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Teachers Can Use It with Their Littles: Using Case Studies to Explore Preservice Teachers' Perceptions of Technology

Amber Beisly *  and Darshani Abeyrathna Herath MudiyanselegInstructional Leadership and Academic Curriculum, University of Oklahoma, Tulsa 74135, OK, USA;
darshaniabeyrathna@ou.edu

* Correspondence: ahbeisly@ou.edu

Abstract: This study explores preservice teachers' (PSTs') attitudes toward technology through case studies conducted in a technology-focused course. Nine PSTs completed four case studies addressing screen time guidelines, virtual reality, the digital divide, and ChatGPT-4. Using the SAMR (Substitution, Augmentation, Modification, Redefinition) model as a coding framework, researchers analyzed 36 written reflections. PSTs often viewed technology as a substitute rather than a transformative tool. While many PSTs expressed skepticism about technology, others acknowledged the potential of tools like ChatGPT to enhance teaching, e.g., providing real-time feedback on writing and translating assignments into native languages. The study underscores the value of case studies in helping PSTs critically evaluate technology's role in teaching and learning. Despite recognizing its inevitability, PSTs need further support to embrace transformative technology use.

Keywords: preservice teachers; case studies; technology integration



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1. Introduction

Technology has often been used to help teachers adapt lessons to meet students' needs (Bernacki et al., 2020). Nevertheless, using technology requires teachers to be familiar with the technology and how to use it to effectively improve instruction (Wilson, 2023). It also requires that teachers are aware of students' comfort or ability to use technology and whether that technology use will improve upon children's understanding (Dong & Mertala, 2021). While teachers may have had exposure to technology through their teacher preparation programs, the dynamic, rapid pace of technology can quickly make education outdated and cause trepidation among preservice teachers (PSTs). PSTs' who feel comfortable using technology are more likely to use it in their classroom (Jita & Sintema, 2022), thus it is important to consider PSTs' feelings toward teaching with technology.

Puentedura's (2014) model of technology integration is a framework for how to gradually integrate technology. The SAMR (Substitute, Augment, Modify, Redefine) model has been used in studies exploring in-service and PSTs' technology integration by documenting how technology use can enhance and transform learning (Vogt & Westerlin, 2021). Gradual integration of technology, starting with direct substitution, may be more practical for PSTs than full-scale implementation (Schriever, 2021). Nevertheless, there is limited research focusing on how PSTs can differentiate SAMR levels or use SAMR as a conceptual framework (Zipke et al., 2019).

This study examines PSTs' feelings toward technology and the level of technology integration as seen in their analysis of case studies. As a teaching method, case studies have been used in prior research to provide PSTs with integrated learning opportunities (Torres

et al., 2023). Case studies provide hands-on opportunities to explore teaching scenarios before they enter the classroom, enabling students to think about the broader implications of technology without constraints (Toogood, 2023). They present real-world situations that model the ethical or moral dilemmas PSTs may face related to technology integration, illuminating PSTs' underlying emotions or beliefs more authentically than a survey or questionnaire. While previous research has explored PSTs' use of technology through case studies involving problem-solving (Qian et al., 2023), instructional design skills (Koehler et al., 2019), or technological content knowledge (Saltan, 2017), there has not been recent research exploring PSTs' feelings toward technology and technology integration as evidenced in their responses to case studies. This study was concerned with how PSTs described technology integration across four case studies, where each one offered an additional opportunity to reexamine their feelings toward technology. The research questions that guided this study are (a) in what ways do PSTs describe integrating technology (according to the SAMR model) given specific case studies, (b) whether PSTs described technology positively or negatively, and (c) what differences emerged, if any, in how PSTs described technology across the various case studies.

2. Conceptual Framework: The SAMR Model

The SAMR model approaches each use or application of technology as a different task and provides teachers with scaffolding to leverage more technology more purposefully (see Table 1).

Table 1. Description and Example of SAMR Levels.

	SAMR Description	Examples
Enhancement	Substitution—technology acts as a direct substitute with no functional improvement. Often, the technology use saves paper and/or time.	Having students type answers instead of handwriting them. Using an online document instead of a paper/pen quiz.
	Augmentation—technology acts as a direct substitute, with functional improvement; technology provides some access to information.	Teacher instruction is supplemented with a video that clarifies directions. Students are able to use the internet to search for information about a topic.
Transformation	Modification—technology allows for significant task redesign from traditional assignments into more interactive tasks that allow for more student collaboration; tasks often move beyond “paper” tasks.	Students create a video presentation using their voice and other digital elements instead of an oral presentation. Students create digital book reports that utilize animation and graphics.
	Redefinition—technology allows for the creation of new tasks previously inconceivable; learning is often connected with real-world applications.	Using Google Earth to measure distance or landforms. Accessing real-time data and using software to create data visualizations. Participating in virtual dissections using VR headsets.

On the first level, substitution, the teacher exchanges a selected activity with a piece of technology, for example, offering a digital form of a worksheet. Technology offers some advantages, but the form of learning is the same. In augmentation, the teacher uses technology to improve the task process in a way that could not be accomplished with a paper/pencil task. Rather than simply filling in answers to a problem on a digital worksheet, students might write answers in a word processing program. This software allows students the ability to insert images or change the way that text looks, thereby enriching the learning

process. These first two levels are often called enhancement because the format of the activities is unaltered. On the modification level, the teacher fundamentally changes and improves upon the task using technology, opening doors that were previously closed. In the above example, the teacher may post the Word document in a shared online document, allowing students to collaborate, comment, and simultaneously view the document. Offering an online version enables students to provide immediate feedback, simultaneously engage in the writing process, and create hyperlinks to websites, videos, or other media. Finally, redefinition occurs when the original task is redefined by the way technology is integrated. The original task is now impossible without the use of technology (Hilton, 2016b). The final two levels of the SAMR model are often called transformative because of how learning and assignments are changed by technology use.

Studies of teachers' SAMR use have consistently found that teachers tend to use lower levels of technology integration in their classrooms (Hughes et al., 2015). Martin (2020) found that most PSTs' responses fell within the substitution tier or at the beginning of the augmentation. Setyaningish (2020), exploring English teachers' technology use, similarly found that most activities commonly fell into substitution and augmentation. However, the level of technology integration may depend upon the purpose of a particular lesson and not the comfort of the technology integration itself. Hilton (2016a) found that participants were more likely to use lower levels for content acquisition, while modification and redefinition were used to practice skills later in a lesson or unit. It may also depend upon the content. For example, Hilbrand's research on social studies teachers found that it was more common for technology use to fall into the substitution and augmentation levels of SAMR, while activities that included social studies skills practice often fell into modification and redefinition. While previous studies explored how teachers use the SAMR model to integrate technology, the model can also present a useful analytical tool to explore to what extent PSTs envision integrating technology.

3. Literature Review

An abundance of research has examined PSTs' beliefs about technology use. Cherner et al. (2014) suggest that these beliefs can be comprised of two categories: resources and instruction. PSTs use technology to accomplish tasks, i.e., using software to take attendance; generally, PSTs are favorable of this use. The second use is an instructional tool, of which the views are quite mixed. On the one hand, PSTs believe that the primary benefit of technology is in children's increased motivation and engagement (Brown et al., 2016). However, PSTs have low self-efficacy in implementing technology into their teaching. Integrating technology into lessons requires additional planning and preparation that many PSTs do not have (Polly et al., 2010).

Research specifically with early childhood PSTs' views of technology indicates that beliefs are dependent upon the child's age when using the technology. For example, technology is a friend to older children but a foe to young children (Dong & Newman, 2016). Similarly, technology is viewed positively as a way to enhance learning but viewed negatively when thinking about children's social development. Teachers may believe that children are on devices a significant portion of the time at home; thus, their classrooms should be technology-free out of concern for children's physical and mental health (Mertala & Salomaa, 2016).

Much of the other literature on PSTs' views of technology can be explored through the context of specific kinds of technological use, i.e., artificial intelligence or virtual reality. Limited research has explored how PSTs feel about these kinds of technology and how they may use it in their field placements or classrooms. The remaining literature review will look at these examples to provide context for the case studies used in this study.

3.1. Screen Time

Screen time refers to the amount of time spent in front of a screen, whether that be a television, tablet, computer, or smartphone (Beatty & Egan, 2020). The American Academy of Pediatrics (2016) recommends that children between the ages of two and five be limited to no more than one hour of screen time per day, with an emphasis on educational content. For older children, consistent limits should be established to ensure that screen time is balanced with sleep, physical activity, and other health behaviors. Children often spend more time on technology at home than at school (Rideout & Robb, 2019). Recent research has underscored the importance of limiting screen time in early childhood education to promote healthy development, as excessive screen exposure may impede cognitive, social, and physical development (García et al., 2021; Lissak, 2018). Young children should prioritize high-quality, interactive content, such as educational videos and applications that encourage verbal responses or physical movement when it comes to their screen time (Panjeti-Madan & Ranganathan, 2023).

Teachers are responsible for guiding screen time usage, making sure the material being learned is age-appropriate and that device-based learning is dynamic, engaging, and meaningful (Pires et al., 2022). Many PSTs see the potential advantages of using technology within the classroom, particularly in terms of improving participation and providing varied methods to convey content (Beatty & Egan, 2020). Some, however, have worries about children's excessive dependence on screens, particularly the influence on their psychological, social, and physical development (Muppalla et al., 2023). There is frequently a concern that screens may replace crucial personal relationships and hands-on learning experiences that are critical for young children's development (Canadian Pediatric Society & Digital Health Task Force, 2017). PSTs are also mindful of the need for clear standards and sufficient training on how to properly incorporate screen time within early childhood education.

3.2. Augmented and Virtual Reality

Augmented reality (AR) and virtual reality (VR) represent transformative technologies when utilized in education (Chang et al., 2022). AR involves overlaying digital content, such as images or information, onto the real world through devices like tablets and smartphones, promoting the real-world experience (Neumann et al., 2022). VR provides a fully immersive, computer-generated context in which users can interact with and explore new settings entirely removed from reality, often using headsets (Neumann et al., 2022).

PSTs express both enthusiasm and doubt about the integration of AR and VR into early childhood education (Taggart et al., 2023). Many PSTs recognize them as effective tools in diversifying the delivery methods related to pedagogy, making children engage more in learning. However, PSTs are also hindered by the limited or insufficient training they have received in integrating AR and VR into planning lessons (Tutkun, 2024). PSTs also report that it is necessary to understand how to merge AR/VR with existing curricula of early childhood education (Neumann et al., 2022). PSTs express additional concerns about how these tools increase the screen time of their students (Tutkun, 2024).

3.3. Digital Divide

The digital divide can be recognized as the discrepancy between individuals with easy and ready access to digital technologies and ways and those deprived of those privileges (Pásztor & Bak, 2020). Initially, the digital divide referred to a generational gap between older people (digital immigrants) and younger, digital natives who had access to and proficiency with technology (Ball et al., 2017). The digital divide can emerge in multiple domains, including access to technology and the internet; digital literacy, which is using

technology to access information; and digital assimilation, which is using technology in various aspects, including communication (Litchfield et al., 2021).

The digital divide reflects broader socio-economic disparities, as access to technology, training, and resources mirrors community opportunity gaps (Russo & Emtage, 2024). The COVID-19 pandemic underscored this divide, showing that merely providing technology did not enhance online learning (Golden et al., 2023). The divide often stems from how technology is used: White and affluent students tend to use it for creativity and problem-solving with more adult mentorship, while minority and low-income students often engage in routine drills with less support (Dubois et al., 2021). This disparity begins early, influenced by whether a school is public or private (Qayyum et al., 2024; Russo & Emtage, 2024).

3.4. Chat GPT

Released in November 2022, Chat Generative Pre-Trained Transformer (ChatGPT) is an advanced AI language model (Roose, 2022). It quickly gained popularity for its ease of use and ability to accomplish a wide variety of tasks across fields (İpek et al., 2023). Its interface is interactive and adaptable; because it utilizes natural language processing based on human language, it allows users to personalize their requests (Eysenbach, 2023).

Yet, almost as quickly as its popularity rose, questions also emerged about its ethical use, particularly within academic contexts, causing large school districts to ban it entirely (Zhang & Tur, 2024). ChatGPT has already become a controversial topic specifically due to its potential to assist the process of education through individualized task completions, immediate feedback, and support in tackling complicated subject areas (Montenegro-Rueda et al., 2023). While it is generally accepted that AI can be manipulated to support learning outcomes, especially in the process of acquisition of language, there is a notable unavailability of reliable data on how AI should be employed in the context of early childhood education (Yi et al., 2024).

ChatGPT has been increasingly integrated and used in teacher preparation programs to aid in tasks related to teaching (Robinson et al., 2023). For example, it has been used to help PSTs write lesson plans and develop student assignments (Karaköse & Tulubas, 2023) as well as developing objectives that can be used for specific grade levels and suggesting instructional activities (Sangkawet et al., 2020). PSTs have been able to utilize ChatGPT to generate prompts, design engaging project ideas, and develop worksheets that accommodate a variety of learning styles for student assignments (Sangkawet et al., 2020). ChatGPT can also simulate potential student questions or answers, allowing instructors to anticipate and prepare responses (Peterson & Basu, 2024). Like other forms of technology, PSTs have mixed feelings about ChatGPT. Many PSTs see advantages in using ChatGPT to save time (Montenegro-Rueda et al., 2023). Yet, Garrote Jurado et al. (2023) found that some teachers stress the need to monitor and guide students on the appropriate use of ChatGPT; many are wary of an overreliance on it.

3.5. The Current Study

Technology integration presents challenges for early childhood teachers, who must consider multiple aspects of children's development and education before selecting a particular piece of technology to integrate (Dong & Newman, 2016). While much literature was concerned with the amount of time children spend on devices (i.e., García et al., 2021; Muppalla et al., 2023), more recent research has revealed the complexities of technology integration (Nikolopoulou, 2021). For example, ChatGPT and VR headsets present opportunities for teachers to transform learning in exciting ways, yet research is lacking on how PSTs envision using these tools in their classrooms (Karaköse & Tulubas, 2023; Neumann et al., 2022). Teacher preparation programs can provide PSTs with opportunities to grapple

with these issues before they are out in the field teaching with the technology (Seufert et al., 2021; Vogt & Westerlin, 2021). To be sure, the use of case studies in teacher preparation courses presents ways to highlight issues related to technology integration, bringing out PSTs underlying feelings toward technology integration (Toogood, 2023; Wilson, 2023).

The purpose of this study is to use the SAMR model as a conceptual framework to explore how PSTs integrate technology. The use of case studies allowed PSTs the space to grapple with technology in more detail than a survey or questionnaire. The use of four separate case studies additionally allows for in-depth analysis across a semester, capturing differences between technologies or changes over time. This qualitative approach allows researchers to explore complex phenomena, like PSTs' feelings toward technology, with rich and detailed data from participants. Our specific research questions are as follows:

1. On what SAMR level do PSTs describe integrating technology in the given case studies?
2. How do PSTs describe technology?
3. What differences emerged, if any, in how PSTs described technology over time?

4. Materials and Methods

Data from this study were taken from a larger study exploring PSTs' beliefs about technology integration. This qualitative phenomenological research focused on how PSTs described their beliefs about various technology applications. The phenomenological paradigm is appropriate when researchers strive to describe, understand, and interpret the multiple realities of PSTs' experiences (Saldana, 2015). This study sought to understand the beliefs of PSTs. This qualitative approach sought internal reliability rather than generalizability (Merriam & Tisdell, 2015).

4.1. Context

Participants in this study included PSTs from one teacher preparation program in the southern United States. Our program is a bachelor's completion program in early childhood. Most participants attended a local community college before matriculating to our university for their final 2 years. Many of our students would be considered non-traditional students who are older, often work full-time, and attend school at night.

Our program is committed to technological integration. In partnership with Apple, we provide each student with an iPad at the beginning of their coursework to use as a student but also to use when facilitating lessons during their field placements. We have purposefully woven aspects of technology into many of our courses and assignments across the program. For example, throughout the program, students build a virtual classroom through Google Slides.

Students take a technology-based course at the beginning of their program. The course focuses on developing familiarity with multiple aspects of technology through hands-on exploration and critical analysis within an early childhood setting. Students visit Makerspaces, practice coding with Ozobots, and create art with Spheros. Students are introduced to the SAMR model early in the course as a framework for planning lessons.

4.2. Participants

This study included data from 11 participants, all female. A total of 63% of students were White (27% were Asian; 9% were Black). Convenience sampling was used in this study because all participants were students enrolled in the technology course that the first author taught. Demographic information about the students was not collected.

4.3. Data Collection Methods

The dataset includes students' responses to case study assignments students completed as part of their coursework. The assignment was presented to the students during class time, with some discussion. Then, students completed the assignment as homework. The case studies were designed by the first author based on issues relevant to early childhood preservice teachers. The case studies were focused on four scenarios: (1) appropriate recommendations for screen time in young children, (2) investing money in virtual reality, (3) access to technology as an equity issue, and (4) the use of Chat GPT in the classroom (see Table 2). The assignment was graded on a rubric for making connections to theories and research, evidence of critical thinking, and writing a clear thesis statement. Appendix A provides a sample of one of the case studies provided to students.

Table 2. Descriptions of case studies.

Case Study	Description
Developmental appropriateness of screen time	Imagine you are a teacher serving on your school's technology committee considering a 1:1 device initiative for students. What are your recommendations for what teachers should consider regarding how much technology to use in the classroom?
Is virtual reality appropriate for young children?	Imagine your school has just been given an \$18,000 grant. Write a proposal for how you would spend the money. You must decide between one of three options: (1) VR headsets, (2) other technology (3) dramatic play materials.
New Mexico: Education, access and the law	In 2018, Yazzie Martinez was a plaintiff suing the state of New Mexico for not providing adequate education to students. In 2021, she sued again to say that things had gotten worse since the pandemic. Write a letter to the local paper that contains your opinion as a local teacher.
Should ChatGPT be used in the classroom?	The teachers at your school are in a vigorous discussion about whether/how to use GPT with students. You are asked to weigh in. Should it be used? Is it considered cheating? What must the school consider before implementing Chat GPT?

All procedures performed in the study involving human participants followed the ethical standards of our institution's research committee (IRB approval no. 15593). Informed consent was obtained from all individual participants included in the study. Pseudonyms were used to ensure confidentiality.

4.4. Data Analysis

Students submitted their assignments through our University's LMS. This data were then downloaded from the LMS and uploaded into Dedoose for coding. Dedoose is a cloud application for managing, analyzing, and presenting qualitative and mixed-method research data (Version 9.2.221; [Sociocultural Research Consultants, 2024](#)). Data were coded through multiple cycles. In the first cycle, structural coding was used to capture participants' descriptions of technology integration ([Saldana, 2015](#)). Initially, the four structural codes used were substitution, augmentation, modification, and redefinition. However, we also found that participants at times simply listed kinds of technology rather than describing how it would be integrated. An additional code of "hardware" was added. We calculated the frequencies of each code for the different case studies. Additional first-cycle coding was done through emotion coding to label the emotions or feelings described by the technology use ([Bazeley, 2020](#)). For example, some participants described the positive effects of using technology on young children, while others expressed their own hesitations or fears for children in their technology use. These were often more general statements (i.e., talking

about technology integration in general) rather than being targeted toward a specific SAMR level.

5. Results

This study explored how PSTs described technology across four case studies. Students were able to describe technology integration most during the digital equity and the ChatGPT case studies (see Table 3). More students also described technology positively in those cases, while VR/AR had the most negative feelings. Finally, there were some changes over time. PSTs described technology most positively as the semester went on. ChatGPT, which was the last case study of the semester, was the only case study where PSTs described integrating technology in transformative ways.

Table 3. Code frequency.

	Screen Time	VR/AR	Digital Equity	Chat GPT
Hardware	2	6	1	0
Substitution	1	1	3	1
Augmentation	1	1	5	2
Modification	0	0	0	3
Redefinition	0	0	0	3
Positive Feelings	3	5	16	15
Negative Feelings	3	7	0	5

The results section will explore the themes that emerged in PSTs' technology integration and feelings toward technology by case. In the discussion section, we pull together themes across the case studies to answer the final research question about PSTs' attitude toward technology across the case studies.

5.1. Screen Time

This was the first case study assignment that students completed to gain an understanding of how PSTs view technology integration. Early childhood educators often hold negative views of technology and might wish to limit the time that students spend on screens in the classroom (Ross-Lightfoot et al., 2024). Many PSTs did not describe a specific use of technology, so it was difficult to determine how they envisioned integrating it into the classroom (see Table 4 for sample codes). For example, Samantha describes screen time as "various ways teachers can integrate technology into learning, such as computers, iPads, and phones". Hannah also describes "interactive and hands-on devices such as tablets with educational apps". Two students described technology integration with families, i.e., video chats and "well-designed e-books with limited distracting features that children read with parents".

We found that many had trepidations about using technology. Samantha writes, "technology overall is a great tool for teachers to use". Ashley similarly states, "educators should ensure children's safety by being hyper aware of websites. Preschool children should learn how technology applies to the world around them." There was one comment from Sarah that is reflective of many PSTs: although children may learn some concept[s] from watching educational programming, they learn better when there is physical interaction.

Table 4. Sample of codes for SAMR levels.

	Screen Time	VR/AR	Digital Equity	Chat GPT
Hardware	Various ways teachers can integrate technology into learning, such as using computers, iPads, and phones.	Tablets and laptops, when utilized effectively, serve as powerful tools to engage students actively in their learning process.	Access to technology includes more than just providing laptops or internet connections; it also means giving students the tools they need to thrive in an increasingly digital environment.	Not observed
Substitution	Infants and toddlers under 18 months can only use video chat with their parents or grandparents.		As a result, students need the internet and computers to complete their homework, quizzes, and assignments.	You could incorporate technology in the classroom with your students by taking turns asking questions and that may be fun for early childhood.
Augmentation	Make games or activities for their students or create lessons with which children can interact.	This VR/AR classroom is designed and set up for teachers to bring their classroom for special periods to engage or enhance what they are currently learning.	Educators can leverage digital tools to create engaging lesson plans, collaborate with peers, and provide timely feedback to students. In some restaurants, you have to scan a QR code to look at the menu, job applications are strictly online, and schools across the country are implementing virtual days throughout the school year.	
Modification	N/O	N/O	N/O	Chatbot can translate assignments into a student's native language.
Redefinition	N/O	N/O	N/O	It can also rewrite responses at different reading levels, making it easier for students to complete their assignments.
Positive Feelings		We cannot deny that VR and AR can create students' interest, increase students' engagement, and make them feel they are not in the classroom.	In today's interconnected world, technology is not just a supplementary tool; it is an integral part of modern education. It enhances students' learning experiences, fosters creativity, and prepares them for the challenges of the future workforce.	I would use ChatGPT appropriately as a teacher whether it is for myself to help with teaching, lesson planning, or communicating professionally with parents. I see this used positively in the classroom.
Negative Feelings	Students can misuse the electronics given to them if they are given too much freedom and time.	VR in the classrooms is damaging the relationships between students and overall human interaction.	Some people can support low-income families by donating school supplies to the school.	Although this site is good and quick to obtain an answer, it will be better for students not to use it in the classroom. They have a long future ahead; therefore, I would not recommend this site to students.

5.2. VR/AR

This case study was designed to examine whether VR/AR headsets could help PSTs describe technology integration more specifically. In the case study, participants were given imaginary funding and asked to purchase VR/AR headsets, general technology, or dramatic play materials. Most students (6) opted to purchase technology and listed kinds of technology to buy, rather than describing how it would be used. The SAMR level could

not be analyzed, e.g., “computers, headphones, keyboards, iPads, and even paid programs within these devices”.

Students described some of the positive benefits of VR/AR headsets. Emily describes headsets as being able to:

broaden students’ communication skills by having them build their own vocabulary by describing what they are seeing, create[ing] mathematical thinking by providing a hands-on approach to their reasoning and logical thinking skills, and enrich[ing] their experiences by giving them a visual aid to the context they are discussing and being taught in class.

For Hannah, headsets can “inspire students’ creativity and spark their imaginations...[it] can motivate them to explore new academic interests”. Finally, Jessica says that “we cannot deny that VR and AR can create students interest, increase students’ engagement and make them feel they are not in the classroom”. These positive sentiments are similar to research by [Beatty and Egan \(2020\)](#), where PSTs can see the educational benefits of technology use.

Students who opted to spend money on technology also had many positive things to say. Samantha describes the “efficiency of technology”, while Sarah states that “using technology has [an] impact on kids’ language development such as vocabulary and interacting with an adult”. For Madison, technology can “nurture students and their different learning styles”. Elizabeth returns to the idea of preparing children to use technology: By investing in technology, we empower our students with skills that are not only relevant but also indispensable in the digital age. Two students mentioned how technology could be used for teachers and students: “technology is the most useful for classroom either for students or teachers” (Sarah) and “technology is a great way to support students and staff” (Taylor).

Students also described the negative aspects of VR/AR. Many mentioned price being a barrier for the purchase of Smartboards or VR headsets that they were “a waste of money”. Madison goes on to state: If I have the budget to buy it, it does not mean I have the budget to maintain it”. Other than the cost, others were worried that VR headsets would not be used as often as Chromebooks or would only be used for content areas like science. Another student was worried about the potential isolation of using VR headsets, believing them to “damage[e] the relationships between students and overall human interactions”. VR/AR headsets could bring up security issues, as described by Jessica as a “potential risk of compromising user privacy”. Finally, one student mentioned that VR is “not including people with disabilities or sensory issues” (Samantha). More specifically, students “may feel uncomfortable or overwhelmed by the feeling of the VR headset so close to their face”. These concerns are in line with other studies where PSTs have listed cost, monitoring, and safety as barriers to using VR/AR headsets ([Cooper et al., 2019](#)).

5.3. The Digital Divide

The third case study presented is designed to highlight the digital divide. It included an overview of a legal case presented in New Mexico by a parent who believed that a lack of funding by the state department was causing unequal access to education ([Lopez, 2023](#)). She sued the state and won. In the meantime, the pandemic brought a new host of inequities to light because of the requirement of online learning and the lack of internet infrastructure in many rural New Mexico communities. The parents sued again and won. By presenting an example of the negative consequences of lack of access (including technology infrastructure), this case study is designed to add a layer to the technology debate—how can we argue for or against technology in our classrooms if we do not have access to it?

There were more examples on the augmentation level than previously and a few examples of substitution. PSTs advocated for technology in their responses, providing examples of how technology could improve access to educational resources. Ashley suggests substituting physical textbooks for online textbooks. Samantha states, “access to technology allows students to engage in online research, collaborate with classmates, and access educational resources beyond the confines of the traditional classroom”. Online resources can also be used to extend or expand children’s learning: high-speed internet allows students to search for the information they need, saving a lot of time compared to traditional textbooks (Jessica). Teachers may also use online tools to “create engaging lesson plans, collaborate with peers, and provide timely feedback to students” (Elizabeth). Two students mentioned virtual spaces—either virtual classrooms or virtual learning days, which could represent higher levels of the model depending upon the activity.

Many spoke positively of technology in describing the need for all to access it. Samantha writes, “the extension for technology relief would focus on the importance of equal access to education and the role of technology in bridging the gap among students”. On the theme of access, another student wrote: As an educator, I have seen the transformation in the power of access to technology. How technology can help achieve for students whether it is engagement, creativity, and academic success”. Another student highlights the implications of lack of access to technology affected learning: It became clear that a lack of access to technology put these children at a significant disadvantage, impeding their learning progress (Madison). Similarly, Samantha writes: the Yazzie Martinex case highlights the disparities in access to technology for students, which directly impacts their ability to fully participate in learning opportunities. Emily simply put, “being disconnected is a disadvantage”. Finally, one student described the importance of technology in preparing students: In today’s interconnected world, technology is not just a supplementary tool; it is an integral part of modern education. It enhances students’ learning experiences, fosters creativity, and prepares them for the challenges of the future workforce (Elizabeth).

The digital divide forced students to think about what access to technology looked like—challenging their conceptions that everyone had technology at home. Samantha notes, “In an age when technology is an essential part of learning, it is critical that all students have access to the resources they require to succeed”. Rather than providing hardware, teachers must ensure that students have access to how to effectively use the hardware. Madison states, “access to technology includes more than just providing laptops or internet connections; it also means giving students the tools they need to thrive in an increasingly digital environment”.

5.4. ChatGPT

The final case centered on the use of ChatGPT in the classroom. Before analyzing information from this case study, participants used ChatGPT; it was the first time some of them used it. The case study was focused on how, if at all, it should be used in the classroom. This aspect of technology saw the most diversity in SAMR responses (at every level) and more modification/redefinition levels. While it should be acknowledged that this case study was at the end of the semester, after PSTs had exposure to a variety of ways in which technology could be integrated (with and without ChatGPT), it was also interesting to note that PSTs also had many more positive comments about technology than negative comments (15 to 5).

Many PSTs included ways that they would use ChatGPT in their room that went beyond substituting. AI affords more possibilities than a worksheet. At the basic level, students described using ChatGPT for brainstorming ideas for class projects. Some talked about using it to generate “new paths for creativity and research. It can help them achieve

a greater grasp of the subjects they study” (Taylor). One student mentioned using AI in writing—from generating ideas to getting feedback, while another sees it as beneficial for assisting “DLL students in communicating with their peers”.

Others talked about the ethical implications of using ChatGPT and teaching students about its use: By incorporating lessons on proper research, attribution, and the ethical use of AI, I aim to equip students with the skills to navigate technology responsibly and ethically (Elizabeth)”. Jessica states, “instead of worrying about how students will negatively use it or ban the app, I will teach students how to use the app to enhance their knowledge”. Similarly, Hannah writes: despite concerns, educators should try the program and teach students how to use it responsibly. And later that “I would emphasize the importance of responsible and ethical use”. Ashley highlights an important theme for technology: ChatGPT is a good tool for the classroom when used appropriately.

In some of the positive comments, PSTs described how it could benefit their teaching. Madison writes, “I would use ChatGPT appropriately as a teacher whether it is for myself to help with teaching, lesson planning, or help communicating professionally with parents”. Elizabeth states, “I believe it also presents an opportunity to reshape how we assess and teach in the digital age”. Taylor states, “Staff members could benefit from ChatGPT and especially teachers!” Jessica describes using ChatGPT to generate lesson plans or create quizzes.

The negative comments highlighted safety concerns for students as well. Emily writes, “some of what ChatGPT puts out is plagiarized content”. Sarah believes that the rapid response rate of ChatGPT might limit students’ critical thinking: “they got [a] response right away, I believe that it decreases students’ abilities of critical thinking and their creative mind to write their answer down”. Hannah warns about the “potential risks of misuse or overreliance on ChatGPT”. Jessica is concerned about students writing, stating, “each time they use ChatGPT instead of using their own words they lose the opportunity to become better students”.

PSTs’ concerns and uses of AI are aligned with the literature on PSTs’ perceptions of AI use. For example, PSTs often focus on the technical dimensions of AI or view it from a security/safety standpoint without thinking about the social impact or how children may benefit from using AI, i.e., both moral sensitivity and social responsibility (Song & Ko, 2024).

6. Discussion

This study used case studies to explore PSTs’ views about technology across the semester during a class focused on technology integration. Yet, while many preservice teachers use technology (particularly for social media), they lack depth in using technology, particularly using technology in the classroom (Seufert et al., 2021). The results of this study highlight that PSTs expect to use technology with students—they view it as a “must” (Dong & Newman, 2016). Rather than viewing technology as a friend or foe, the PSTs grapple with how and when to use technology beyond whether to use it. Students have mixed views of technology use—highlighting both ethical and developmental issues. Although the PSTs feel like technology use is inevitable, they do not always feel equipped to use technology, nor are they able to highlight ways in which technology can be integrated into the SAMR model (Casey et al., 2023). Thus, reframing the question of whether or not to use technology as which technology and in what ways it should be used is essential in considering the themes across the case studies. This is in line with research that explores that it is not whether technology is used but *how* it is used that makes a difference in children’s learning and development (Nikolopoulou, 2021). Many PSTs believe in the importance of technology

in the classroom. Nevertheless, several barriers prevent PSTs from integrating technology in transformative ways.

6.1. The Teacher's Role

Across the cases, PSTs described their role in enabling technology in the classroom, which can be summarized as a facilitator, a provider, or a protector. Many PSTs described how technology could be used to enhance learning, which is in line with research on PSTs who believe technology can increase children's motivation and engagement (Brown et al., 2016). The use of digital technology is more appealing than pencil and paper tasks, so students may be more likely to complete the activity (Zipke et al., 2019). This was seen across all of these case studies. Nevertheless, most responses were categorized within the substitution or augmentation levels, suggesting that PSTs have ideas about using technology but lack skill in developing activities where students truly engage with it as a learning tool.

PSTs believe that technology use is inevitable, and as such, their role is to provide technology to prepare students for the digital world. Many students see their roles as helping students navigate issues of using technology (Mouronte-López et al., 2023). As such, using technology is an investment in students' future success (Taggart et al., 2023). For example, PSTs wanted students to be familiar with ChatGPT or VR to be competitive in a future workforce. Friedrichs (2015) similarly reported that technology usage was necessary to prepare children for the changing society in which they live. Yet, this is in some ways in tension with the SAMR model because exposure to various technologies could be accomplished at the lower levels. Simply exposing students to technology may not adequately prepare them to use technology effectively.

One other role that emerged through the case studies was that of a protector. Students grappled with the belief that students were constantly using technology and that they, as teachers, should protect students from it. PSTs believed that students were on screens at home, and their responses indicated that technology that the use of technology in schools was purposeful. Although this was evident in the VR/AR case study, it came through in other applications. In the literature, PSTs reported believing that technology was constantly being used and that schools should have a technology-free environment (Istemic Starčič et al., 2016). In some ways, this is in contradiction with their role as a provider of technology—how can PSTs limit screen time but also believe that they need to provide students with access to technology? The digital divide case study caused them to confront what may be a bias or assumption about whether young children had access to technology (Qayyum et al., 2024).

6.2. Barriers to Technology Integration

The use of case studies helps shed light on issues PSTs grapple with as they consider digital technology, AI, and early childhood education. While early childhood has traditionally been technology-averse, this study's findings highlight how PSTs consider when and how to use technology. While many believe technology is necessary and beneficial for students, they struggle to balance preparing children for the current technology landscape while supporting their growth and development overall. AI has complicated how teachers use digital technology in their classrooms. On the one hand, PSTs were excited about all the possibilities AI could afford in diversifying their lessons and helping automate teacher tasks. At the same time, they are hesitant to adopt AI more fully because they do not fully understand it.

The case studies revealed PSTs' beliefs about technology as well as how they imagined using it. Given that many PSTs described technology integration on the lower levels of

the SAMR model, it is important to consider what barriers may exist that prevent PSTs from imagining more transformative uses of technology. [Tondeur et al. \(2017\)](#) discuss potential barriers teachers face in technology integration as first and second-order barriers. First-order barriers include access to resources, training, and support, which may hinder teachers' technology integration. Many of the PSTs cited these first-order barriers when thinking about technology integration—accessing VR headsets, paying for technology equipment, and accessing the internet. These first-order barriers must be addressed before PSTs can integrate technology.

Second-order barriers include PSTs' feelings and beliefs about technology integration, which have an impact on how or how willing PSTs are to integrate technology into their lessons ([Nikolopoulou, 2021](#)). This study found several themes across the case studies that highlight PSTs' second-order beliefs, including the inevitableness of technology and the need to protect children from technology. Unlike prior research (i.e., [Polly et al., 2010](#)), PSTs did not cite a lack of support or confidence in using various technologies. PSTs seem to be ready to utilize technology in their classrooms but lack knowledge about how to do this more purposefully. This is a large knowledge gap that is the work of teacher preparation programs.

7. Conclusions

The study highlights several important considerations for teacher educators in supporting PSTs in navigating issues related to the intersection of AI, digital technology, and early childhood education. [Cheek et al. \(2019\)](#) highlight multiple layers that need to be utilized to ensure that PSTs are comfortable and confident in integrating technology. The first is to provide PSTs with technology experiences. In this research, when PSTs had direct experiences, as with ChatGPT, they were better able to think through technology as an instructional tool if they had first had experiences using it for personal use. Providing PSTs with experiences using VR headsets can enhance their understanding of their capacities. However, providing unplugged experiences can also go a long way in helping PSTs envision how technology can improve upon the skills or content development. Providing unplugged experiences can also help PSTs focus on the learner rather than the technology (i.e., how can I use these robots in my lesson vs. how can I teach computational thinking?).

In [Cheek et al.'s \(2019\)](#) second level, PSTs need preparation to use technology. On a program level, teacher preparation programs need to integrate technology more meaningfully across content areas to ensure that PSTs match content to pedagogical knowledge. PSTs will not leave one technology course with the skill necessary to engage in integration at the redefinition level. The literature highlights the continuous need for training and professional development beyond the education classroom ([Sangkawet et al., 2020](#)). While this is not a new idea, the results of this study (potential changes across the semester, but limited changes) reinforce the idea that PSTs need several experiences integrating technology to change second-order barriers. While the SAMR model provides a useful framework for teachers to use when considering technology, seeing multiple examples across content areas and age groups will extend PSTs' skills in selecting the technology that matches the objectives.

[Cheek et al. \(2019\)](#)'s last level is to use technology to build capacity and enhance learning, which might include enhanced coaching while PSTs are engaged in teaching with technology. This could include looking at video analysis of candidate instruction, live feedback using technological tools like Bluetooth earpieces, or simulations of teaching scenarios using virtual classrooms. In these examples, PSTs have opportunities to receive feedback in real-time on how they are teaching. Research utilizing these methods (as reported by Cheek et al.) showed that PSTs reported more confidence in their teaching

abilities using technology. These methods provide the potential to help address PST's second-order barriers and create more lasting change.

We would propose adding one contextual layer to Cheek et al.'s model. While PSTs must be provided practice with using technology, using technology for teaching, and using technology to improve teaching, we believe that technology itself is not objective. An important part of teacher education programs and technology courses is to raise awareness about the ethical issues related to technology use around the digital divide. COVID-19 highlighted disparities in access to hardware and internet connectivity (Catalano et al., 2021), and other research has shed light on how school districts, even with access to technology, do not integrate it equitably.

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Appendix A. Sample Case Study

[What] is Developmentally Appropriate Screen Time?

China is enacting legislation to limit children's screen time: <https://www.cnn.com/videos/world/2023/09/04/china-screen-time-limit-watson-dnt-lead-vpx.cnn> (accessed on 13 March 2025).

First, look at the recommendations from the following professional organizations:

- "Screen Time Recommendations for Children Under Six" Zero to Three (<https://www.zerotothree.org/resource/screen-time-recommendations-for-children-under-six/> (accessed on 13 March 2025)).
- What are some screen time guidelines for social media applications? American Academy of Pediatrics (<https://www.aap.org/en/patient-care/media-and-children/center-of-excellence-on-social-media-and-youth-mental-health/social-media-and-youth-mental-health-q-and-a-portal/middle-childhood/middle-childhood-questions/screen-time-guidelines/> (accessed on 13 March 2025)).
- "Screen Time and Children" American Academy of Child and Adolescent Psychiatry (https://www.aacap.org/AACAP/Families_and_Youth/Facts_for_Families/FFF-Guide/Children-And-Watching-TV-054.aspx#:~:text=Between%2018%20and%2024%20months,limit%20activities%20that%20include%20screens (accessed on 13 March 2025)).

Then, read NAEYC's position statement on technology, found here (https://www.naeyc.org/sites/default/files/globally-shared/downloads/PDFs/resources/position-statements/ps_technology.pdf (accessed on 13 March 2025)).

For your assignment:

You are serving as the teacher representative for your school's technology committee. The school is considering a 1:1 device initiative for students in all grade levels. What are your recommendations for what teachers need to consider regarding how much

technology should be integrated into the classroom? Think about your answer to the following questions:

- Should each grade level have a mandatory maximum or minimum of screen time per day?
- What kinds of technology should be provided for each grade level?
- How can we ensure that technology applications are high quality?

Here are some resources to get you started, but you may always want to do your own research. Skim the articles below to help formulate your opinion. There is no right/wrong answer; rather, the goal is to write an informed opinion.

Popular Press:

- Going Beyond Screen Time: “Using screen time and digital technology for learning: children and pre-teens” (<https://raisingchildren.net.au/school-age/school-learning/learning-ideas/screen-time-helps-children-learn#:~:text=Screen%20time%20can%20help%20children,to%20play%20games%20or%20apps> (accessed on 13 March 2025)).
- “5 ways screen time can benefit children and families” (<https://www.childtrends.org/publications/5-ways-screen-time-can-benefit-children-and-families> (accessed on 13 March 2025)).
- “The good, the bad and the ugly of children’s screen time during the COVID-19 pandemic” (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8444888/> (accessed on 13 March 2025)).

Professional Resources:

- PEW Research Center: Parenting Children in the Age of Screens (<https://www.pewresearch.org/internet/2020/07/28/parenting-children-in-the-age-of-screens/> (accessed on 13 March 2025)).
- The use of touch-screen tablets in early childhood: Children’s knowledge, skills and attitudes (<https://www.sciencedirect.com/science/article/pii/S0190740917310319> (accessed on 13 March 2025)).

Examples of district technology plans:

- Atlanta Public Schools (https://docs.google.com/document/d/1LChooT-STT2IVjD0tCczNpWY_eUATLphC-LXm9ft4xo/preview?tab=t.0 (accessed on 13 March 2025)).

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