maintaining their attentiveness for hours as opposed to minutes (Kulik & Fletcher, 2016).

Figure 2

PLATO (Intelligent Tutoring System)

Many ITS programs were designed to close learning gaps for students with disabilities (Chatzara et al., 2017). When evaluating the historical impact of AIED, Chen, Chen, and Lin (2020) used a narrative framework to investigate the effects of intelligent tutoring on instruction. The authors concluded that advancements in ITS technology made it possible for educators to dynamically customize lessons (Chen et al., 2020). As instructional AI systems began to succeed ITS computer programs, machines became automated with the technology to interact with children on an emotional level (Chen et al., 2020). AI systems embedded with emotional response software allowed researchers to use robots and cobots to interpersonally connect with children (Poulou & Poulou, 2017), thus creating the opportunity for machines to deliver direct instruction (Chen et al., 2020).

While AIED has existed for over 50 years, it is still unclear—for educators—how to exploit the technology in an academic setting (Zawacki-Richter et al., 2019). There was a call amongst scholars to use AI far beyond the scope of a supplemental tool for teaching (Feifer, 2020; Sharkey, 2016). For AI to be substantive in education, the technology must independently teach students in the classroom (Brougham & Haar, 2017). Some school districts are exploring pedagogical opportunities for AI (Shi et al., 2018), and gradual shifts in paradigms are transitioning instructional models from computer-assisted instruction to online learning, to instructional cobots (Kulik & Fletcher, 2016). AIED researchers are beginning to focus on innovation more so than application (Brougham & Haar, 2017; Feifer, 2020; Sharkey, 2016). Hence, the idea of employing robotic teachers to work collaboratively with general educators is the next logical progression (Chen et al., 2020).

Robotic Teachers

Although the idea of using robots to circumvent teacher shortages is less explored in literature, robots in education are not unfamiliar. Ewijk et al. (2020) led focus group sessions with a total of 18 teachers and examined 10 ethical concerns associated with the implementation of a robotic teacher in the classroom (Ewijk et al., 2020). The contributing authors identified 10 ethical concerns amongst the educators, which included: 1) accountability; 2) applicability; 3) freedom from bias; 4) friendship & attachment; 5) human contact; 6) privacy & security; 7) psychological welfare & happiness; 8) safety; 9) trust & deception and 10) usability (Ewijk et al., 2020). Participants in the research study mentioned opportunities and concerns for employing robotic teachers in education (Ewijk et al., 2020). On one hand, participants expressed enthusiasm for facial recognition software that could be embedded in machines—aiding the robots in differentiating between children and calling them by name (Ewijk et al., 2020). On the other hand, participants mentioned privacy concerns with using such facial recognition software with children, and they were particularly wary of the data being hacked or used maliciously (Ewijk et al., 2020).

While some teachers saw potential for using robotic instructors in the subject areas of language arts and math, other teachers were apprehensive regarding the physical safety of children interacting with robots (Ewijk et al., 2020). Technophobic and technophilic dispositions emerged throughout participants' responses. Although Ewijk et al. (2020) were not focused on illuminating technophobia nor technophilia in their investigation, identifiable patterns in language that could be categorized as either fear or admiration for technology were thematic, as illustrated in the sample responses retrieved from their research, shown below in Figure 3.

Figure 3

Ewijk et al. (2020) Sample Responses from Moral Values Related to Robots in Education

Value	*Example*
Privacy & Security	Unauthorised or secondary use of data, ability to record the behaviour of children and move in the same physical space.
Applicability	Improve learning, help with doing homework, technology being inadequate.
Psychological Welfare & Happiness	Calming a child, personalised social supportive behaviour, Uncanny Valley effect, fear.
Usability	Beyond the classroom learning, providing access to resources not available before.
Accountability	Responsibility for software, responsibility for safety, responsibility for costs.
Human Contact	Child preferring the companionship of a robot over that of their human peers, a robot creating new social interactions.
Trust & Deception	A child might imagine that the robot really cares about them, a robot being able to listen to a child.
Friendship & Attachment	Becoming emotionally attached to a robot, a robot forming a relationship with a child.
Freedom from Bias	Creating a learning environment which is tailored to children's unique learning styles.
Safety	Fear of a robot hitting a child, loose or exposed mechanical parts on a robot.
Miscellaneous	Considerations or conflicts between two or multiple values.

Technophobic Technophilic Neutral

Newton and Newton (2019) also foreshadowed the expansion of AI in education. The authors reflected on plausible applications of robotic teachers in the classroom, and subsequently developed a 10-point code of practice for future educators. The code reads as follows:

1. There should be a collective judgement of the suitability of the assumptions, values and beliefs reflected in the robot's teaching, and also about matters that should be reserved for the human teacher.

2. A human teacher should be responsible for arranging and managing the learning environment, and for the kinds and quality of teaching and learning which takes place.
3. A human teacher should be present when a robot teacher is in use.
4. Care should be taken to ensure that data collected by the robot or human teacher is secure and is maintained only for the minimum length of time it is needed, after which it is destroyed.
5. Decisions taken by a robot about teaching and learning should be monitored and, if judged inappropriate, changed at the teacher's discretion.
6. Younger children should not interact only or predominantly with a robot teacher; an upper limit of time in robot-human interaction should be imposed.
7. The teacher should ensure that young children see, experience and reflect on human-human interaction in ways which illustrate its nature, and exercise the skills of interpersonal behavior.
8. The teacher should ensure that children interact with robot teachers appropriately.
9. Care should be taken to discourage a habit of shallow thinking arising from robot use, or of leaving thinking and decisions to the robot teacher.
10. Care should be taken to ensure that children exercise a wide range of thought in the classroom, giving due weight to higher levels of purposeful thinking and to thinking dispositions, and for which the human teacher should be largely responsible. (Newton & Newton 2019, pg. 6).

Co-teaching with Machines

Most students with disabilities receive their instruction through co-teaching—having a general education teacher and special education teacher working together in a shared space

(Billingsley et al., 2020). Under the co-teaching model, cobots could be used to substitute the roles of absent special educators in the classroom (Kulik & Fletcher, 2016). Although previous research studies have not focused on employing autonomous machines as co-teachers, there are publications that highlight AI's ability to modify curricula and provide accommodations for children who are intellectually disabled (Edwards et al. 2016; Sharkey, 2016; Wlodek et al., 2015).

In a collaborative setting, the greatest barrier to effective co-teaching is knowledge of content (Scruggs & Mastropieri, 2017). Mastering content-knowledge across multiple disciplines is especially difficult for human special educators (Brock et al. 2017). Special education teachers must have knowledge of the content being taught to understand how to successfully evaluate learning problems and implement appropriate interventions (Scruggs & Mastropieri, 2017). Additionally, content-knowledge gaps appear particularly pronounced in middle and high schools (Scruggs & Mastropieri, 2017), and co-teaching at the secondary level can be challenging for many special education teachers, as they must continuously work to learn subject matter unrelated to their field (Boe et al., 1997; Carver-Thomas et al., 2019).

Rytivaara, Pulkkinen, and de Bruin (2019) outlined the primary duties and responsibilities of general and special education co-teachers in a collaborative setting. The authors determined that general educators were typically responsible for delivering the core academic content, planning the curriculum, and assessing students' proficiency (Rytivaara et al., 2019). Whereas, special education co-teachers were primarily responsible for evaluating problems related to social-learning and behavior (Rytivaara et al., 2019). The duties and responsibilities of special education teachers were heavily reliant on building strong work relations with students and staff—tasks that have already been quantified and replicated by artificially intelligent machines (Chen et al., 2020).

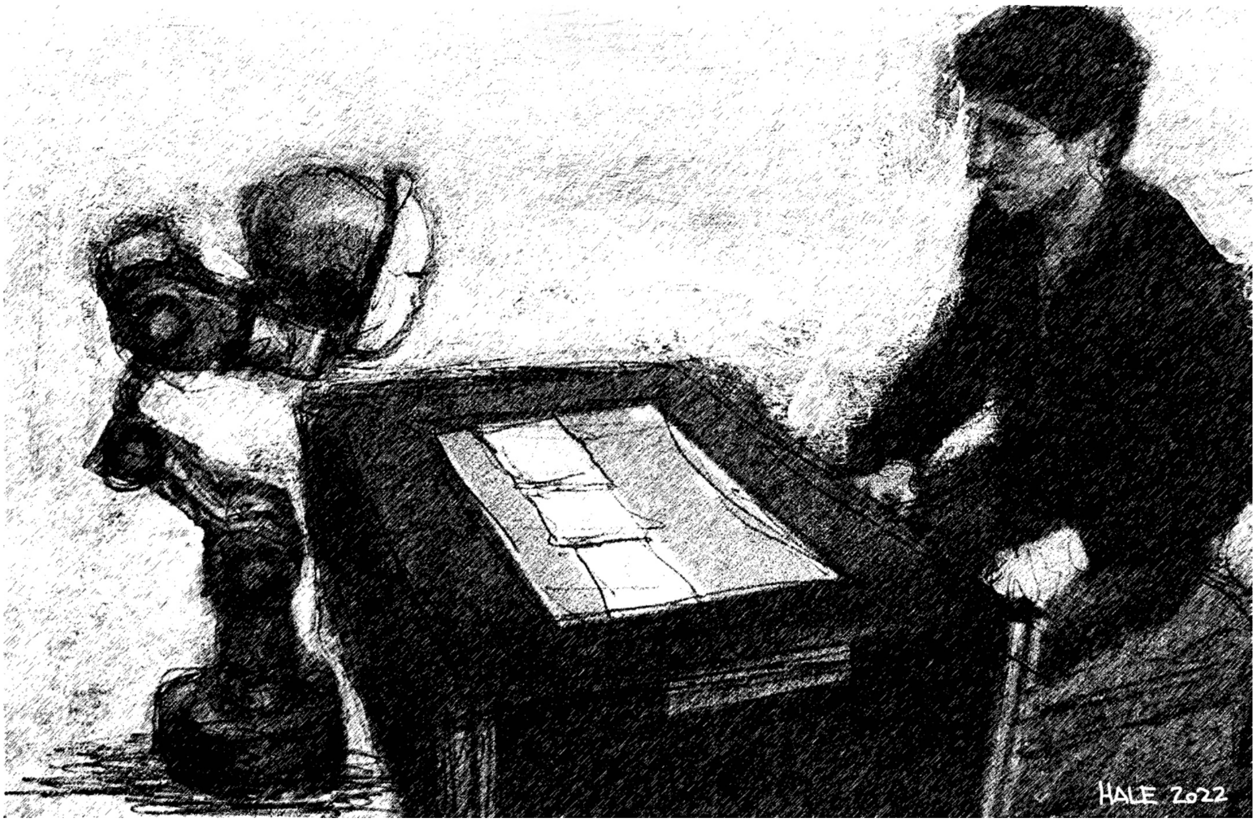
Legitimizing artificial co-teachers in the classroom will require a change in perspective regarding who or what is permitted to teach. For instance, IBM's WATSON, an artificially intelligent computer system that answers questions in natural language, demonstrated the capacity to which modern AI technologies can learn and work in a classroom (Ferrucci, 2010). WATSON successfully replicated human intelligence using questioning and answering protocols, which engaged learners in query-based conversations that simulated natural teacher-pupil interactions (Wlodek et al., 2015). With technologies such as WATSON being readily available for employment, opportunities exist for machines to teach alongside human instructors (Chen et al., 2020).

Machine Learning

The present role of AI role in education is centered on effective ways for computer programs to learn to leverage the complementary strengths of human instructors (McArthur et al., 2005). There are AI systems like Amazon's Alexa, which personalize interactions with users, enabling them to explore auditory content in the manner that best suits their persona (Zawacki-Richter et al., 2019). Greeff and Belpaeme's (2015) experimental research study on human-machine interactions revealed the propensity of human beings to interpersonally connect with intelligent machines during game play. In their study, Greeff and Belpaeme (2015) randomly assigned 38 participants to communal and non-communal conditions with an AI robot (seen below in Figure 4). The robot provided social cues (eye contact and facial expressions) while interacting with participants in a language game. During the communal exchanges, the robot modified and improved its communication output—illustrating how machines can learn through interpersonal interactions (Greeff & Belpaeme, 2015). Subsequent findings showed participants increased their communications when the robot exhibited facial cues (Greeff & Belpaeme, 2015).

Figure 4

Greeff & Belpaeme's Experimental Set-up



The mission to teach robots to be more human has led researchers to embedding AI technology into machines that read the physiological signals of human beings (Rytivaara et al., 2019). Algahtani and Ramzan's (2019) meta-analysis of AI systems employing physiological sensors to learn human behavior shows how AI can be trained to use non-invasive approaches to respond to social cues such as attentiveness, doubt, carelessness and so on. The meta-analysis included 129 medical studies involving human-to-computer interfacing and AI (Algahtani & Ramzan, 2019). Most of the AI systems were interfaced with visual and auditory sensors, notwithstanding a few systems featured haptic interfacing that utilized computer hardware to collect physiological information based on human touch (Algahtani & Ramzan, 2019).

AI systems like ALEKS or Assessment and Learning in Knowledge Spaces replicate human intelligence by automating the pedagogical functions of a teacher (Fang et al., 2019). ALEKS uses problem conception and feedback generation to differentiate its instruction to users (Fang et al., 2019). Although ALEKS is virtually based and not embedded in the form of a robot or cobot, it is far more advance than its 50-year-old ITS predecessors (Kulik & Fletcher, 2016). ALEKS boasts technological breakthroughs in cross-media intelligence to the point of imitating human consciousness (Fang et al. 2019). The AI system accommodates an array of learning modalities including visual, auditory, and kinesthetic learning styles (Algahtani & Ramzan, 2019), and it applies the information to determine each user's precise knowledge of a subject (Fang et al. 2019).

In another research study involving machine learning, Senft, Kennedy, Lemaignan, and Belpaeme (2017) investigated the efficiency of interactive learning by soliciting non-expert participants to verbally interact with an intelligent robot. Forty participants were given control over the actions of the machine and verbalized maneuvers as it completed errands around a mock kitchen. The researchers found that AI can successfully take on tasks that require flexibility and deductive reasoning (Senft,, et al, 2017).

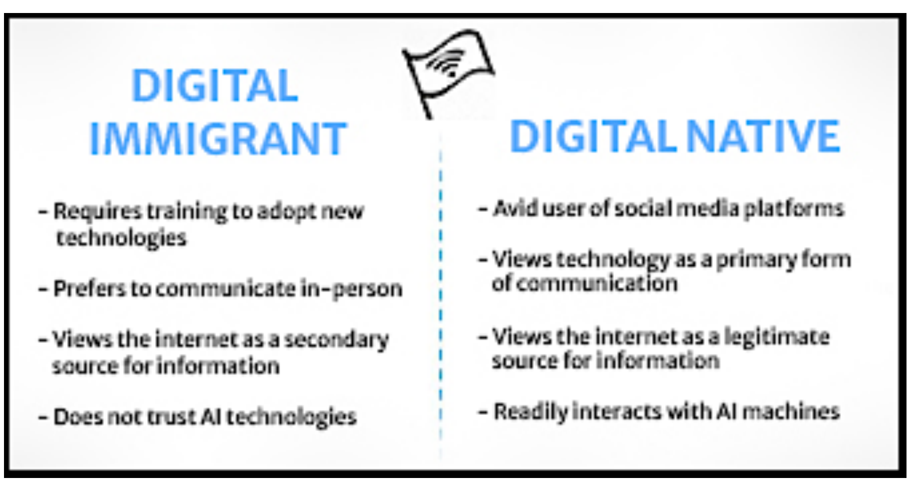
Machine learning illustrates how AI can teach itself—when burdened with incomplete data—and improve on its own using social cues, physiology, and knowledge input (Algahtani & Ramzan, 2019; Fang et al., 2019; Greeff & Belpaeme, 2015). The idea of employing artificial co-teachers in the classroom may be inscrutable because artificially intelligent robots and cobots function in ways that are generally perceived as human (Khasawneh, 2018). Nonetheless, AI can learn and act on the academic, social, and physiological needs of children (Algahtani & Ramzan, 2019; Fang et al., 2019; Greeff & Belpaeme, 2015), and these skill sets may be troublesome to individuals who view AI as pseudo-human (Ito, 2018).

Generational Perspectives

Most K-12 students are digitally native citizens; however, the educators responsible for leading them tend to be both immigrants to the digital world and novice to AI technology—illustrated below in Figure 5 (Coombes, 2009; Finnana & Robert, 2018). Generational gaps play a major role in technological loitering (Loewus, 2017). School districts are being led by baby boomers (Finnana & Robert, 2018), while the average classroom teacher is a member of the generation x cohort (Loewus, 2017). District technology leaders, whose generations pre-date the internet, have varying experiences as it relates to technology usage in the classroom (Pradhan, 2020). They are familiar with a time when teachers physically scripted lesson plans and special educators hand-wrote IEPs (Finnana & Robert, 2018). They witnessed the downward trend of paradigms such as Bloom's taxonomy, differentiated instruction, and scaffolding (Loewus, 2017).

Figure 5

Characteristics of Digital Immigrants vs. Digital Natives



Despite the number of school leaders who are older than the age of 55 having access to an assortment of technologies, many do not interact with AI on an intentional basis (Pradhan, 2020). A divide exists between digital immigrants and digital natives with respect to autonomous machines (Coombes, 2009; Finnana & Robert, 2018). On the other hand, school-age children have grown accustomed to AI, and by the year 2030, most children will spend the greater part of their day interacting with an intelligent machine (Haenlein & Kaplan, 2019).

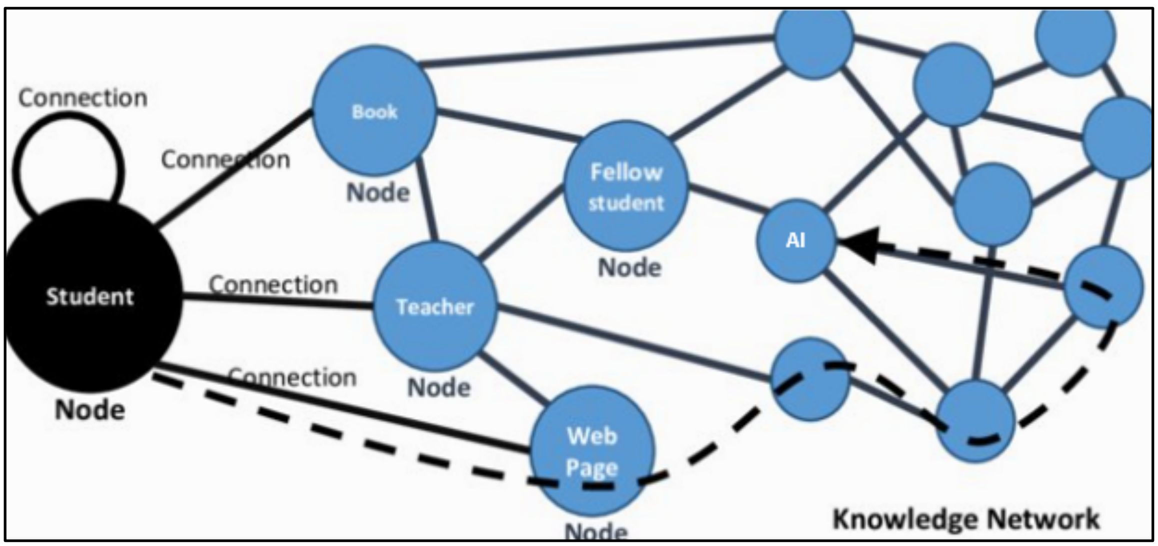
The preemptive role of educators is to regulate students' connections to AI (Kouicem et al., 2018). AI is already interconnected with children on microlevels through toys, virtual assistants, and video games (Saito, 2021). In fact, children under the age of five routinely interact with AI that is embedded in adaptive learning software (Haenlein & Kaplan, 2019; Siemens, 2005). It may be that teachers are no longer the primary sources of knowledge; instead, intelligent systems serve as the new learning hubs for information (Saito, 2021).

Connectivism, a learning theory for the digital age, endows AI with a role in knowledge transfer. Downes (2012), one of the primary theorists of connectivism, reasons that learning occurs when information is cycled through intrinsic and extrinsic networks—from the organic nodes of the human brain to the auxiliary nodes of digital space (Siemens, 2005). Thus, the minds of children are extended deep into a virtual plane—with AI being an usher to that plane (Downes, 2012). To this end, students will innately use AI to process information far beyond the scope of their cognitive abilities (Renda & Kuys, 2015).

Educational traditionalists often refer to Bloom's Taxonomy (Bloom, 1984) as the framework for teaching (Jensen et al., 2014). Bloom (1984) illustrated a linear model for knowledge transfer, in which teachers moved students from basic recall to complex reconstructions of information—requiring the mastery of prerequisites before moving to subsequent levels. In contrast, Downes (2012) imagines content mastery as the ability to navigate across informational networks, as illustrated below in Figure 6. Both Bloom (1984) and Downes (2012) presented frameworks for understanding knowledge transfer; however, their theories differ with respect to *when* and at what stage content mastery is achieved. Bloom (1984) places mastery at what he refers to as the creation phase—being able to generate and produce from knowledge—while Downes (2012) argues that mastery can never be achieved because information is constantly changing, and learners can only deepen or expand their connections to knowledge.

Figure 6

Connectivism and the Knowledge Network



Downe's (2012) theory of a connected learning experience is represented in the educational practice of flipped learning. Because the role of educators is to regulate students' connections to AI (Kouicem et al., 2018), flipped learning methodologies are subsequently relevant to the conversation of using artificial co-teachers in the classroom (Siemens, 2005). Flipped learning encourages students to connect to information independently, outside of lectures from a classroom teacher (Limniou et al., 2018). In a flipped classroom, the teacher presents the academic content, then students use books, AI search engines, and other media to independently connect to the information (Limniou et al., 2018). Students then collectively exchange what they learned with their peers, thus expanding their knowledge of the content (Limniou et al., 2018). This type of self-directed learning places AI within the scheme of knowledge transfer (Siemens, 2005), and students who participate in flipped classrooms show improved educational experiences as compared to students who participate in traditional modes of instruction (Maycock et al., 2018).

The merits of Bloom (1984) may no longer be relevant in a technologically advanced civilization because the process of learning is no longer hierarchical, nor is it linear (Downes, 2012). A child's connectiveness to AI allows him or her to access information that is diffused across a complex network of nodes (Siemens, 2005). It would be difficult—if not impossible—for human instructors to appropriately determine the educational needs of students who are tapped into an informational schema that is as massively open as the internet (Downes, 2012). AI can readily interpret the needs of students who learn in the digital space (Fang et al., 2019), and enhance the effectiveness of instruction for teachers who support those connections (Edwards et al., 2016).

As the presence of AI grows in education, the roles of classroom teachers will shift from Bloom-dominated vernacular to 21st century connectivism (Renda & Kuys, 2015). Younger generations are connecting to information through technological pathways that are fast and efficient (Siemens, 2005). Because AI is irreversibly changing the way societies operate (Forbus, 2016; Veblen, 1919), including the way knowledge is transferred (Garg & Sharma, 2020), educators would need to attune their roles to compliment the technology (Christensen et al., 2018).

Gaps in Literature

While the inclusive classroom setting offers the perfect habitat for AI systems to flourish (Renz & Hilbig, 2020), little to no research exists on robotic teachers being used to circumvent the absence of a special educator. There are knowledge gaps, theoretical gaps, and empirical gaps pertaining to the receptivity of artificial co-teachers. Educational technology companies looking to develop instructional robots for the U.S. market would need to assess educators' willingness to employ and form colleagueship with AI (Ito, 2018). Moreover, few studies mention technophobia and technophilia as factors in an individual's receptivity of autonomous tech. Fear and optimism are understood to be fundamental human emotions (McClure, 2018), thus research is needed to understand the impact these sentiments have on decisions to employ robotic teachers in the classroom (Nestik et al., 2018).

Knowledge Gaps

Western society is largely considered to be technologically mature—that is—technological affordances are the backdrop of everyday social encounters (Bruun & Duka, 2018). As America continues to expand usages of AI, creative applications of the technology will reach a terminus in education (Christensen et al., 2018). The more prevalent AI becomes in society, the more determinant its presence in education will be (Zawacki-Richter et al., 2019). Artificially intelligent machines are no longer imaginative representations of science-fiction and refining the technology will require increased knowledge and governance (Forbus, 2016).

In 2016, the White House Office of Science and Technology Policy (OSTP) proposed strategies and protocols to address how the nation will prepare for a future society inhabited with AI (Arnold & Scheutz, 2018). The draft proposal included an *AI Bill of Rights*, which regulates the development of responsible AI systems, the roles of the government, the private sector, and the research community (Arnold & Scheutz, 2018). The AI industry is primarily operated by private tech companies, and the OSTP is looking to close knowledge gaps by increasing stakeholder engagement from the public sector—to include public education (Brougham & Haar, 2017; Feifer, 2020).

The U.S. government's vision for intelligent machines in education is to fit the science and technology into an existing schematic and have it regulated by educators in the same way AI was integrated in the automotive industry and regulated by automakers (OSTP, 2016). For this reason, there is a need to understand educators' responsiveness to robotic teachers in the classroom (Haenlein & Kaplan, 2019). If educators are not receptive to the idea of using robots to teach, even if the technology circumvents an identifiable problem such as special education teacher attrition, then future explorations in AIDE may be fruitless (Creswell & Poth, 2018).

Theoretical Gaps

There are also theoretical gaps related to school leaders' willingness to employ artificial co-teachers in education (Humble & Mozelius, 2019). While technological determinism (Veblen, 1919) does explain the transformative potential of AI, the theory does not necessarily portend that technophobia or technophilia will precipitate from technological change (Haenlein & Kaplan, 2019). There could be non-technological factors that account for district technology leaders' willingness or apprehension to use robotic teachers in the classroom (Goguen, 2004; Hauer, 2017). One factor could be the unpredictable nature of live instruction. Lessons do not always follow a structured plan, and there may be amendments to time, activities, classroom discussions, and so on (Wolff et al., 2017). If students are exhibiting behavior problems, a robot may not know to temporarily suspend instruction and re-engage students after order is restored. Thus, district technology leaders' receptivity of artificial co-teachers could be less impacted by technophobia/technophilia and more impacted by practical considerations involving classroom management, finances, special educational laws, ethics, etc. (Goguen, 2004; Hauer, 2017). If non-technological conditions explain why district technology leaders are precluding the employment of robotic teachers, then technological determinism would not be a factor.

Empirical Gaps

Society is moving from the informational age to the age of automation (Min et al., 2019), and schools will likely incorporate AI-led instruction within the next decade (Edwards et al., 2016). There was a limited amount of data available on educators' willingness to work with robotic teachers in the classroom (Ito, 2018). Moreover, there were no studies that focused on the intrinsic drivers and barriers of school leaders to employ robotic teachers within their district. Research on school leaders serving as change agents for technology integration was ample (Edwards et al., 2016; Masullo, 2017; Walsh, 2004); nonetheless, there were no identifiable concessions for using artificial co-teachers to circumvent teacher shortages.

Conclusion

Within the next decade, educators will need to train to work with AI machines in a collaborative setting (Newton & Newton 2019). This training should be informed by research. School leaders will need to reflect on their own psychological orientations toward AI, identifying technophobic and technophilic dispositions that may impact their willingness to employ and work with artificial co-teachers in the classroom. Artificial co-teachers would be unaffected by the workloads that tend to lead so many teachers to leave the profession (Billingsley et al., 2020; Bruun & Duka, 2018), as machines are designed for continuous usage; they are not biological units that need recovery time. Moreover, AI is unparalleled in speed and productivity at the workplace (OSTP, 2016). The idea of using robots or cobots to circumvent special education teacher shortages does not necessarily mean permanently replacing special education teachers; rather it is a viable solution for enhancing the effectiveness of educators who are overwhelmed by their duties and responsibilities (Ivanov & Webster, 2017).

Forty-nine states report shortages for special education teachers in the classroom (National Coalition on Personnel Shortages in Special Education and Related Services, 2019). In fact, the number of special education teachers serving in co-taught classrooms has declined 20% over the past decade (Samuels & Harwin, 2018). When special education co-teachers leave, the quality of education for students with disabilities suffers (Hagaman & Casey, 2018). Opportunities now exist for educators to use AI technology beyond the scope of supplementation. District technology leaders will face a wave of innovative AI systems designed for the classroom (Renz & Hilbig, 2020), and with this in mind, there is a growing consensus that schools should become less dependent on traditional solutions for inexorable problems such as teacher retention and attrition (McArthur et al., 2005; Renz & Hilbig, 2020; Whitney, 2017).

Research in using intelligent machines in education identifies several factors that tend to explain educators' acceptance of and resistance to AI technologies (Brougham & Haar, 2017; Geng et al., 2019). There are varying levels of support for using robots and cobots in the classroom, which could lead to counterintuitive outcomes for the integration of artificial co-teachers in education (Edwards & Ramirez, 2016). Due to the accelerating evolution of AI and its disruptive presence in education (Christensen et al., 2018), educators are preemptively preparing—mostly out of fear—for scenarios that are embellished by books, film, and other media, highlighting a fantasized war between mankind and machine (Renz & Hilbig, 2020).

Because we once knew a world where social interactions were face to face, where knowledge had to be meticulously searched for within the solemn walls of a library, pre-internet generations tend to view autonomous machines as a bad thing, a sign of a dying civilization (Finnana & Robert, 2018). In spite of this technophobic disposition, school districts are obligated to use their resources to ensure that the needs of special education students are being continuously met (Hale, 2019). This study allows technology companies to draw upon the technophobic and technophilic sentiments of district technology leaders, in order to design robotic teachers that are non-threatening, pragmatic, and tolerable.

Summary

This chapter introduced literature on the use of instructional robots in education. The chapter began with an examination of Veblen's (1919) theory of technological determinism, as it relates to technology being an exogenous force on human thought and action. Veblen's (1919) theory serves as a conceptual model for understanding district technology leaders' reception to the idea of employing robotic teachers to offer specialized instruction to students with disabilities in the absence of a special education teacher. Given the tenor of Veblen's (1919) theory to account for cumulative causation, I established grounds for investigating technophobia as a phenomenon that galvanizes prejudice against AI machines in education (Nestik et al., 2018). I also explored technophilia as an intrinsic barrier to district technology leaders' willingness to employ AI machines in the classroom.

Literature on technological determinism and the unintended institutional consequences of machine integration were also reviewed, and information on technophobia and technophilia was presented in order to determine how certain psychological constructs could influence district technology leaders' receptivity to artificial co-teachers in the classroom. This chapter included a brief history of instructional robots in education, introducing Intelligent Tutoring Systems and segueing into projections of a future human/machine collaborative teaching environment.

Machine learning was also examined— illuminating how artificial co-teachers could develop interpersonal relationships with students in the classroom.

There were knowledge gaps, theoretical gaps, and empirical gaps pertaining to the receptivity of artificial co-teachers, thus indicating the need for researching educators' responsiveness to the idea of employing robotic teachers. With this literature in view, this hermeneutic phenomenological study aimed to investigate (1) the receptivity of district technology leaders to use AI to fill service gaps caused by the special education teacher shortage, (2) how technophobia and technophilia contribute to the opinions, thoughts, and feelings of district leaders toward the idea of employing artificial co-teachers, and (3) what concessions were needed to support the integration of artificial co-teachers in the classroom.

CHAPTER THREE: METHODS

Overview

The purpose of this hermeneutic phenomenological research study was to understand district technology leaders' receptivity to employing artificial co-teachers, based on their lived experiences with AI. This chapter begins with a discussion on the rationale for using qualitative research in conjunction with hermeneutic phenomenology. Because perspectives on technology and its benefits/impediments tend to vary (Korukonda, 2005; Merritt, 2019), it was meaningful to investigate the roles technophobia and technophilia played in district technology leaders' presuppositions toward AI and robotic teachers (Heideggar, 1962). This chapter includes a detailed description of the research design and a list of research questions. Additionally, the setting is described, highlighting special education teacher vacancy and technological capacity as justifications for site selection. Data collection and data analysis procedures are discussed, and the contributing author expounds on data trustworthiness, as well as safeguards that were put in place to protect the identities of research participants.

Research Design

I used qualitative research methods refined into a hermeneutic phenomenological design to conduct this study. According to Creswell and Poth (2018), qualitative research is intended to make sense of reality by describing and explaining experiences found in the social world. Because the aim of this study was to understand district leaders' responsiveness, a qualitative exploration was appropriate (Creswell & Poth, 2018). Qualitative research allows for descriptions of participants' inclinations to be interpreted into data (Creswell & Poth, 2018).

Phenomenology is predicated on understanding the human experience and exploring how a phenomenon is perceived by individuals in the phenomenological event (De Warren, 2009;

Moustakas, 1994). The receptivity of robotic teachers could be illuminated through the lived experiences of district technology leaders who interact with AI and other advanced technologies (De Warren, 2009). It is important to realize hermeneutic phenomenology, developed by Heideggar (1962), is a derivative of phenomenology aimed at defining the human experience as singular (van Manen, 1990). In other words, the apprehension of a phenomenon—its meaning, its context, its interpretation—is subjective, not only to those who experience it, but to those who interpret that experience as well (Crowther et al., 2017; Heideggar, 1962). Because a person cannot step outside of his or her own awareness in the world, bias will always frame their perception of phenomena (van Manen, 1990). In this case, the district technology leaders' receptivity of artificial co-teachers was inseparable from their presuppositions of AI, robots, and machines (van Manen, 1990). Moreover, my interpretation of technology leaders' experiences with artificially intelligent machines was inseparable from my own expertise and understanding of technophobia and technophilia (van Manen, 1990). The use of the hermeneutic phenomenological research design provided a deeper, contextual understanding of receptivity as a subjective form of reality that was impacted by one's fear and enthusiasm for technology (Heideggar, 1962; Saltman, 2016).

Following the theory of technological determinism, I argued that school leaders precluding the employment of robotic teachers to fill instructional voids in the classroom could have been driven by an irrational fear of AI and the deterministic outlook of a future society led by AI. According to Heideggar (1962), an individual's presuppositions of the world frames their understanding of new experiences. Previously learned concepts, as well as previous exposure to ideas and experiences are critical to how one interprets a phenomenon (Heideggar, 1962; van

Manen, 1990). It could be reasoned that all human beings are subjected to the predisposition of their own consciousness (Boyd & Holton, 2018).

The principles of hermeneutic phenomenology are centered on the lived experiences of both the researcher and the participant (van Manen, 1990). Researchers who apply the design are concerned with giving meaning to the multiple realities in existence (Boyd & Holton, 2018; van Manen, 1990). Given that district technology leaders' responsiveness to the idea of employing robotic teachers would be impacted by their presuppositions of AI (van Manen, 1990), the use of the hermeneutic phenomenological design was most appropriate.

Research Questions

The following research questions were derived from the theoretical framework of technological determinism (Veblen, 1919) and centered on Heideggar 's (1962) hermeneutic phenomenological design:

Central Research Question

How do district technology leaders describe their willingness or apprehension to employ AI machines to independently instruct students with disabilities in the classroom (Renz & Hilbig, 2020)?

Sub-Question One

What motives or concerns do district leaders have for using robots to instruct students with disabilities?

Sub-Question Two

How does technophobia and technophilia contribute to the thoughts, opinions, and feelings of district technology leaders toward the idea of using artificial co-teachers?

Sub-Question Three

What concessions are needed to strengthen district technology leaders' willingness to employ AI machines/software to independently instruct students with disabilities in the classroom?

Setting and Participants

This study was conducted virtually, in a large public-school district with a high number of special education teacher vacancies. The district is technologically-rich—spending nearly 2 million per year on instructional devices and infrastructure—making it a prime location for the investigation. The pseudonym, Jade County School District (JCSD), is being used to protect the locality of the research site.

Site

JCSD is situated in the southeastern region of the United States. The student population is roughly 102,000, with 10% being identified as students with disabilities (JCSD, 2021). There are 6,000 teachers, 17% of which have less than three years of experience, and seven percent of which are non-certified (JCSD, 2021). Leadership within JCSD is comprised of a seven-member board that oversees the superintendent and superintendent's cabinet. There are eight cabinet members who manage operations, human resources, finances, information, academics, student support, and research/evaluation. The district also retains seven regional superintendents who supervise clusters of schools throughout the county.

An important caveat in site-selection for a phenomenological study is the researcher's connection to the site (Alase, 2017). According to Creswell and Poth (2018), qualitative researchers should strive to select sites with no personal interests. In doing so, the full expression of perspectives may be captured (Creswell & Poth, 2018), as the researcher limits his or her subjectivity (Moustakas, 1994). The contributing author of this study has no vested interest in JCSD.

Creswell and Poth (2018) also contend that qualitative researchers should investigate the phenomenon within the natural setting. Because this study solicited qualitative data from district leadership, the natural setting for this investigation would have been the district offices and board room facilities. However, due to COVID-19 restrictions, access to these spaces were limited. Hence, this research was carried out virtually, using the Microsoft Teams platform. Although virtual interviews slightly augment observations of natural behavior (Creswell & Poth, 2018), the format provided an opportunity for the synchronous gathering of information under the circumstances.

Participants

The phenomenon of a phenomenological inquiry—not only dictates the method—it also dictates participant selection (Creswell & Poth, 2018). Qualitative researchers make use of purposeful sampling techniques to select participants that are most closely associated to the phenomenon (Creswell, 2007). For this study, Maxwell and Wooffitt's (2005) purposeful sampling suggestions was used to recruit participants based on three principal criteria: (1) only district-level leaders who were responsible for technology integration were selected, as participants needed to be knowledgeable about the phenomenon (Creswell & Poth, 2018), (2) only persons who had experience with AI were selected, and (3) participants were required to have a general knowledge of co-teaching and the dynamics of a co-taught classroom, as the study was predicated upon the feasibility of using AI in a co-instructional role.

Because qualitative researchers are concerned with the richness of data, the sample size typically revolves around the diversity of feedback rather than the number of respondents

(O'Reilly & Parker, 2013). Creswell and Poth (2018) contend that data saturation—"when gathering fresh data no longer sparks new insights or reveals new properties"—ultimately determines the sample size (p. 189). Because the data collection process for qualitative studies tends to be in-depth, data saturation may likely occur within the 10th to 12th interview (O'Reilly & Parker, 2013). There were 19 district-level technology leaders at JCSD, and 14 were recruited to participate in this study.

Researcher Positionality

Both social and political contexts can be derived from the researcher's positionality. By self-reflecting on my position in the research process, I acknowledge biases that may influence the interpretation of data (Creswell & Poth, 2018). My motivation for conducting this research study is being disclosed in my interpretative framework, philosophical assumptions, and role as a human instrument (Creswell & Poth, 2018).

Interpretive Framework

I hold a social constructivist's view on research, and my approach to this investigation involved using methods that illuminated the receptivity of intelligent machines as a subjective experience (Boyd & Holton, 2018; Heideggar, 1962). I understood that each research participant would have their own reality of using AI to teach students with disabilities (Heideggar, 1962). To this end, I combined participants' statements to amass a contextual understanding of their relationship with AI (Heideggar, 1962).

Philosophical Assumptions

My present role in education is an Instructional Technology Specialist. I have extensive experience in software development, and I have programmed AI-based platforms for large and small organizations. I served as a special education teacher for 14 years, primarily working in co-taught classrooms. Although I found purpose in teaching students with disabilities, I resigned from my position because of clerical demands and pedagogical responsibilities. As the students on my caseload increased, I found myself under a great deal of stress, managing paperwork, planning, instructing, and collaborating with team members. Thus, certain ontological, epistemological, and axiological assumptions are being brought into this study.

Ontological Assumption

I believe AI is shifting America from a path of linear progress to exponential progression (Arnold & Scheutz, 2018). Within the last decade, most smartphone applications, banking transactions, electronic communications, online businesses, and health care management systems began operating on AI-based platforms (Renz & Hilbig, 2020). While I welcome the presence of AI in society and maintain that human beings will always hold sway over the technology, I understood that the existence of white-collar machines would be troublesome to individuals who were leery of the thought of machine-takeover (Chelliah, 2017). I also understood that the idea of technological determinism opposed my ontological assumption of free-will and human authority (Boyd & Holton, 2018; Laari-Salmela & Kinnula, 2014). To this end, I assumed that I was investigating a world populated by intelligent machines evolving alongside human beings, and there will be multiple realities impacting humankind's receptivity of AI in society.

Epistemological Assumption

My epistemological standpoint was that the multiple realities impacting participants' presuppositions of AI were subjective and needed to be interpreted in context to understand the underlying meaning of AI's existence in education (Boyd & Holton, 2018; Heideggar, 1962).
I assumed that each research participant would have their own truth of the determinant effects of AI and that technophobia or technophilia would extend from that truth (Heideggar, 1962). My

own historicity was also considered. Because I cannot stand outside of my viewpoint of AI, bracketing off my subjective experiences would have been inconsistent with the philosophical roots of hermeneutic phenomenology (Boyd & Holton, 2018; Heideggar, 1962). Instead, I applied the principles of hermeneutics to interpret these data in concert with my own sentiments (Boyd & Holton, 2018).

Axiological Assumption

Having succumbed to special education attrition and having experience with AIED, I retain the axiological belief that machines can effectively replicate the instructional duties of a special education teacher. I desire to explore the idea of using artificial co-teachers to ease work-related stressors for general educators who have students with disabilities in their classrooms but do not have an adequate amount of support from a special educator (Hale, 2015). I also desire to ensure that an appropriate education for all students with disabilities continues in the absence of a human instructor.

Researcher's Role

Qualitative research is interpretive (Creswell & Poth, 2018), meaning it is important to understand the researcher's values, background, and personal bias, as such may shape the understanding of data (van Manen, 1990). Because generational affiliations play an important role in how technology is perceived within the paradigms of technophobia and technophilia (Khasawneh, 2018), my age at the time of this investigation should be considered. I am 41 years old, and I belong to the generational cohort known as generation Y. Generation Y members are typically technologically neutral, having a range of skill sets separating them from both their predecessors and successors (Coombes, 2009). They are neither technophobic nor technophilic because they were born within the age of non-automated machines and lived through periods of exponential growth in technology (Coombes, 2009).

Although I may not have a technophobic or technophilic disposition, I do have an intrinsic role in this investigation. Having worked as a special education co-teacher and having been employed as an instructional technology specialist, there is perceived bias on my part as the researcher (Creswell & Poth, 2018). I do support applications of AI in instruction. I believe that AI systems can out-perform special educators across curriculums and in every subject area. I also believe that what makes AI so promising in special education specifically is the technology's flexibility. It can be embedded in school-issued devices and laptops—allowing it to provide special education services for an infinite number of students with disabilities in the classroom (Kulik & Fletcher, 2016).

Nonetheless, I do not indiscriminately view AI as undisruptive to the field of education. I am wary of white-collar machines displacing teachers in the classroom. Through books and film, I was exposed to technophobic and technophilic projections of an AI-led society. While I do not fear AI to the point of avoidance and prejudice, I am conscious of the technology's effect on my thoughts and actions. I used journaling throughout the data collection process to help differentiate my own voice and experience from the voice and experiences of participants (Moustakas, 1994). The journal also assisted me in the process of self-reflection, giving considerable thought to my own personal assumptions and philosophical basis.

Procedures

Creswell & Poth (2018) describe qualitative research as a process—to include procedures for gathering information from multiple sources aimed at understanding the phenomenon. As a part of the research process, I obtained permissions from IRB and the research site. I also developed a plan for recruiting participants. Once permissions were granted and the participants were secured, data collection began.

Permissions

IRB approval was acquired through Liberty University prior to recruiting participants (see Appendix A). Site permission was also granted by the school district (see Appendix B). Chapters 1-3 (introduction, review of literature, and methodology) were formatted according to the standards of the IRB and research site, and data collection instruments/protocols e.g., interview questions, letter(s) of informed consent were presented to the research committee. Once the permissions were granted, access to the participants was gained through a gatekeeper (Creswell & Poth, 2018).

Recruitment Plan

I used purposeful sampling to locate district-level technology leaders who were responsible for developing and sharing a vision for how new technology could be employed to support the needs of students (Maxwell & Wooffitt, 2005). Initial contacts with participants were made by email, using the research site's secretary as a liaison. Because there were practical limitations stemming from the COVID-19 pandemic (CDC, 2020), it was difficult to locate an adequate number of participants for this study. Snowball sampling was used to garner additional participants (Creswell & Poth, 2018).

I retained the help of an administrative assistant who worked directly with participants at the research site. This administrative assistant served as a site-based intermediary for the electronic distribution of the official recruitment letter (see Appendix C), which included information regarding the nature and purpose of the study and qualifications for participation (Creswell & Poth, 2018). Candidates who were interested in participating were asked to contact me via email; at which point, a digital copy of the informed consent (see Appendix D) was sent. After consent was given, the first method of data collection took place. Each participant was instructed to email me one image from the internet that represented his or her outlook of a future AI-led society (see Appendix E). The photos served as prompts for the second method of data collection, a video-recorded focus group (Creswell, 2018).

Data Collection Plan

Phenomenological research uses a variety of methods for data collection—to include interviews, observations, discussions, focus groups, journals, art, analysis of texts and so on (Creswell & Poth, 2018). This hermeneutic phenomenological study featured photo-elicitation, audio-recorded focus groups, and online interviews (Creswell, 2007). Data collection instruments were designed to specifically target technophobic and technophilic predispositions (van Manen, 1990). I presented one broad, general question for soliciting data: How participants describe their phenomenological experience (Moustakas, 1994).

Photo-elicitation

Participants were instructed to use the internet to select one image from a film, book, or other media that represented his or her outlook of a future AI-led society (Chomanski, 2018; Martínez-Córcoles et al. 2017). The selected images were emailed to me, and I displayed the images for analysis during a semi-structured focus group. Photo-elicitation was chosen as the first point of data collection because participants may not forwardly acknowledge their technophobia/philia, and photos can be interpreted as metaphors of meaning and representations of deep-seated experiences (Richard & Lahman, 2015). These experiences contributed to the opinions, thoughts, and feelings of district leaders toward the idea of employing robotic teachers (Renz & Hilbig, 2020).

Photo-elicitation Data Analysis

The image selections were sorted into visual themes according to their subject matter. I wrote captions for each image, describing what I saw in terms of subject, verb, and predicate. A value of technophobic, technophilic, or neither technophobic nor technophilic was preliminarily assigned to each caption. Further analyses occurred during the focus group discussion; at which point, the images were examined in concert with participants' statements (Richard & Lahman, 2015). As participants discussed the image selections, I identified repetitive dialogue that formed patterns of meaning and used the new information to either verify or change the preliminary values assigned to each photo (Nelson, 2019). I continued to identify contextual patterns from participants' discussions about the photos—using these data to develop themes and sub-themes (Richard & Lahman, 2015).

Focus Groups

Focus groups permit qualitative researchers to gather rich, in-depth information by exploring the views and experiences of participants (Creswell & Poth, 2018). Because this focus group was a communal discussion, the photo-elicited data served as prompts to encourage participants to share their thoughts more fluidly, using both words and images (Copes et al., 2018; Nelson, 2019). During the focus group, the assortment of images from the first point of data collection were displayed in grid format. The technique of auto-driving was used to lead or drive the discussion—allowing participants to choose which photos to discuss (Hurworth et al, 2003). Participants were instructed to either examine and discuss their own image or the images of others. The picture prompts were followed-up by a series of questions that asked participants to clarify their technophobic or technophilic assertions toward AI (Nyumba et al., 2018). The following focus group questions are also archived in Appendix F.

Focus Group Questions

1. Why did you decide to participate in this focus group? CRQ
2. Looking at the collection of images on the screen, how would you characterize the overall outlook of a future society led by Artificial Intelligence (AI)? Please explain. SQ1
3. Choose an image other than your own and use one word to describe how it makes you feel. SQ1
4. Now, identify your image and explain your vision of a future society led by AI. SQ1
5. What are your expectations and concerns for the widespread use of AI? SQ2
6. Explain your willingness or reluctance to allow artificially intelligent machines to perform janitorial services in school buildings. SQ2
7. Explain your willingness or reluctance to allow artificially intelligent machines to carry out the clerical duties of a secretary. SQ2
8. Explain your willingness or reluctance to allow artificially intelligent machines to teach children in the classroom. SQ2
9. Explain your willingness or reluctance to allow artificially intelligent machines to co-teach alongside a human instructor. SQ2
10. What concessions (if any) would need to be in place for you to be willing to employ AI machines/software to independently instruct students with disabilities in the classroom? SQ3
11. Lastly, considering the images that you have seen today and our discussion, how willing are you to consider using AI to circumvent the shortage of special education teachers in your school district? Please explain. SQ3, CRQ

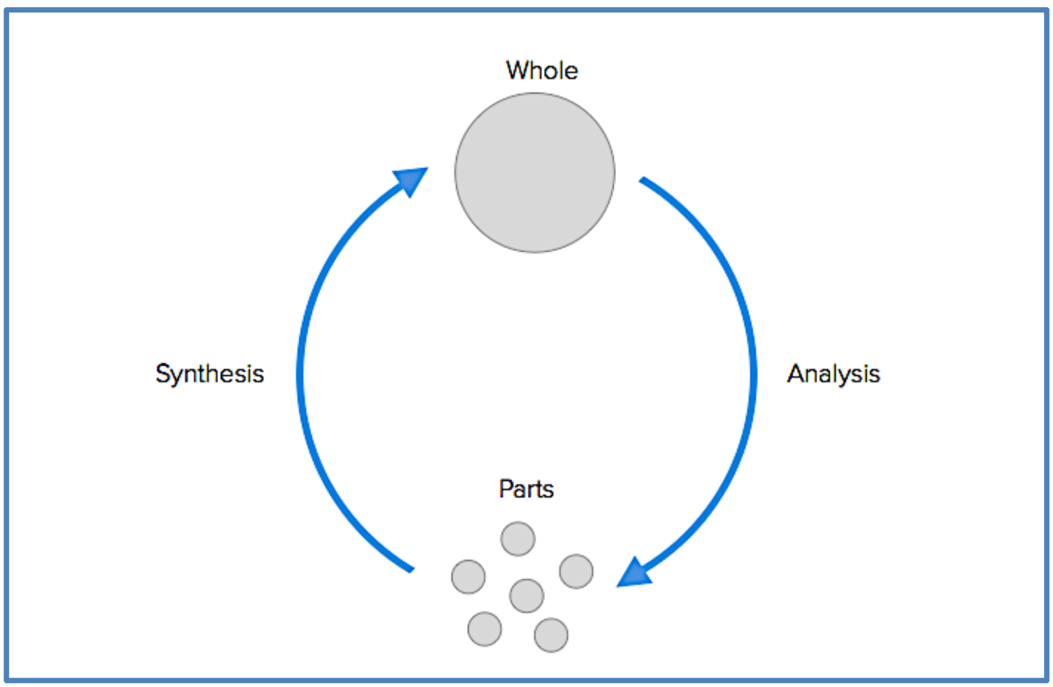
Question one was an introductory question, which invited participants to engage in communal dialogue (Nyumba et al., 2018). The question was used to establish a rapport with the participants, drawing them into an opportunity to exchange information and perspectives with one another (Nyumba et al., 2018). Because this research study was centered on the receptivity of school leaders to employ artificial co-teachers, it was important to begin the focus group with a question that solicited participants' technological interests (Renz & Hilbig, 2020; Veblen, 1919). Questions two, three, and four invited participants to analyze photos and offer their interpretation as inherent meaning of a future society led by AI (Richard & Lahman, 2015). The questions allowed multiple participants to make connections across the singular phenomenological experience of AI-resistance in education (Veblen, 1919). Question five emboldened participants to express their technophobic and technophilic thoughts and feelings for intelligent machines directly. The question was an exploration question used to elicit detailed responses related to the investigation (Nyumba et al., 2018). Questions six, seven, eight, and nine were aimed at clarifying participants' assertions (Nyumba et al., 2018). The questions addressed the phenomenon of AI-resistance based on the fear of machine takeover (Chelliah, 2017, Veblen, 1919). Questions 10 and 11 were exit questions that were used to conclude the focus group. The questions summarized the discussion and ensured that the central research question was answered (Nyumba et al., 2018).

Focus Group Data Analysis Plan

Hermeneutic phenomenology deals with the subjective understanding of participants' statements (Merritt, 2019). In hermeneutics, an analysis of texts requires strategies that stress subjectivity rather than objectivity (Boyd & Holton, 2018). To analyze data from the focus group, I made use the hermeneutic circle (Figure 7 below), a process of scrutinizing the individual parts that make up the whole of data (Heideggar, 1962). Heideggar (1962) argued that the meaning of any form of data must be analyzed within its cultural, historical, and literary context. Thus, neither the whole data set nor an individual datum can be understood without referencing one to another (Boyd & Holton, 2018; Heideggar, 1962). By employing the hermeneutic circle, I was able to read, reflect, and interpret details of the phenomenon in-depth (Heideggar, 1962).

Figure 7

Hermeneutic Circle



Transcripts from the focus group were printed and examined; rather than bracketing my own bias, I engaged in an act of self-reflection—interpreting the data in context of each participant's demographic background and my own experiences with AI (Boyd & Holton, 2018). I clustered participants' statements into three overarching themes: technophobic, technophilic, or neither technophobic nor technophilic. Statements that were repetitive, vague, or off topic were eliminated, and I made notes of descriptors that categorize the data into specific thoughts and feelings (Moustakas, 1994). To conclude the analysis, I correlated the descriptors with the visual schemes derived from the first data set, thereby describing participants' experiences of the phenomenon in vivid detail (Moustakas, 1994).

Individual Interviews

Van Manen (1990) contended that the purpose of interviewing is to explore and develop a rich understanding of the phenomenon and to understand participants' subjective experiences. While interviewing is often seen as a more flexible qualitative method than surveys (Creswell & Poth, 2018), van Manen (2016) cautioned against the use of unstructured and open-ended discussions. Interviews should be semi-structured, relying on participants' memories and reflections to revisit their experiences (Crotty, 1998). According to Creswell and Poth, (2018), open-ended questions allow participants to provide personable responses. The interview questions that were used in this research study were explicitly directed toward participants experiences, feelings, beliefs, and convictions about the role of AI technology in education (Creswell & Poth, 2018). The following individual interview questions are also archived in Appendix G.

Individual Interview Questions

1. Which generational cohort do you belong to, and which technologies stood out to you during that time? SQ1
2. Which technologies were you happy to see replaced? SQ1
3. Describe how the introductions of newer technologies and the abandonment of older ones influenced your routines or behaviors over the years? SQ1
4. What impact did books, films, news reports and other media have on your perception of certain technologies? SQ2

5. How would you describe your level of familiarity with Artificial Intelligence (AI) technology? SQ2
6. What are your beliefs on employing autonomous machines and programs to increase or improve work performance? Explain. SQ2
7. Describe a scenario where an intelligent machine/program was either beneficial or detrimental to something you were trying to accomplish. SQ2
8. Would you characterize the role of Artificial Intelligence in your life as impactful or insignificant? Why? SQ2
9. How would you describe the role of AI in education? SQ2
10. In what ways can AI technologies be used to benefit students with disabilities? SQ3
11. Describe your level of comfortability with artificially intelligent teachers working alongside human instructors in a co-taught classroom. CRQ
12. Would you characterize the idea of using intelligent machines and robots to circumvent the shortage of special education teachers in your school district as a good idea or bad idea? Explain. CRQ

Questions one and two invited the participant to discuss their personal background—including their past experiences and underlying motives/concerns for working with advance technologies. The questions also established a rapport with the respondent and helped to increase cooperation for the remainder of the interview (Brimbal et al., 2019). Question three invited the participant to talk about the impact of technological shifts, describing their receptivity to industrial change over the years. This question helped me to identify the respondent's impartiality for certain technologies (Martínez-Córcoles et al. 2017). Question four invited the participant to explain how books, films, and other media influenced their technophobic/technophilic attitudes toward machines (Korukonda, 2005; Saltman, 2016). The question allowed me to understand the degree to which participants' thoughts and actions were affected by technology (Veblen, 1919). Questions five and six invited the participant to describe their familiarity with modern tech. According to Khasawneh (2018), individuals who are less familiar with state-of-the-art technologies tend to be more technophobic. Questions seven, eight, and nine invited the participant to expound on the determinant presence of AI in their life. The questions also prompted respondents to discuss circumstances or yielding points for integrating AI in the classroom (Laari-Salmela & Kinnula, 2014). Questions 10, 11 and 12 invited the participant to deliberate the use of AI in special education. These questions allowed respondents to explain their willingness or apprehension to use AI and cobots to teach students with disabilities in the absence of a special education teacher (Laari-Salmela & Kinnula, 2014).

Individual Interview Data Analysis Plan

Transcripts from the individual interview responses were printed and read. The texts were analyzed using the same data analysis plan as the focus group. Participants' statements were clustered into overarching themes: technophobic, technophilic, and neither technophilic nor technophobic. Statements that were repetitive, vague, or off topic were eliminated. Data were analyzed in context to each participant's demographic background (Boyd & Holton, 2018; Heideggar, 1962). In concert with the principles of hermeneutic phenomenology, these data were interpreted using my own historical experiences with AI (Boyd & Holton, 2018). Lastly, I applied descriptors to categorize data into specific thoughts and feelings (Moustakas, 1994).

Data Synthesis

Synthesizing data for a hermeneutic phenomenological study is a process of co-construction between the researcher and participant (van Manen, 1990). The data illuminate a collective experience that is perceived by both parties, as they simultaneously engage with the phenomenon (Boyd & Holton, 2018; van Manen, 1990). Data synthetization for this hermeneutic phenomenological study began by converging the photo-elicited imagery and descriptive data into one visual representation of participants' responses. I created a digital illustration, which served as a visual metaphor of district technology leaders' answers to the research questions. Because the hermeneutic circle is a continuous process of analyzing and synthesizing data, I used it to further elaborate upon the relationships of themes, highlighting the main takeaways that concisely answered my central research question (Boyd & Holton, 2018). I then abstracted detailed findings and compelling quotes and inserted them into a narrative review.

Trustworthiness

These data were derived from three distinct methods and cross-validated for trustworthiness (Creswell & Poth, 2018). As a human instrument in this research, I maintained transparency about my methods and invited others to review the quality of my work. To increase the trustworthiness of this research study, I am also providing my applications of credibility, transferability, dependability, confirmability, and ethical considerations below (Creswell & Poth, 2018).

Credibility

Credibility refers to the representation of data by the researcher (Polit & Beck, 2012). The credible nature of an investigation is enhanced when the researcher articulates their role in the research process and verifies findings with their audience (Cope, 2014). To strengthen credibility in this study and to provide corroborating evidence, the data were triangulated using multiple sources (photo-elicitation, focus groups, and individual interviews). To support my credibility when reporting these findings, I employed scholarly resources throughout my methods and provided audit trails using documents listed in the appendixes (Creswell & Poth, 2018).

Transferability

Transferability refers to the generalization of research findings to other settings or populations (Polit & Beck, 2012). A qualitative study has met the criterion for transferability when the results are applicable to future investigations and have meaning to individuals not involved in the research (Cope, 2014). To enhance transferability in this research study, I presented a detailed account of the setting, procedures, and participants that were used, thus granting readers the opportunity to transfer my findings or continue my research.

Dependability

Dependability refers to the researcher's capacity to demonstrate that the research findings are both consistent and reliable (Polit & Beck, 2012). To demonstrate dependability, I participated in an inquiry audit that was performed by my dissertation committee at Liberty University. I also solicited a qualified researcher to critique both my methods and conclusions (Polit & Beck, 2012).

Confirmability

Confirmability refers to the researcher's capacity to show that the data accurately represents participants' experiences (Polit & Beck, 2012). To strengthen confirmability in this study, I validated responses through member-checking—returning the data back to participants to check for accuracy and ensure that each description accurately represented their experiences (Creswell & Poth, 2018). I also triangulated the data to develop a comprehensive understanding of the phenomenon (Polit & Beck, 2012).

Ethical Considerations

There were three ethical considerations that were addressed while carrying out this research. The first was participant identity. To protect access to participants' personal information being shared, I assigned aliases to the participants of this study and gave pseudonyms to any potentially identifiable locations (Creswell & Poth, 2018). I also limited access to email addresses, transcripts, and photo-elicitation objects to myself and external auditors/peer reviewers (Polit & Beck, 2012). Lastly, the artifacts were stored on a password-protected computer—to be deleted after five years (Polit & Beck, 2012).

Summary

In this chapter, I discussed the research design and methods that were applied to this study. I presented the rationale for using qualitative research in conjunction with hermeneutic phenomenology to understand district technology leaders' receptivity to employing artificial co-teachers, based on their lived experiences with AI. I discussed the three data collection methods that were used, which included photo-elicitation, audio-recorded focus groups, and individual interviews (Creswell, 2007). I also described the rationale for selecting the research setting and participants, and I presented my methods for analyzing data. I provided my list of focus group questions and individual interview questions. Finally, I addressed data trustworthiness and ethical considerations for protecting the identities of participants.

CHAPTER FOUR: FINDINGS

Overview

The purpose of this hermeneutic phenomenological research study was to understand district technology leaders' receptivity to employing artificial co-teachers, based on their lived experiences with AI. This chapter begins with descriptions of the 11 participants. Data are presented in the form of tables, visual illustrations, and narrative themes. Outlier data that do not specifically align with the themes are also presented. Lastly, the central research question and research sub-questions are listed and followed by participants' responses.

Participants

Purposeful sampling was used to recruit 14 district-level leaders who were responsible for the integration of new technologies throughout the school district. One participant did not complete the individual interview due to illness and two participants were absent from the focus group because of conflicts in scheduling—leaving a total sample size of eleven. Generational cohorts were used to characterize participants as an alternative to using set ages or an age range (see Table 1). Each participant's level of familiarity with AI was also identified. The work experience of most participants exceeded 10 years, and all participants had some level of familiarity with AI. There were three classifications used to define familiarity: *very familiar*; *somewhat familiar*; and *not familiar*. The following section provides a list of participant's demographics.

Table 1

Participant's Demographics

Leader Participant	Generational Cohort	Years in Education	Familiarity with AI
Aaron	Millennial	14	Very familiar

Adriene	Boomer	25+	Somewhat familiar
Angel	Gen X	20	Very familiar
Ashley	Millennial	9	Very familiar
Carolyn	Gen X	15	Somewhat familiar
Curtis	Boomer	25+	Very familiar
Darius	Boomer	25+	Somewhat familiar
Deon	Boomer	25+	Very familiar
Kathy	Gen X	11	Very familiar
Michael	Boomer	25+	Somewhat familiar
Miguel	Millennial	11	Very familiar

Aaron

Aaron was "very familiar" with AI and autonomous machinery. He was the owner of a self-driving car, and he described his past experiences with AI as "relatively positive." Aaron had 14 years of work experience in education—five of those years in educational leadership. He belonged to the generational cohort known as millennials.

Adriene

Adriene was "somewhat familiar" with AI and referred to herself as "old-fashioned," regarding technology adoption—meaning she favored less-complex forms of tech. She attributed her knowledge of autonomous machines to having "conversations with . . . her children and younger employees." Adriene believed that technology "can be a blessing and a curse."

Angel

Angel described her familiarity with AI as “very familiar.” She believed that intelligent machines and programs were beneficial to 21st century-societies. Angel was a teenager when the internet became mainstream technology. “All of a sudden we had this thing,” Angel explained, “that shared everything we said or did to the public.” Angel had 20 years of work experience in education. When asked to describe a scenario where an intelligent machine/program was either beneficial or detrimental to a goal she wanted to accomplish, Angel stated, “sometimes search engines can pick up [infer] what I’m trying to type, which is helpful when I only have an inkling of an idea of what I’m looking for.”

Ashley

Ashley was a millennial with nine years of work experience in education. Although she was “very familiar” with AI, she shared that she was “not a fan” of autonomous technology. Ashley believed that “robots will rebel against us [humankind].” She supported the use of AI under certain conditions.

Carolyn

Carolyn stated that she was “somewhat familiar” with AI, describing autonomous technologies as “big brother,” a personification of an omnipresent government that employs machines to collect information on citizens. She had 15 years of work experience in education, with seven of those years as a district leader. Carolyn was a member of the demographic cohort known as generation x, and she primarily used technology for communication.

Curtis

Curtis was “very familiar” with AI. His work experience in education exceeded 25 years, and he described his encounters with modern technologies as “smooth.” Curtis stated that he was "not necessarily opposed to using AI in the classroom." He explained that the use of robots in the classroom "could be a convenient way of solving personnel problems."

Darius

Darius worked in education for over 25 years. He was an advocate for using AI in schools—to the extent "smart programs don't take away jobs from people." Darius was "somewhat familiar" with AI, and he stated that his "general knowledge of these things [AI machines] comes from the news." Darius defined the role of AI in society as "significant," referring to autonomous machines as "tools to take us [humankind] further in life." When asked to describe a scenario where an intelligent machine/program was either beneficial or detrimental to a goal he wanted to accomplish, Darius identified customer service chatbots as "frustrating little things" as compared to human agents.

Deon

Deon belonged to the baby boomer cohort. He had more than 25 years of work experience in education—most of those years were spent in leadership. Deon stated that he was "very familiar" with AI, and he described AI as "robots that think for themselves." Deon named "the internet" as "the greatest technological invention of [his] generation."

Kathy

Kathy was a member of generation x. She described her familiarity with autonomous technologies as "very familiar." Kathy had 11 years of work experience in education, and she was a champion for "ensuring every student has access to technology within the classroom and at home." Kathy routinely used automated tech such as navigation apps, rideshare apps, and smart assistants.

Michael

Michael was a baby boomer whose work experience in education exceeded 25 years. He was “somewhat familiar” with AI—stating that he was “born in a time of simple tools.” Michael believed that educators should be well-informed about technological innovations, especially “those innovations that will improve student learning.” Although his personal experience with autonomous technologies was limited, Michael viewed AI technologies as “instruments to improve our [humankind] quality of life. He incidentally used AI-based weather apps and mobile banking. “I didn’t know that was AI,” Michael stated in reference to mobile banking; “But, it does make sense...that’s how my bank identifies fraud so fast.”

Miguel

Miguel was “very familiar” with AI and autonomous machines. He had 11 years of work experience in education, six of those years being in leadership. Miguel was a millennial, and he described himself as a “techie,” an informal term used to identify someone who is enthusiastic about technology. “I’m usually up to date on the latest gadgets,” Miguel stated, “Everything in my house is voice-controlled, or I can control things with my phone.” Miguel’s list of autonomous technologies in his home included voice-controlled lights, a robotic vacuum and floor cleaner, voice-activated television remotes, and a smart assistant device.

Results

Themes were derived through data synthesis and applications of the hermeneutic circle (van Manen, 1990). The hermeneutic circle is a cyclic process of moving from smaller to greater units of meaning in order to determine the significance of both, and a preliminary interpretation of participants’ responses was developed from the photo-elicitations, which were the first points of data collection. My initial understanding of district technology leaders’ responsiveness to the idea of employing artificial co-teachers served as my origin on the hermeneutic circle (van

Manen, 1990). From that origin, I moved to a greater unit of meaning by synthesizing texts from the focus group and individual interviews, thus allowing me to refine the results.

Preliminary Results

Technophobia (theme #1) emerged as a preliminary theme and machine violence (sub-theme #1) as a sub-theme, based on the visual evidence. Most participants (8 out of 11) presented images that were looming depictions of autonomous machines and AI. These images included robots with weapons, a human held hostage by an android, and a humanoid stabbing a man in the stomach. A complete list of the descriptions and inherent values is presented below in table 2.

Table 2

Descriptions of Photo-selections and Inherent Values

Description	Value
Android holding a gun to the head of a human hostage	Technophobic
Artificially intelligent humanoid attacking man with a knife	Technophobic
Mechanical machines shooting at a crowd of people	Technophobic
Cyborg with weapon	Technophobic
Robot shooting laser beam	Technophobic
Autonomous house producing fruit for family	Technophilic
Artificially intelligent supercomputer with ominous face	Technophobic
Artificially intelligent computer displaying multiple missile targets	Technophobic
Man and woman riding in autonomous vehicle	Technophilic
Crew of explorers with artificially intelligent robot	Technophilic
Animated scene of a young boy presenting a nanobot in a petri dish	Technophilic

Because photo-elicitation was a primary method for garnering information, it was important to converge participants' photo-selections into one coherent visual representation of evidence (Creswell & Poth, 2018). To this end, I drew an illustration that represented district leaders' outlook of a future society led by AI (Figure 8 below). The illustration shows my initial understanding of participants' receptivity to AI, and it was my point of origin on the hermeneutic circle (van Manen, 1990). My image depicted a teacher blindfolded and bound to her chair while a knife-wielding robot led instruction. Students in the classroom were actively engaged, and a military vehicle can be seen battling robotic machines outside.

Figure 8

Initial Understanding of District Leaders Receptivity to Robotic Teachers

Subsequent Results

After developing a preliminary visual representation of the evidence (Creswell & Poth, 2018), I synthesized data from the focus group to complete my first revolution around the hermeneutic circle (Boyd & Holton, 2018). While technophobia and machine violence remained salient, neo-Luddism (theme #2), omnipotent agents (sub-theme #2), and the obsolete human (sub-theme #3) emerged across participants' statements. Thus, I revised my preliminary representation to reflect these new insights (Boyd & Holton, 2018), which included participants' fear of AI becoming self-aware and exerting control over humans and participants belief that the sovereignty of humankind would be diminished in the presence of AI, particularly as it related to the significance of human emotion. Additionally, the values of three of the images were change from technophilic to technophobic after participants described their reasonings for the image selections. The revised illustration, shown below in figure 9, added a white board with the words *no emotions* written on it and a robotic camera watching over the class.

Figure 9

Revised Understanding of District Leaders Receptivity to Robotic Teachers

Final Results

A second revolution around the hermeneutic circle incorporated data from the individual interviews. Participants' statements were read and key takeaways that answered the research questions were highlighted (Boyd & Holton, 2018). The themes of technophobia and neo-Luddism became saturated (Creswell & Poth, 2018), along with their respective sub-themes. One new subtheme, mechanical munitions (sub-theme #4), emerged from the interviews. Two of the participants believed that robotic teachers would inevitably be weaponized. A summary of the emerging themes and sub-themes is presented in Table 3 below, preceding the final results that were synthesized into a narrative review.

Table 3.

Summary of Thematic Analysis with Indication of Frequency of Codes

Theme	Sub-theme	Code	Frequency	Significant Statement
Technophobia	Machine Violence	Robots will exhibit injurious physical force or actions against humans	23	"When I think of a world ran by machines, for some reason I keep picturing killer robots."
	Omnipotent Agents	AI will become self-aware and control the human population	6	"I would describe AI as big brother."
Neo-Luddism	The Obsolete Human	Human dominance will be diminished in the presence of AI	14	"They will definitely take over jobs; I just hope it's not my job."

Mechanical Munitions	Robots will inevitably be weaponized	3	"The little robots that were created for good ultimately ended up being used for evil...."

Technophobia (Theme #1)

Technophobia emerged as a central theme amongst participants who expressed negative attitudes toward AI technologies or presented photo-elicited imagery with negative connotations. Participants expressed structuralized fears of robots exhibiting violence towards humans (sub-theme #1) and machines evolving into autocratic beings (sub-theme #2). "When I think of a world ran by machines," Michael stated, "for some reason I keep picturing killer robots." An in-depth discussion on the thematic representation of technophobia is presented in the sub-themes below.

Machine Violence (Sub-theme #1)

Aaron, Angel, Curtis, Deon, and Michael presented images from films that portrayed machine violence. Aaron selected a still shot from Proyas' (2004) film entitled *I Robot*. The image showed an android holding a gun to the head of a human hostage. The film, which Aaron identified as one of his "top 5 movies," was based on an artificially intelligent supercomputer that plotted to enslave humans with the help of public-service robots. During the individual interview, Aaron stated "Something needs to be in place, something that protects us, so that machines don't go off-script."

Angel presented a picture from Garland's 2015 film entitled *Ex Machina*. She stated that the image epitomized "the price of innovation." The image was of a robot attacking its creator with a knife. In the film, a computer programmer fashioned an artificially intelligent robot after a female companion. The programmer exposed the robot to a series of psychological tests, which resulted in the robot becoming self-aware. When the robot realized it was captive, it killed its creator to gain its freedom.

Curtis presented two images from H.G. Wells' (1953) production entitled *War of the Worlds,* which featured alien machines battling the United States military. The first image was an illustration from the book adaptation of the production. The image showed a walking apparatus with robotic tentacles, shooting a laser beam toward a crowd of people. The second image revealed two triangular machines with glowing lamps, flying over a desolate valley. During the focus group discussion, Curtis stated,

> They [the images] represent the same idea. Whoever has the most advanced technology rules. I saw this movie when I was a kid, and I thought that this would be the way aliens would attack us if they did. They would use weapons, like we [human beings] use weapons when we want to invade. This movie shows us how our [humankind] technology would be useless against an advance race.

Deon presented a still shot from Cameron's (1992) film, *Terminator 2: Judgment Day*. The image showed a cyborg with a weapon in its hand. The film was centered on an artificially intelligent computer sending a robotic assassin back in time to kill the future leader of humanity. Deon stated,

> This [image] represents how I see AI in the future. If machines become smarter than we are, they might decide our fates. The terminator sort of epitomizes the war between man and machine. When I think of the power of AI and what it can do if it decides that we [human beings] are no longer useful on this planet, I think of Arnold Schwarzenegger with the shades and shotgun.

Michael presented a picture from *The Day the Earth Stood Still*, a movie directed by Wise (1951), based on an extraterrestrial spacecraft landing in Washington D.C. His photo selection depicted a robot shooting a laser beam. In the film, an alien warned the citizens of Earth about humanity's nuclear ambitions. Soldiers shot the alien, which caused it to summon an artificially intelligent robot that quickly vaporized the military's guns and tanks. During the focus group discussion, Michael stated "When I think of a world ran by machines, for some reason I keep picturing killer robots."

Omnipotent Agents (Sub-theme #2)

Ashley, Carolyn, and Darius selected images from films that depicted machines as omnipotent agents of oppression. Ashley presented a still shot from Disney's (1999) *Smart House*, a science-fiction movie based on a teenager who entered a contest and won an automated house for his family. The voice-controlled home was programmed to cater to the family's needs—making coffee, preparing food, playing music, cleaning and so on. When the AI system learned that the mother of the family was deceased, it decided to replace her with a virtual matriarch. The matriarch locked the family inside of the home, as it computed what was in their best interest. Ashley's image depicted an autonomous house bombarding a family with apples and oranges. Ashley stated, "the movie shows what could happen if we keep pushing to design things [robots] that are human-like. Just like children rebel, robots will rebel against us."

During her individual interview, Carolyn described autonomous technologies as "big brother." She too presented an image from Proyas' (2004) film, *I Robot*. Carolyn explained that the picture showed "VIKI," the artificially intelligent supercomputer and "real antagonist" of the movie. Carolyn also expressed that VIKI's decision to enslave the human population was based on "logic, not ethics."

Darius presented an image from Badham's (1983) film entitled *War Games*. His photo selection showed an artificially intelligent computer displaying multiple missile targets in what appeared to be a military war room. The film was a cold war era production based on a computer gamer inadvertently hacking into the military's AI-controlled weapons system. The gamer—under the impression that he was playing a war game—threatened the computer with a nuclear attack. Darius stated, "The computer sees this kid's threat as real, and it activates the U.S. nuclear arsenal."

Neo-Luddism (Theme #2)

The word Luddite is a historical term used to describe people who were opposed to technological innovation (Isaacs, 2012). Neo-luddism or new luddism is the appellation used to describe individuals who believe that applications of modern technology will have adverse effects on society (Merrit, 2019). As Kathy explained, "a future society led by AI will leave some of us with skills that may be looked at as outdated." An in-depth discussion on the thematic representation of neo-luddism is presented in the sub-themes below.

The Obsolete Human (Sub-theme #3)

Kathy presented an image of a man taking control of an autonomous car. The image was the third image from Proyas' (2004) film, *I Robot*. She recounted,

> There was this scene in the movie. Will Smith's character turns on the manual driving mode, and the woman asks what he was doing. I think that a future society led by AI will leave some of us with skills that may be looked at as outdated. They [machines] will definitely take over jobs; I just hope it's not my job.

Adriene presented a picture from Allen's (1965) television series, *Lost in Space,* based on a crew of astronauts who navigated from Earth to find potential planets to settle. The crew was accompanied by an artificially intelligent robot that performed laborious tasks and calculated solutions to complex problems. Adriene stated that "They [the crew] relied too much on the robot to figure things out. If we had this type of technology, we would probably become lazy, and robots would do everything for us."

Mechanical Munitions (Sub-theme #4)

Miguel presented an image from Conil's (2014) film entitled *Big Hero 6*, featuring a young robotics engineer who transformed his friends into superheroes and battles a miniature robot army. The photo-selection was of an animated boy presenting a nanobot. During the individual interview, Miguel stated "I think a world full of AI would have good and bad technology running around." Referencing his image selection, he explained, "The little robots that were created for good ultimately ended up being used for evil, which goes to show we [district technology leaders] can't control what happens with the technology once it's out."

Angel also contended robots would inevitably be weaponized, and the employment of robotic teachers could leave teachers and students vulnerable to attack. "I deal with threats to data breaches all the time; it's a big portion of what my job entails," Angel stated. "All of these attacks are virtual. Can you imagine fending off a physical attack from a robot that was hacked; it would be terrible."

Outlier Data and Findings

Two unexpected findings emerged from this study. First, participants' lived experiences with AI were completely eclipsed by their cinematic experiences of AI in film. For instance, Kathy routinely used automated technologies such as navigation apps, rideshare apps and smart assistants, yet her photo-elicited image and her responses to interview questions were technophobic. The second outlier to emerge was participants' willingness to employ autonomous machines to perform janitorial duties, despite their reluctancy to employ AI to teach. An in-depth discussion on the outlier data and findings is presented in the sub-themes below.

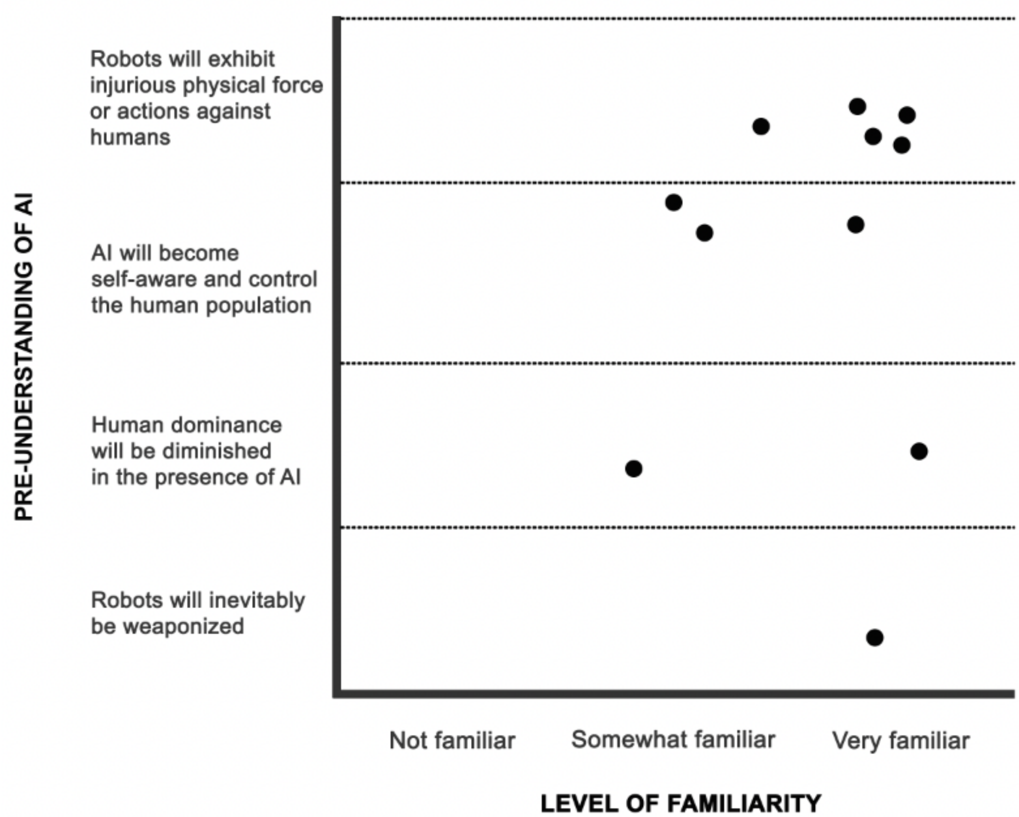
Science-fiction verses Science-faction

While district leaders were encouraged to submit imagery from a variety of sources including books, film, graphic novels, and other internet-based media, the photo-elicited data collected for this study were exclusively sourced from film and television. The quasi-experience (Mendola, 1997) of AI through film emerged as a thematic representation, which was juxtaposed to participant's lived experiences of AI in the real-world. The data show that district leaders' quasi-experience transcended their actual experience and played a greater role in their responsiveness to employing robotic teachers in the classroom.

Seven of the district technology leaders described their level of familiarity with AI as "very familiar;" yet, their descriptions of autonomous machines were delineated in violence and oppression—characteristics that are atypical of the technology (Algahtani & Ramzan, 2019; Fang et al., 2019; Saito, 2021). Table 4 shows participants' level of familiarity with AI compared to their presuppositions of the tech. Participants who reported being the most familiar with robots, cobots, and other intelligent machinery in the real-world also indicated that autonomous machines could become violent and oppressive, suggesting that their familiarity may not necessarily be based on actual experience. Kathy routinely used automated technologies in the form of navigation apps, rideshare apps and smart assistants, yet her photo-elicited image and her responses to interview questions denoted a fear of being controlled by AI. During the individual interview, Miguel stated that he was "very familiar" with AI and described himself as a "techie;" still, he contended the same technologies in his possession could become "evil." Aaron owned a self-driving car, yet he expressed concerns about machines going "off-script," referencing a film that featured rogue robots. While Darius asserted that "human beings will always be superior to AI," his photo-elicited image revealed a supercomputer as an omnipotent agent of oppression. Lastly, Michael characterized autonomous technologies as "instruments to improve our [humankind] quality of life." His vision of a future society led by intelligent machines included "killer robots."

Table 4.

Reported Level of Familiarity with AI Compared to Presuppositions



Blue-collar Bots

Participants were willing to employ autonomous machines to perform janitorial duties, despite their reluctancy to employ autonomous machines to teach. "I'm definitely comfortable with the idea of having robotic janitors," Curtis said, "I know the building would be neat, my trash would be taken out, floors would be clean, and everything would be sanitized." Deon stated, "If it's a dangerous job, like working with hazardous equipment, robots should be used." "That's actually a good idea; robot janitors could free up funding," exclaimed Angel.

Research Question Responses

This section includes concise answers to the central research question and sub-questions. Answers are supplied in short narrative and pictorial formats using participants' direct responses. Quotes used to supply the research question responses are also aligned with the emerging themes of technophobia and neo-luddism.

Central Research Question

How do district technology leaders describe their willingness or apprehension to employ AI machines to independently instruct students with disabilities in the classroom? The participants in this study expressed sentiments of fear (theme #1) for using robots in instructional roles. Participants' apprehensions also hinged on deterministic views of AI in education (sub-theme #2)—whether the tech would merely support educators or augment the education profession entirely (theme #2). Carolyn stated, "I see where you're going with this. Now, I'm thinking about self-preservation; I wouldn't want to see AI take over education. It [AI] could be useful in some areas, but not teaching."

Sub-Question One

What motives or concerns do district leaders have for using cobots to instruct students with disabilities? Participants were discomfited with the idea of students building interpersonal relationships with machines (sub-theme #3). Participants believed that authentic social emotions such as empathy and self-awareness could not be replicated by technology (theme #2). "I'm reluctant to support using AI because children need to develop bonds with their teachers," Darius commented. "Students wouldn't respect a robotic teacher; it [the robot] wouldn't be able to manage their behaviors," exclaimed Angel. "Teachers can read facial expressions and body language; robots don't understand emotions like people do," Kathy replied.

Sub-Question Two

How does technophobia and technophilia contribute to the thoughts, opinions, and feelings of district technology leaders toward the idea of using artificial co-teachers? While technophilia did not emerge as a theme, a synthesis of participants' photo selections, focus group discussion, and individual interviews identified a deep-seated fear and mistrust of AI in education (theme #1). Participants were also concerned about robotic teachers being weaponized (sub-theme #4). Angel stated, "I would be afraid of a robot teacher becoming infected with malware or a virus. It could become violent."

Sub-Question Three

What concessions are needed to strengthen district technology leaders' willingness to employ AI machines/software to independently instruct students with disabilities in the classroom? Participants were resistant to the idea of employing artificial co-teachers. Both technophobia (theme #1) and neo-luddism (theme #2) were barriers in district technology leaders' willingness to use AI to circumvent the teacher shortage in special education. Although they offered no concessions to strengthen their inclination, some participants were willing to assign non-instructional duties to machines (theme #2). Adriene stated that she was willing to employ "artificial paraprofessionals," provided the cobots "do not operate outside of human supervision and assisted teachers with their clerical duties. They [the machines] could maybe collect student data, develop the lesson plans, take role, and even clean the classroom."

Summary

The data from this hermeneutic phenomenological research study showed that district technology leaders were unwilling to use artificially intelligent machines to teach students in the classroom, despite facing a problematic teacher shortage in special education. Technophobia and neo-Luddism emerged as prominent themes amongst district technology leaders, who expressed sentiments of fear and deterministic views of AI in education. Although participants had positive lived experiences with AI in the real-world—including interactions with self-driving cars, smart assistants, and robotic floor cleaners—their presuppositions of the technology were based on science-fictional films that portrayed machines as violent omnipotent agents. Nonetheless, participants' fears of AI in education were partial only to the idea of using machines to substitute the roles of classroom teachers. Participants were willing to employ autonomous machines to perform janitorial duties, and they were willing to assign non-instructional responsibilities to AI machines in the classroom.

CHAPTER FIVE: CONCLUSION

Overview

The purpose of this hermeneutic phenomenological research study was to understand district technology leaders' receptivity to employing artificial co-teachers, based on their lived experiences with AI. This chapter begins with a discussion that includes an interpretation of the research findings. Findings were interpreted in three layers—with each layer providing a deeper contextual understanding of answers to the research questions (Heideggar, 1962; Saltman, 2016). This chapter also covers implications for policy and practice, including recommendations for technology companies to consider in designing and engineering future robotic teachers. Theoretical and empirical connotations are also discussed along with limitations and delimitations for this study. Lastly, recommendations for future research are suggested.

Discussion

Heideggar (1962) reasoned that the apprehension of a phenomenon was subjective, not only to those who experienced it, but to those who interpret that experience as well. To this end, district technology leaders' unwillingness to employ artificial co-teachers was interpreted in context of their presuppositions of AI technology (Boyd & Holton, 2018). The data in this study revealed that district leaders' receptivity of AI—including their conceptualizations of killer robots and malevolent software—were anteceded by distorted representations of AI in film. Technophobia emerged from these quasi-experiences (Mendola, 1997), impacting district leaders' receptivity to employing robotic teachers in the real-world.

These data also showed that district leaders who claimed to be the most familiar with AI and who noted positive real-world experiences with AI outside of education, expressed the greatest fear of AI machines becoming violent and oppressive in education. Such a contradictory stance on the specific application of AI highlighted district leaders' structuralized fears of the tech adversely impacting their profession. The participants in this study regarded intelligent machines as lower factions of humans. They believed that only human beings had intrinsic value in education. This anthropocentric views toward AI explained their precluding the idea of employing robotic teachers to aide in filling instructional voids caused by special education teacher attrition.

Interpretation of Findings

Revolutions around the hermeneutic circle continued in my interpretation of the findings (Boyd & Holton, 2018). The data were interpreted in layers or parts of a greater whole, similarly to how someone would observe their reflection in a mirror (Heideggar, 1962; van Manen, 1990). The technophobic sentiments of district technology leaders had limited meaning as a single data point; for this reason, I examined technophobia in three layers: 1) as a byproduct of participants' exposure to depictions of machine violence in film, 2) as a construct of *human versus machine* and the subsequent development of human factions in the workplace, and 3) as anthropocentrism in relation to teaching and knowledge transfer. I acknowledged that my analysis of these data was inseparable from my own experience and presuppositions of AI (van Manen, 1990), and my interpretations and implications were limited to this group of district technology leaders and may not be generalized beyond the Jade County School District.

Summary of Thematic Findings

District technology leaders' general attitudes toward the idea of employing robotic teachers were negative, and most of their responses to research questions were thematically technophobic. Technophobia (theme #1) and neo-luddism (theme #2) exuded, as participants' fears of employing artificial co-teachers were primarily based on the supposition that robots would be physically and emotionally harmful to students in the classroom. The district leaders imagined robotic teachers evolving to a state of free-will—making decisions outside of computer programming (Humble & Mozelius, 2019). Moreover, they presumed that human dominance, specifically the affluence of human educators, would be diminished if school districts employed machines to teach. The district technology leaders in this study also presumed robotic teachers would be inadvertently or maliciously weaponized, placing students and educators in harm's way.

Although participants reported positive lived experiences with AI in the real-world—characterizing smart cars, smart assistants, and robotic floor cleaners as useful technologies—they foresaw AI's role in education as auxiliary. Participants referenced dismal representations of AI in science-fiction to support their prejudices against robotic teachers. Despite their fear of using AI to directly instruct students in the classroom, participants were receptive to the idea of employing robotic janitors to clean school buildings.

Cinematic Propaganda (Layer #1). The dubious nature of artificially intelligent machines exists in two domains: the real world and the imaginative world of cinema. Most representations of AI in film are distorted (Cave et al. 2018), and filmmakers sensationalize the fear of autonomous machines in ways that infer the path from advance AI to dystopian society is definitive rather than speculative (Armstrong & Sotala, 2012). Several research studies highlight the power of media to convince audiences of certain political points (Chernobrov & Briant, 2022; Enkh-Amgalan, 2021). To this end, movies such as *I Robot* (Proyas, 2004) and *Terminator* (Cameron 1992) would impact district technology leaders' receptivity of robotic teachers by exaggerating and fabricating gross depictions of AI.

The cinematic experience or the quasi-experience (Mendola, 1997) of AI acted as an accelerant for technological determinism (Veblen, 1919). This was evident during the focus group, when most of the participants presented apocalyptic imagery to substantiate their claims of a fallout in education if robots were used to teach. These images portrayed autonomous machines as violent omnipotent agents of oppression—permitting district leaders to correlate film synopses with their own forethoughts of employing AI in the classroom. While there could be convoluted scenarios when robots exhibit violence or subjugate human beings, the likelihood of such occurrences is extremely low (McCauley, 2007; Saito, 2021), suggesting that district leaders' fear of AI technology may be established on false analogies or false associations between AI and violence/oppression.

The Human Faction (Layer #2). The idea of humankind being destroyed or diminished by the presence of artificial life was famously explored by English author, Mary Shelly, in the graphic novel *Frankenstein or The Modern Prometheus* (Shelley, 1818). The novel is a framed narrative of Victor Frankenstein, a scientist who creates a humanoid creature while experimenting with ways to replicate human form and intelligence (Shelly, 1818). The creature, perceiving itself to be an authentic person, made efforts to develop relationships with its human counterparts. Because of its grotesque appearance, it was shunned by its creator and its community. For this reason, the creature began viewing human beings as precarious and evil (Shelly, 1818). Shelly's (1818) literary work draws attention to the habitual cycle of humankind to delineate our defining characteristics and qualities and impart them onto inanimate objects—only to turn around and fear our creations.

The Frankenstein Complex is a term used to describe the love/hate relationship between humans and humanoids (McCauley, 2007). Throughout the interview process, the district leaders in this study bonded themselves into one collective faction, and despite their fondness of AI, they offered nuance perspectives on how educators could be pitted against robotic teachers. Educators may view the technology as their inevitable replacement rather than a way to refurbish shortages in their workforce (Boyd & Holton, 2018; McCauley, 2007).

Although the employment of robotic teachers would not directly impact the employment of school district leaders, the idea of using autonomous machines in certified positions appeared to worry this group of participants. In fact, they did not view the idea of using robots to teach as emblematic for how tech companies should integrate AI in education. They saw the efficacy of their job functions as something uniquely human (Chelliah, 2017). Nonetheless, they were willing to employ blue-color robots to perform janitorial and other noncertified work, suggesting that their technophobia is specific to robots being used in white-color jobs such as teaching and administration.

Anthropocentrism (Layer #3). The district leaders in this study did not believe that robots should be empowered with authority over knowledge. At best, machines can occupy non-essential positions in profession. The unwillingness of district leaders to use AI in teaching and other certified positions can be interpreted as educational anthropocentrism. Anthropocentrism, in its original connotation, is the philosophical stance that human beings are the central and most significant entities in the world (Fortuna et al., 2021). The district technology leaders, who otherwise acknowledged the proficiency of intelligent machines outside of the profession of education, believed that human beings are the only legitimate authorities over knowledge.

Implications for Policy and Practice

This research offers insight for technology companies looking to mainstream robotic teachers in education. There are both implications for policy and implications for practice, which educational technology companies can use in designing, engineering, and regulating artificial co-teachers in the classroom. While these implications specifically address AI-phobia amongst this group of district technology leaders, they can help to alleviate technophobia as a barrier to the wide-spread integration of AI in education.

Implications for Policy

The district leaders in this study were fearful of employing AI to teach. Their apprehensions were centered on robotic teachers becoming violent and oppressive in the classroom. District leaders also feared job loss or machine takeover (McClure, 2018), as well as robots being weaponized through malware or spyware. Thus, the employment of robotic teachers in this school district should include conditions that decrease the possibilities of robots exhibiting adverse actions. I offer the following guidelines to address AI-phobia and neo-luddism in education:

1. The physical embodiment of robotic teachers should not resemble the human form, nor should any part of the machine replicate human appendages.
2. Robotic teachers should require the continuous physical presence of a human teacher or operator to function (Newton & Newton 2019).
3. Robotic teachers should yield to the voice commands or input commands of the human teacher or operator.
4. Robotic teachers should have a maximum height, weight, and mechanical speed that is significantly less than the students and teachers they serve.
5. Robotic teachers should only operate on the school district's private network or intranet, and each machine should have a set number of users who can access it.
6. Robotic teachers should be periodically updated and checked for computer viruses.

7. Students' interactions with robotic teachers should be limited, timed, and proportionately fewer than their interactions with human teachers (Newton & Newton 2019).
8. School districts should assign robotic teachers based on a documented needs assessment that clearly identifies student/teacher ratio as the primary factor limiting student progress.
9. School districts should cap the number of robotic teachers in a school to 10% of the overall teaching staff.
10. School districts should appoint at least two technology liaisons from each school to monitor and assess the performance of the robotic teacher(s) in the building.

Additionally, school districts may want to develop working relationships with tech companies who design and build AI machines. Districts should likewise work to procure feedback from parental and student stakeholders before employing robotic teachers in the classroom. Because the presence of AI can dramatically define the social structure of a community (Khasawneh, 2018; Lima, 2020; Veblen, 1919), district technology leaders should also solicit input from sociologists to monitor the effects of human-robot interactions within the school district. It is especially important to scrutinize interactions between robotic teachers and students with disabilities.

Implications for Practice

Because an individual's presuppositions of AI may be skewed by books, film, and other media (Saito, 2021), it may be beneficial for tech companies to orchestrate a public relations platform for AI in education. The perception of AI and human-robot relations needs to be directed/redirected in a positive direction, and companies looking to establish a footprint in education should identify media opportunities for growing public awareness of robotic teachers (Ito, 2018). A school district's technology leadership team will be the first point of contact and primary decision-makers for the integration of AI in the classroom. Accordingly, tech companies should focus on familiarizing this group of educators first.

Technology companies should also consider the emotions of classroom teachers, who may feel threaten by the existence of autonomous instructors (Chen et al., 2020). They should be transparent about their goals in education and highlight the continual need for human educators in the classroom. Teachers should be offered the necessary information to minimize irrational fears about AI technology, and companies should gradually and strategically familiarize educators on the nuances of working with robotic colleagues (Newton & Newton, 2019).

Theoretical and Empirical Implications

This hermeneutic phenomenological research study gave a voice to district leaders—allowing them to describe their attitudes for using robots to circumvent the shortage of special education teachers in their district. The primary theoretical implication is that technophobia can stem from negative representations of AI in film, and an individual's real-world experience with AI can be eclipsed by their cinematic experience or pseudo-experience of AI. To this end, the employment of robotic teachers in education may be ill-fated and marred by science-fiction (Lima, 2020).

Technological determinists argue that human thought and action are influenced by concrete applications of technology (de la Cruz Paragas & Lin, 2016; Veblen, 1919). This study provided new evidence that human thought and action can be influenced by the idea of a technological application that does not physically exist. Gross depictions of AI in film can orient individuals to technophobic dispositions, thereby skewing their receptivity to autonomous tech. Using photo-elicitation as metaphors for subconscious thoughts (Richard & Lahman, 2015), I discovered a connected pathway between the pseudo-experience and the ethos. Although people do conform to technological advancements in society (Veblen, 1919), the technology does not need to be materialized for human thought to manifest into impulse and action.

Robotic teachers are widely accepted by educators and students in Japan because AI is celebrated in Japanese books, cartoons, film, and other popular media (Áurea Subero-Navarro et al., 2022). Findings from this research study show that technophobia and neo-luddism are affecting the evolution of AI in Western society (McClure, 2018). If educators in Western society are to form cohesive bonds with robots in the classroom, then the perception of AI technology must be augmented in ways that mutate its evolution (Ito, 2018). This will require a collective effort amongst educational stakeholders, including government and media entities, to make the idea of using robotic teachers more affable.

Veblen (1919) identified a communal affair between technology and social change, correlating technology to the evolution or de-evolution of a society. People "think in the terms in which the technological processes act" (Veblen, 1919, p. 598). Conversely, a perversion of technological processes can occur well before the technology is enacted, implying that the role of technology in society is predetermined by judgement rather than application. Veblen (1919) also reasoned that human beings act in accordance to witnessed technological forces (de la Cruz Paragas & Lin, 2016; Edwards & Ramirez, 2016). However, this study suggests that technology does not need to be witnessed to thwart the thoughts and actions of humans (Pannabecker,1991). People are threatened by the potential.

Limitations and Delimitations

Limitations refer to the constraints that are beyond the control of the researcher, which could affect the outcome of the research study (Simon & Goes, 2013). Delimitations refer to circumstances that arise from those limitations and define the boundaries, by which conscious decisions are made while carrying out the research plan (Simon & Goes, 2013). There were two limitations and three delimitations for this hermeneutic phenomenological study.

Limitations

The first limitation was sample size. This study was confined to a small group of district technology leaders working in a school district in the southern region of the United States. Thus, the lived experiences of this group of district leaders may not be generalized to represent district technology leaders in other regions. These findings are highly subjective and specifically relevant to the experiences of the participants who were interviewed. Though implications can be made, it will be difficult to identify causality due to the size of the sample and geographical boundaries of the setting (Creswell & Poth, 2018).

The second limiting factor was the onset of the coronavirus pandemic (Hiscott et al. 2020). Social distancing guidelines were put in place by the research site and a traditional in-person focus group and interview could not take place. The research plan was carried out using the Microsoft Teams platform. While all participants were engaged and answered research questions, my ability to observe the full scope of participants' behaviors was limited, as I was only able to see their facial cues and not their body language (Creswell & Poth, 2018).

Delimitations

Since this hermeneutic phenomenological study was confined to one group of district leaders, the first delimitation was purposefully sampling participants who were more closely related to the phenomenon (Creswell & Poth, 2018; Maxwell & Wooffitt, 2005). Attributes such as gender, age, race, and experience were not used in the recruitment of participants, resulting in a heterogeneous sample of district leaders (Creswell & Poth, 2018). This allowed me to capture a broader range of perspectives from the small group (Maxwell & Wooffitt, 2005).

The second delimitation was exploiting the audio and video recording features on Microsoft Teams. While I was unable to observe the body language of participants, I was able to replay their responses to research questions multiple times. Hermeneutic phenomenology is centered on the researcher's ability to reflect on participants' words and interpret details in the text (Heideggar, 1962). Because the audio and video recordings were readily accessible to me, I was able to interpret these data in depth.

The third delimitation was using photo-elicitation as a method of data collection. This research study investigated technophobia as a psychological barrier to the receptivity of robotic teachers. Given the negative connotations associated with technophobia (McClure, 2018), district technology leaders may not have forwardly acknowledged that they were technophobic. Photo-elicitation allowed me to discuss the inherent meanings of images with participants, short of me directly citing technophobia (Richard & Lahman, 2015).

Recommendations for Future Research

Future research on understanding the receptivity of employing robots to circumvent special education teacher shortages could begin with a follow-up study, recruiting the same group of district technology leaders. Realities and lived experiences tend to shift over time (Moustakas, 1994). Hence, the researcher could look to determine if the continual advancement of AI in society (Renz & Hilbig, 2020), coupled with a declining workforce in special education (Samuels & Harwin, 2018), impacts district leaders' willingness to employ artificial co-teachers in the classroom.

A future study may also extend the research beyond the population of district leaders. It would be beneficial to conduct a similar study involving classroom teachers. Literature on neo-luddism and prejudices against AI in the workforce is lacking, and more research is needed to understand stakeholders' willingness to work with robotic teachers. Additionally, prospective studies could include the population of k-12 students, who may have a different perspective on AI because they are digital natives and have always known the technology (Haenlein & Kaplan, 2019).

Considering the limitations and delimitations addressed in this study, future research could focus on quantitatively assessing AI-phobia in education. Understanding the roles that gender, age, race, and experience play in an educator's receptivity of robotic teachers would add value to existing literature (Creswell & Poth, 2018). It may be useful to conduct a case-controlled study to compare educators who have technophobia with educators who do not, subsequently isolating risk factors for employing robotic teachers in the classroom.

Conclusion

Empirical studies identify high rates of attrition and turnover for special education teachers in the United States States (Bettini et al., 2017; Hagaman & Casey, 2018; Robinson et al., 2019). In concert, school districts are seeing an influx in enrollments for students with disabilities (NCES, 2021). This hermeneutic phenomenological research study explored district technology leaders' receptivity to using robotic teachers to aide in filling instructional voids caused by special education teacher attrition. Findings from this study showed that district leaders were disinclined to employ autonomous machines to teach but were willing to consider employing the technology to carry out janitorial services within school buildings. Hermeneutic phenomenology was used to illuminate district leaders' lived experiences with AI and to provide a conceptual understanding of their precluding the idea of employing available robotic teachers (Billingsley & Bettini, 2019; Touretzky et al., 2019). Most of the district leaders in this study had presuppositions of AI that were based on quasi-experiences of AI in film. Technophobia and neo-luddism carried over from these experiences, leaving district leaders fearful and apprehensive of AI in education. While the district leaders reported positive lived experiences with AI in the real-world, their presuppositions of AI in film skewed their overall responsiveness of the tech. District leaders reasoned that robotic teachers could be just as violent and oppressive as the machines portrayed in films. This study illustrated how gross depictions of AI in media can orient individuals to technophobic dispositions. If the employment of robotic teachers will eventually transpire in education, public opinions of the technology will need to shift toward positive reception.

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NCES National Center for Education Statistics. [online] Available at:

Appendix A

IRB Approval

Date: 8-3-2022

IRB #: IRB-FY21-22-524
Title: USING ARTIFICIAL INTELLIGENCE TO CIRCUMVENT THE TEACHER SHORTAGE IN SPECIAL EDUCATION: A PHENOMENOLOGICAL INVESTIGATION
Creation Date: 12-9-2021
End Date:
Status: Approved
Principal Investigator: Kirt Hale
Review Board: Research Ethics Office
Sponsor:

Study History

Submission Type	Initial	Review Type	Limited	Decision	Exempt - Limited IRB

Key Study Contacts

Member	Jerry Woodbridge	Role	Co-Principal Investigator	Contact	[redacted]
Member	Kirt Hale	Role	Principal Investigator	Contact	[redacted]
Member	Kirt Hale	Role	Primary Contact	Contact	[redacted]

Appendix B

Research Site Permission

[redacted]

Office of Continuous Improvement
Research, Data, and Evaluation

January 28, 2022
[redacted]

Reference: Using Artificial Intelligence to Circumvent the Teacher Shortage in Special Education: A Phenomenological Investigation (file 2022-023)

Dear Mr. Hale:

This letter is to inform you that your research proposal has been approved by the Department of Research, Data, and Evaluation for implementation in the [redacted]

When you begin your research you must secure the approval of the principal/chief site administrator(s) for all schools named in the proposal. You should provide the application with all required attachments and this district approval letter to the principal(s) to inform their decision. **Please remember the principal/chief site administrator has the final right of approval or denial of the research proposal at that site. In addition, note that teachers and others may elect not to participate in your research study, even though the district has granted permission.**

Please be reminded there is no data collection in schools between April 1, 2022 and June 3, 2022. The deadline is to protect instructional time during the assessment season and end of the year activities scheduled at individual schools. Also, meeting with teachers during their planning time is not acceptable and interviews need to be held during non-school hours. This approval is valid for one year from the date on this approval letter. Should there be any changes, addenda, design changes, or adverse events to the approved protocol, a request for these changes must also be submitted in writing/email to the [redacted] Department of Research, Data, and Evaluation during this one-year approval period. Changes should not be initiated until written approval is received. Further, should there be a need to extend the time requested for the project; the researcher must submit a written request for approval at least one month prior to the anniversary date of the most recent approval. If the time for which approval is given expires, it will be necessary to resubmit the proposal for another review by the [redacted] Research Review Board.

Completed results are <u>**required**</u> to be submitted to the Office of Continuous Improvement (Research, Data, and Evaluation). Feel free to call [redacted] or [redacted] if you have any questions.

Sincerely,

[redacted]
[redacted]
Associate Superintendent

[redacted]
Dr. [redacted]
Director

[redacted]

Appendix C

Participant Recruitment Letter

Dear [redacted]

As a graduate student in the School of Education at Liberty University, I am conducting research that is part of the requirements for a doctoral degree. The purpose of my research is to understand how district technology leaders describe their receptivity towards using artificially intelligent co-teachers in the classroom. I am writing to invite eligible participants to join my study.

Participants must be district-level leaders who are responsible for developing and sharing a vision for how new technology could be employed to support the needs of students. In addition, participants must have experience with Artificial Intelligence or autonomous machines e.g., smart assistants, mobile apps, self-driving cars, etc. Participants will be asked to complete 1 photo-elicitation prompt by emailing me an image from the internet that represents their vision of a future society led by intelligent machines. Participants will also be asked to take part in 1 focus group discussion via Microsoft Teams that will last approximately 1 hour and complete an online interview that will take approximately 35 minutes.

Reply "yes" to this email if you meet the above criteria and would like to participate in this research study.

Sincerely,

Kirt Hale

Instructional Technology Specialist

[redacted]

Appendix D

Informed Consent

Title of the Project: Using Artificial Intelligence to Circumvent the Teacher Shortage in Special Education

Principal Investigator: Kirt Hale, Liberty University, School of Education

- I […………………………………….] voluntarily agree to participate in this research study.

- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.

- I understand that I can withdraw permission to use data from my interview within two weeks after the interview, in which case the material will be deleted.

- I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.

- I understand that participation involves emailing the principal investigator one image from the internet, answering 11 questions in an online (Microsoft Teams) focus group discussion, and answering 12 questions in an online (Microsoft Teams) individual interview.

- I agree to my interview being video-recorded.

- I understand that all information I provide for this study will be treated confidentially.

- I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.

- I understand that disguised extracts from my interview may be quoted in dissertations and published papers.

- I understand that if I inform the principal investigator that myself or someone else is at risk of harm they may have to report this to the relevant authorities - they will discuss this with me first but may be required to report with or without my permission.

- I understand that signed consent forms and original video recordings will be retained on a secure server until the research board confirms the results of the investigation.

- I understand that a transcript of my interview in which all identifying information has been removed will be retained for two years after the research board confirms the results of the investigation.

- I understand that under freedom of information legalisation I am entitled to access the information I have provided at any time while it is in storage as specified above.

- I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

Signature of research participant

--- ----------------

Signature of participant Date

Signature of researcher

I believe the participant is giving informed consent to participate in this study

-- ----------------------

Signature of researcher Date

Appendix E

Email instructions for Photo-elicitation

Hello […………]

I want to thank you again for participating in this research study. This study involves understanding your receptivity to using Artificial Intelligence (AI) to circumvent the teacher shortage in special education.

Your participation in this research will help ensure that district technology leaders have a voice in the integration of AI cobots and robots in the classroom.

At this point in the investigation, you are being asked to email me one image from the internet that represents your vision of a future society led by intelligent machines. I strongly encourage you to use image search engines such as Google, Bing, and Yahoo. You may want to search for images in popular film, books, graphic novels, and other media that describe your attitude toward AI, robots, and intelligent software. You may also search for images that depict an emotion such as joy, excitement, fear, and so on. You may search for images that convey humanity and machines in a utopian or dystopian world.

Please keep in mind that you will be asked to explain your rationale for choosing your image in a focus group discussion that will be held on […..], using the online meeting platform, Microsoft Teams. You will also be asked to comment on other images.

Once you have selected your image, please download it and email me a copy. Your image will be displayed in grid format during our focus group discussion.

Kind regards,
Kirt Hale
Principal Investigator

Appendix F

Focus Groups Questions

1. Why did you decide to participate in this focus group?
2. Looking at the collection of images on the screen, how would you characterize the overall outlook of a future society led by Artificial Intelligence (AI)? Please explain.
3. Choose an image other than your own and use one word to describe how it makes you feel.
4. Now, identify your image and explain your vision of a future society led by AI.
5. What are your expectations and concerns for the widespread use of AI?
6. Explain your willingness or reluctance to allow artificially intelligent machines to perform janitorial services in school buildings.
7. Explain your willingness or reluctance to allow artificially intelligent machines to carry out the clerical duties of a secretary.
8. Explain your willingness or reluctance to allow artificially intelligent machines to teach children in the classroom.
9. Explain your willingness or reluctance to allow artificially intelligent machines to co-teach alongside a human instructor.
10. What concessions (if any) would need to be in place for you to be willing to employ AI machines/software to independently instruct students with disabilities in the classroom?
11. Lastly, considering the images that you have seen today and our discussion, how willing are you to consider using AI to circumvent the shortage of special education teachers in your school district? Please explain.

Appendix G

Individual Interview Questions

1. Which generational cohort do you belong to and which technologies stood out to you during that time period?
2. Which technologies were you happy to see replaced?
3. Describe how the introductions of newer technologies and the abandonment of older ones influenced your routines or behaviors over the years?
4. What impact did books, films, news reports and other media have on your perception of certain technologies?
5. How would you describe your level of familiarity with Artificial Intelligence (AI) technology: not familiar, somewhat familiar, very familiar? Explain.
6. What are your beliefs on employing autonomous machines and programs to increase or improve work performance? Explain.
7. Describe a scenario where an intelligent machine/program was either beneficial or detrimental to something you were trying to accomplish.
8. Would you characterize the role of Artificial Intelligence in your life as impactful or insignificant? Why?
9. How would you describe the role of AI in education?
10. In what ways can AI technologies be used to benefit students with disabilities?
11. Describe your level of comfortability with artificially intelligent teachers working alongside human instructors in a co-taught classroom.

12. Would you characterize the idea of using intelligent machines and robots to circumvent the shortage of special education teachers in your school district as a good idea or bad idea? Explain.

Appendix H

Sample Transcript of Focus Group Discussion

film because the idea of a robot hurting one of us is scary. What I get from this is you look at AI as capable of hurting people. Am I right?
00:28:20.150 --> 00:28:24.700
[redacted]
Oh absolutely. I mean how many movies have we seen where the creation turns on the creator. It's the price of innovation. We design these things to be like us. And we are violent.
00:28:25.430 --> 00:28:42.850
[redacted]
I'd like to piggy bat off of what [redacted] said. The robot wouldn't be violent. It wouldn't be violent on its own. But it could be hacked. What will happen if a terrorist or someone bored hacks one of the robot teachers and the robot I don't know stabs a child. Where would we be legally as a school district?
00:28:44.010 --> 00:29:02.720
Hale, Kirt
You bring up a good point. If we could somehow minimize the risks of the robotic teachers being hacked, would you support the idea of using machines to teach. I guess what I'm asking is what con what concessions would you need to be in place for you to be willing to employ AI machines to independently instruct students with disabilities in the classroom?
00:29:20.140 --> 00:29:25.010
[redacted]
To me none. It's just a bad idea.
00:29:30.460 --> 00:29:36.860
[redacted]
Yeah I wouldn't feel comfortable signing off on that.
00:29:43.200 --> 00:30:05.550
[redacted]
I agree it's a big risk to many unknowns. We could probably use them as paraprofessionals but not as teachers. I like the idea of robot janitors too. We could use robots in any position that doesn't require interaction with the children. I think that's what we're all afraid of. Children being hurt.
00:30:07.000 --> 00:30:15.910
Hale, Kirt
Anyone else
00:30:36.010 --> 00:31:16.850
[redacted]
Umm, I like the idea of artificial paraprofessionals. I agree with [redacted] Teachers are too close to students. If we were to make robot paras though, we would need to make sure they do not operate outside of human supervision and assisted teachers with their clerical duties. They could maybe collect student data develop the lesson plans take role, and even clean the classroom.
00:31:19.010 --> 00:31:26.160

Appendix I

Sample Interview Transcript

00:17:48.910 --> 00:18:16.480
[redacted]
Let's see. The first book that I read that was based on technology was probably a comic book. The see or marvel. They had all kinds of technology. I remember the ex men comics had these giant robots called centurions. The army had to specifically design something that could kill the ex men who had supernatural powers. Seeing things like that really stretched my imagination for what was possible.
00:18:01.650 --> 00:18:04.250
Hale, Kirt
I see. So would you like to see giant robots in existence?
00:18:05.580 --> 00:18:08.840
[redacted]
Heck no man. Those things were scary.
00:18:21.800 --> 00:18:47.670
Hale, Kirt
Yeah. So, yeah, how would you describe your level of familiarity with artificial intelligence technology? Would you say that you are not very familiar, somewhat familiar, or very familiar? If if you would explain.
00:18:52.660 --> 00:19:23.570
[redacted]
I would say that I am very familiar with AI. I actually drive a Tesla. It has tons of AI features. Now I will confess that I've never used the self-driving mode because I'm just not ready for that. I've seen the reports where those things crash. But I do support the initiative of the company. Shelf driving cars are the future.
00:19:29.040 --> 00:19:36.760
Hale, Kirt
It's interesting that you don't use the self-driving mode in your car. Would you say that you don't trust the technology to keep you safe.
00:19:38.520 --> 00:19:59.470
[redacted]
Yeah veah its hard to relax. I mean I would be giving up control to a machine. That part is difficult to me because I'm a control freak but I think that after I see some real data on it I would be more comfortable.
00:20:10.790 --> 00:20:18.240
Hale, Kirt
Interesting.
00:20:22.450 --> 00:20:31.840
Hale, Kirt
So tell me what are your beliefs on employing autonomous machines and programs to increase or improve work performance?
00:20:34.620 --> 00:20:57.860
[redacted]