A Case Study of Virtual Kindergarten Teachers in Technology-Enhanced Classrooms

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***Abstract*—With the threat of future global pandemics and the possible necessity to mandate schools to transition to temporary online learning, it is imperative to provide kindergarten teachers with effective pedagogical practices using technological devices and resources in virtual classrooms. To address this challenge, this case study aims to discover 1) the attitudes and beliefs towards digital screen-based technologies or resources in the virtual classroom, 2) the benefits and challenges of teaching and learning in virtual kindergarten classrooms, 3) the digital screen-based technological tools or resources FDK educators are currently implementing, 4) how educators used the tools or resources to document play-based learning virtually, 5) and what do educators need to integrate technology into their virtual pedagogical practices effectively. Using semi-structured interviews from 11 early childhood educators and one teacher-researcher from virtual kindergarten classrooms in Ontario, Canada, a thematic content analysis from the typed transcripts and reflective notes was adopted to generate emerging themes. The findings demonstrated that 1) educators had a similar positive attitude towards technology in kindergarten as in other countries worldwide, 2) the benefits and challenges of virtual teaching and learning, 3) update on what types of technological devices and resources educators especially in the virtual milieu, are using, 4) and ways to support successful technology integration into virtual pedagogical practices. The findings from this study, in conjunction with other current research, provide practical recommendations for virtual kindergarten educators, parents, school boards, and policymakers.**

***Index Terms*—Virtual teachers, technology-enhanced classrooms, kindergarten, digital screen-based devices.**

I. Introduction

'The Net Generation' [1] and 'Digital Natives' [2] are the first terminologies used to characterize the first era of children developing in a world engulfed with progressively preeminent and omnipresent digital screen-based devices. These current generations of children, especially Gen Alpha (2010-present) and Gen Z (1995-2009), receive information and interact with technology at an unimaginable rate than children from previous generations, whose prior direct experiences and information from individuals, places and objects in the real-world operated as the initial exposure to acquiring knowledge [3], [4]. Children spend a greater amount of time in front of screen devices [5]. In classrooms, smartboards, iPads, digital games or software and educational videos are increasingly implemented, and educators, principals, school administrators, and governments have advocated for more technology use in the classroom [6], [7].

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Mindful of these accelerated advancements in digital technologies and becoming more accessible to young children, questions emerge about introducing virtual teaching and using technological devices or resources in kindergarten classrooms [8], [9]. With the increasing availability of technology and immediate introduction in classrooms at a very early age, children may be prevented from learning and reinforcing basic skills. Recent research indicates that technology interferes with vital physical, psychosocial, and developmental domains [10]. Children are not given the opportunity to learn important skills such as problem-solving and self-regulation or less exposure to imaginative play, physical play, and real-life social interactions, which are important for healthy development [11]-[13]. With the drastic increase of digital technologies in classrooms, especially now with a new virtual learning environment because of COVID-19, further exploration into how teachers use digital screen-based technologies and resources in play-based Full-Day Kindergarten (FDK) virtual classrooms is required.

In virtual teaching and learning [14], [15], technologies resources are required for both educators and students. It is argued that using digital technologies is an important tool for designing and implementing a technology-enhanced curriculum and pedagogy (e.g., play-based learning) in early childhood settings [16]. However, several studies have reported high levels of technology stress or anxiety in teachers [17]-[19], although teachers' beliefs and attitudes are one of the key constructs of effective technology integration in promoting student learning [20]. For instance, Fernández-Batanero *et al.*'s [21] systematic review of the published literature from 2005 to 2019 reveals the impact of educational technology on the development of teachers' stress and anxiety in various forms. This result could be inconsistent with numerous other studies which reported the benefits of technology to teachers. Furthermore, research on early childhood educators' attitudes and beliefs toward digital screen-based technologies and digital resources in virtual kindergarten is scarce.

The gaps of this study, in conjunction with the aims of the research, are to see early childhood educators' attitudes and beliefs towards digital screen-based technologies and digital resources in virtual kindergarten, the benefits and challenges of teaching and learning in virtual kindergarten, the technologies and resources educators used in virtual kindergarten, how educators documented play-based learning virtually, and what educators require to teach kindergarten virtually. Presently, there is little or emerging research regarding the beliefs and attitudes towards virtual teaching and learning in kindergarten, the challenges and benefits of virtual kindergarten teaching and learning, the technologies and resources used in virtual kindergarten, and recommendations for kindergarten stakeholders [14], [22],

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[23]. Based on the study's research intent, a case study about kindergarten educators' experiences teaching and learning virtually is warranted.

In summary, this study addresses these gaps as it will provide updates on the types of resources educators use, specifically in the virtual classroom and insights into the benefits and challenges in virtual kindergarten classrooms. Moreover, as virtual learning is a new phenomenon, this study will add to the literature and future historical context on how educators navigated this new teaching milieu.

This study aims to understand how kindergarten educators implement the FDK curriculum through digital screen-based devices in a way that virtually promotes purposeful, meaningful, efficient, and effective learning for FDK students. Within its limitations, this study aims to determine what attitudes educators have towards digital screen-based technologies, why they have these attitudes towards digital screen-based technology, and how digital screen-based technologies are used in FDK virtual classrooms to improve student learning.

II. Literature Review

In education, it is common practice to implement cutting-edge technologies in schools to ameliorate student learning and provide teachers with effective teaching practices. Throughout the years, educators have witnessed a plethora of technological devices enter and leave, applied, revamped, or omitted from schools. Fundamentally, this phenomenon has been occurring globally in most developed and developing countries, and many curriculum documents worldwide promote the use of digital technology [24], [25]. However, as technology use increases in kindergarten classrooms and specifically virtual classrooms locally, nationally, and globally due to the pandemic, and its potential contributions or adverse consequences to student learning, it has made educators, parents, and even medical professionals concerned with its effect on child development [13], [26], [27]. As technological growth continues to increase exponentially in our interconnected, globalized world and the flooding of digital screen-based learning into our homes and schools for the foreseeable future, can educators find a middle ground with the utilization of digital screen-based devices, especially in virtual classrooms?

A. Integrating Technology into Pedagogical Practice

Students and educators can use technology in kindergarten as a tool, extension, resource, or facilitator in the classroom. These digital screen-based technologies teach many subjects, such as math, science, language, social studies, and art, and are frequently conducted through play-based learning and inquiry [10]. The presence of technology in home environments for online learning has increased due to the pandemic. This brings into question how technology can support Kindergarten curriculum in online learning environments.

Danniels *et al.*'s [28] research explored how technology was used to support student learning and assessment in 20 kindergarten classrooms. The purpose of integrating technology into assessment practices was to "improve the ease, speed, or efficiency of these assessment of learning practices" (p. 7). Technology can also be used to support student learning in play. They found that "visual methods of assessment afforded by technology help to capture the learning processes that occur when children are engaged in play-based activities" (p. 9). The challenges of capturing visual forms of student learning for teachers are organizing and interpreting the various forms of student learning data. Kindergarten educators in the study stated it was important to understand "assessment of learning (what a photo/video is actually capturing) and assessment for learning practices (what the next steps are for that student's learning)" (p. 9). Danniels *et al*. [28] further propose developing a partnership between developers who create applications for teachers. In addition, researchers and teachers should collaborate to make technology accessible and effective for teachers to use. This study demonstrated how technology could be an effective tool for instruction, assessment practices and an effective tool for documenting meaningful learning experiences of children.

Therefore, promoting teachers' competencies in integrating technology into teachers' pedagogical content knowledge (PCK) has become a pressing issue in teacher education and professional development. For example, Koehler and Mishra [29] proposed the technological pedagogical content knowledge (TPACK) framework consisting of three dimensions of technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). TPACK's application is to determine how educators support student learning via technology integration in their teaching practice. TK comprises the educator's ability to understand technology sufficiently to adjust to changes, identify when technology can aid or hinder the attainment of an expectation and the capacity to employ it effectively in the classroom. PK is the educators' ability to facilitate learning through the process and methods or practices of teaching. CK is the educators' comprehension of particular subjects that ought to be learned by students. Between each pair of dimensions, they intersect to form technological content knowledge, technological pedagogical knowledge, and pedagogical content knowledge. Once all three dimensions intersect together to form a Reuleaux triangle [30], they emerge as technological, pedagogical, and content knowledge.

Various online apps can be used to support young children's learning experiences in open-ended ways. The role of educators is shifting in kindergarten classrooms from educator-led to learner centred [31], [32]. Prensky [2] recommends that "young people (students) need to focus on using new tools, finding information, making meaning, and creating. Adults (teachers) must focus on questioning, coaching and guiding, providing context, ensuring rigor and meaning and ensuring quality results" (p. 10). Kim [33] also describes a technology-enhanced curriculum where students are seen as researchers and critical thinkers and teachers as designers. In this sense, students play an equal role in their learning process and take responsibility for what and how they learn. When students are given access to technology such as audio podcasts, games, or blogs and opportunities to explore, navigate and overcome technological challenges, they build valuable skills and confidence with technology. In the partnering pedagogy, teachers differentiate activities for

students through the arts, music, or oral presentations to allow for varied student perspectives to emerge.

B. Attitudes and Beliefs of Teachers toward Technology

Discrepancies of attitudes among teachers towards digital screen use in classrooms range positively and negatively. Constructing a meaningful, creative, and engaging milieu for students with digital screen-based technologies remains problematic for many educators. A pivotal component of education is determining and introducing innovative technological devices into schools to improve student learning [34]. However, school boards unceasingly aggrandize technology and motivate teachers to incorporate technology in the classroom, causing additional stress for teachers, especially veteran educators [35]. The lack of unanimity and ambivalence regarding the merits or disadvantages of digital technology in classrooms has influenced teachers' ideologies, preferences, and opinions toward digital screen-based technology's role in learning and pedagogy. Research indicates that there are numerous reasons why teachers are reluctant to incorporate technology in the classroom. Many factors include the availability of devices, outdated devices, access to software applications, the absence of guidance on potential use, low confidence in teachers using digital screen-based devices, and ambiguity in policy support [36].

C. Screen-Based Technological Devices Use in Kindergarten

Teachers have seen new screen-based technological devices or resources come and go, actualized in practice, substituted or omitted from the classroom [6], [37]. Students and educators utilize various technological resources and devices to augment learning and practical pedagogical tools in FDK classrooms. These devices consist of but are not limited to desktop computers, laptops, tablets (e.g., iPads), smartboards, educational games or videos, and eBooks [7], [38]. Digital screen-based devices can be beneficial tools and great extensions for students and educators. One of the critical arguments in kindergarten classrooms is developmental appropriateness to learning [39]-[41]. Despite attitudes toward screen-based technologies, its incorporation in teaching sheds new light on its actualization in 21st century learning.

Studies on kindergarten students with technology have demonstrated positive results in early cognitive development [42]. Technology use in early learning environments enhances "the quality of young children's play and learning by promoting creativity, curiosity, exploration, collaboration and problem solving" [38, p. 166]. Research suggests that screen-based technological devices stimulate interactions and strengthen children's colloquial skills between their teachers and peers [43]. According to Saharon and Kerlitz, technological devices "improve children's cognitive functions, such as visual, analogical, abstract, and mathematical-logical, and their creative thinking, memory, literacy development, motor-visual coordination, vocabulary, and metacognition" [26, p. 166].

On the other hand, health research reveals that extended consumption of digital screen-based devices negatively affects children's overall health and development [26]. Educational researchers are apprehensive about children's overindulgence in heavy screen time use. Recently, medical professionals have released guidelines for parents on how much screen time children should spend per day [5]. The convenience of screen-based devices becoming more portable and accessible to children may diminish vital human interactions and other critical physical activities. Physical play through sensorimotor activities (i.e., climbing, physical manipulation of objects) is necessary for developing visual-motor skills, which are inhibited when children use screen-based devices. These introductory skills have significantly influenced future success in math and science subjects [13]. Furthermore, early learning through unstructured play stimulates growth in problem-solving skills, empathy, self-regulation and social skills prior to academic learning. Therefore, the effects of long-term digital screen-based device use and lack of care from educators are not apparent until much later [44].

III. Methods

Our case study aims to deepen our understanding of digital screen-based pedagogical practices, attitudes, beliefs and technologies used in one virtual school, particularly FDK teachers [45], by addressing the three research questions: 1) What are the attitudes and beliefs towards digital screen-based technologies and digital resources by FDK educators; and the benefits and challenges of teaching and learning in virtual kindergarten classrooms? 2) What digital screen-based technological tools are FDK teachers currently implementing, and how are they used to document play-based learning, and 3) What do teachers need to know to integrate technology into their virtual pedagogical practices effectively? As virtual learning is a new phenomenon, it will provide a more in-depth look into how educators navigate this new teaching environment.

A qualitative case study was selected as a research method when an experimental design was not suited or feasible for this study. To respond to these research questions, we collected multiple sources of evidence that "address fitness for purpose, and skills probing beneath the surface of phenomena" [46, p. 389]. Convenience sampling and snowball sampling were used in this study to recruit virtual kindergarten teachers, as it was difficult to reach these participants [46]. One source was from one virtual school located in Southwestern Ontario, specifically the educators from virtual FDK classrooms. Also, 11 teacher participants as registered early childhood educators (RECE) or Ontario Certified Teachers (OCT) were recruited from public social media forums (see Table I). Data sources included semi-structured interviews (15-20 minutes in length) using anecdotal notes and teacher-researcher reflective notes.

This study used both qualitative and quantitative methods. The qualitative data were analyzed using NVivo 12 software which analyzed the written transcripts of the educator interviews and the teacher-researcher reflection notes. The quantitative data were analyzed using Microsoft Excel [47], which analyzed the descriptive statistics of the participants' sex, education level, specialization, qualifications, and years of teaching. In an inductive method, a thematic content analysis was used to analyze the semi-structured interviews of written transcripts and teacher-researcher reflective notes

[45]. We employed the following seven steps [45]: defining the units of analysis; paraphrasing the relevant passages of text; defining the level of abstraction required of the paraphrasing; data reduction and deletion (e.g., removing paraphrases that duplicate meaning); data reduction by combining and integrating paraphrases at the level of abstraction required; putting together the new statements into a category system, and reviewing the new category system against the original data.

The coding analysis began with careful, line-by-line coding of the first few transcripts until there was no need to develop new codes, as the existing codes could entirely cover the newly inputted data. After coding the first five transcripts, 79 classifications were created. These codes were scrutinized before coding the data from the subsequent interviews in order to aggregate the classifications. Next, the codes were visually analyzed after reviewing and rereading the coded interviews numerous times. The purpose of this phase was to ensure that the created codes precisely described the coded data. In addition, there were no duplicates or codes that covered the same topic but were phrased differently.

Afterwards, these descriptive codes were organized into a "parent-child" relationship, a term used in NVivo to refer to the hierarchical organization of codes. Following that, each code was reviewed, and duplicates were removed by "merging" two or more codes into one. Some of the codes were also becoming more inclusive at this point. Then these codes were then utilized to code the subsequent interviews in a process known as focused coding. As more transcripts were reviewed and processed, the analysis required more and more analytical thinking and elucidation. Thus, the codes were gradually altered by merging from line-by-line, descriptive codes predominantly expressed in gerund forms and used to sort the data into more inclusive and conceptual codes to further classify, synthesize and conceptualize the current coding framework. The number of codes in the final thematic framework was reduced to 61 due to these processes.

Throughout the data analysis, the steps mentioned earlier occurred regularly. Although the preponderance of subsequent interviews was classified using the same codes, new codes were developed occasionally. Simultaneously, the analysis of combining and re-naming the codes was ongoing, with the goal of revealing a final set of themes and sub-themes that would be presented and debated in this study.

Data triangulation is vital when collecting qualitative data, such as interviews and teacher-researcher reflections, and coupled with persistent observations and peer debriefings, strengthened the validity of this study [48]. Triangulation in this study consisted of “a variety of data sources, different perspectives,” and “different methods pitted against one another to cross check data and interpretation” [48]. In addition, multiple data collection methods in qualitative research can establish shared perspectives [49].

To protect the study's validity, reliability, and trustworthiness, two methods were used to safeguard against a loss of credibility. The methods included persistent observations and peer debriefings. Persistent observations involved members from our research team (i.e., 1 MA student, 1 PhD student, and a supervisor) consistently observing the teacher-researcher’s virtual class. From these observations, the research team proposed questions through a knowledge forum (i.e., KF6), and the teacher-researcher would respond to these questions. These responses would be the data from the teacher-researcher reflective notes. In addition, peer debriefing sessions from the research team were conducted to strengthen the objective evaluation of the study and data analysis. Peer debriefing involved an “opportunity to test the growing insights against those of uninvolved peers” and “to receive advice about important methodological steps in emergent design” [49]. Therefore, cautiously employing these precautions with data triangulation ensured a more valid, reliable and trustworthy study [49].

IV. Findings

A. Attitudes and Beliefs of Virtual FDK Teachers towards Digital Screen-Based Technologies

The interviews with teacher participants reveal teacher participants’ attitudes and beliefs towards virtual teaching and learning regarding the benefits and challenges for teachers and students**.**

1) Benefits of virtual learning and teaching

Though the participants devoted more time conferring the diverse challenges, nevertheless educators were cognizant of the specific ***benefits of virtual learning and teaching***. These, in turn, were differentiated into benefits for educators themselves and those regarding the students.

TABLE I: Teacher Participant Profiles

Teacher	Age	Gender	A professional designation	Level of teacher training	Years teaching
Teacher 1	33	F	RECE	ECE	11
Teacher 2	28	F	OCT	BEd	2
Teacher 3	52	F	OCT	BEd	17
Teacher 4	51	F	OCT & Music	BEd	25
Teacher 5	53	F	RECE	ECE	30
Teacher 6	42	F	OCT	a Master of Teaching	17
Teacher 7	27	F	OCT	BEd	2
Teacher 8	25	F	OCT	BEd	2
Teacher 9	26	F	OCT	BEd	2
Teacher 10	39	F	RECE	ECE	27
Teacher 11	43	F	OCT	BEd	20

a) Benefits of virtual learning

Regarding virtual learning for students, as Fig. 1 shows, ***convenience and efficiency*** were also discussed indicating, “shorter days for students” (Teacher 5) and that children have a “more flexible schedule” (Teacher 1) as a result. This sub-theme was part of a broader benefit of merely being in ***the comfort of own home,*** which was seen to be less distracting and stressful than the in-person classrooms. “Students are able to work quietly in their homes,” according to Teacher 3, and are “more attentive in some ways than a typical kindergarten classroom.” Thus, a few believed that online learning is ***less distracting*** in general. Most significantly, being allowed to stay at home is ***better for kids with anxiety*** since it is a “far more comfortable environment” (Teacher 7), particularly for children who “have social anxiety when going to school” (Teacher 1) or are “shy” (Teacher 7).

As previously stated, parents play an essential role in their

children's education, and online learning provides additional options for parents to participate. Teacher participants who mentioned this benefit believed that "parents are much more actively involved in their children's learning than in bricks and mortar" (Teacher 5) and that "there is the opportunity for more parent engagement and support" (Teacher 1). Finally, the benefit mentioned above for teachers who can readily communicate with individual students is that this ability can provide students with more ***individual attention*** from their teachers.

b) Benefits of virtual teaching

The most acknowledged benefit of virtual teaching is that it is ***convenient and efficient***.

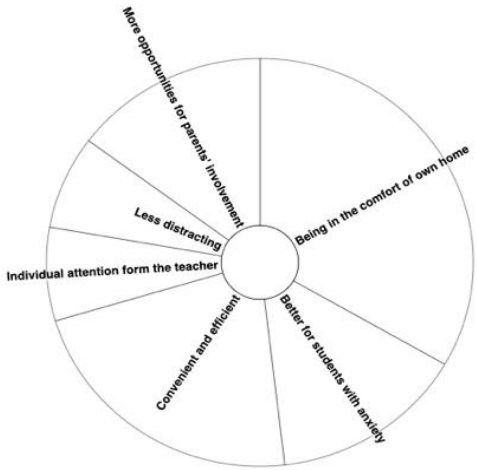

Fig. 1. Benefits of virtual learning.

The teacher participants expressed that it "provides a flexible schedule for educators" (Teacher 1) and it is "less physically taxing and mentally taxing than in the classroom" (Teacher 5). This sub-theme leads to another advantage: it is ***good for mental health and a sense of safety***. This form of labour, according to Teacher 5, is less psychologically exhausting, which may be due in part to the fact that the "element of care [is] with the parents" (Teacher 3). However, the majority of teachers who mentioned this advantage of virtual teaching mentioned the lack of "covid stress (Teacher 2), which includes the stress of being infected, as well as the stress of having to adhere to restrictions and policies.

As Fig. 2 shows, another benefit stemming from the previously mentioned convenience and efficiency is that virtual teaching can facilitate a ***good work-life balance***. Those that commented, for example, stated that educators could save time since "transitions are shorter" (Participant 8) and teachers eliminate the time to commute. The benefit of online education, according to three teacher participants, is that it is simple to ***communicate with individual children***. In addition, teachers complimented being able to "call on children individually without other distractions" (Teacher 5), which can be best utilized with virtual breakout rooms. Finally, two teacher participants stated that the ability to ***connect with parents*** was simple, stating that "we are more accessible to one another (Teacher 5) and that engaging with parents is "easier than in the classroom" (Teacher 11). This finding represents the critical role of parents, which will be discussed several times throughout this study as it emerges in relation to each of the major themes.

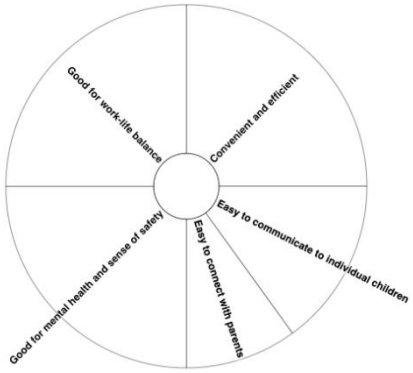

Fig. 2. Benefits of virtual teaching.

2) Challenges of virtual learning and teaching

Teacher participants offered more comments regarding ***the challenge of virtual learning and teaching*** than they did about the benefits. The challenges are divided into three categories: those affecting teachers, those affecting students, and those concerning both teachers and students.

a) Challenges of virtual learning

There were 6 challenges of virtual learning during the teacher interviews and teacher-researcher reflections (see Figure 3). The most discussed challenge was that this learning mode could be challenging for low socio-economic status families. For example, some families may have inadequate access "to the internet and devices" (Teacher 2) and may not have additional resources. In other cases, there may also be a general "poor family dynamic" (Teacher 8).

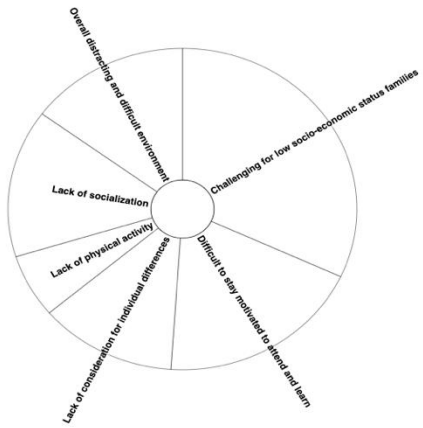

Fig. 3. Challenges of virtual learning.

Another discussed challenge is that it may be ***difficult to stay motivated to attend and learn***. Although learning at home may be, as previously stated, a convenient and "safe environment" for students, some children may find it difficult to adhere to the routines as rigorously as they would in bricks and mortar schools (Teacher 5). Some teacher participants expressed worry about "struggle with certain students coming late" (Teacher 1) and a "student not coming prepared to class [and] not knowing or having the supplies" (Teacher 4). The majority of teachers who replied on this issue raised concerns about "tough" and "inconsistent" (Teacher 7) online class attendance.

Another issue in virtual classrooms is the ***lack of socialization*** among students. The children are "alone without peer interactions (Teacher 4) and do not "get the benefit of socializing and being physically active with their

friends (Teacher 1). Furthermore, as Teacher 3 pointed out, there is a "lack of modelling from stronger students when grouped by academic ability," which is an aspect of "socialization" that directly relates to academic achievement.

While staying at home offers many potential benefits, particularly for students who may be anxious about going to school, it may also prove to be a challenge under certain circumstances. As a result, five teacher participants raised concerns that learning at home may be ***an overall distracting and difficult environment***, citing a variety of "home distractions" (Teacher 2), such as siblings, parents, and various sorts of "background noise" (Teacher 10).

Lack of consideration for individual differences was a challenge identified both during the teacher interviews and teacher-researcher reflections. The main issue was that virtual learning might not be appropriate for students of all ages and abilities. As the teacher-researcher reflected in the journal about the use of presentation slides (i.e., Google Slides, PowerPoint) posted by the FDK team for students, for example, "the implementation of interactive software is very difficult in kindergarten," and because "children's [fine motor] development ranges, only about one-third of my students would be able to participate in an interactive virtual activity [during the first half of the year]. I can see these interactive games being used in older grades…but not in kindergarten". Similar concerns were raised by a few who commented in the interviews, with the main concern being that "virtual learning environment is not best suited for early learners" (Teacher 7). One of the reasons for these worries is that teachers found it challenging to apply student-centered play-based learning in the virtual environment. The ***lack of physical activity*** was another challenge of virtual learning.

b) Challenges of virtual teaching

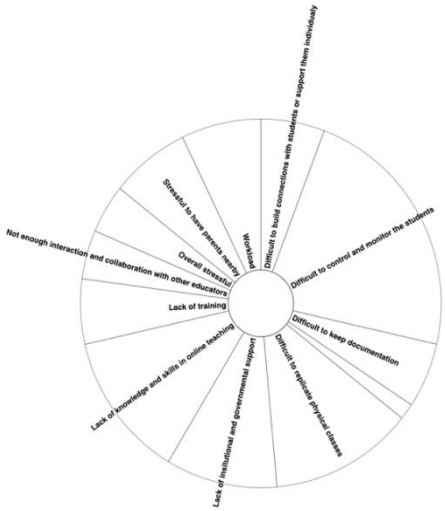

Fig. 4. Challenges of virtual teaching.

There were 11 challenges of virtual teaching during the teacher interviews and teacher-researcher reflections (see Figure 4). The most commonly stated challenge relating to teachers is how it is ***difficult to control and monitor the students*** in an online setting. Reflecting on the previously discussed finding that students may find it challenging to stay motivated and attend, the main concern was about absences and tardiness, as well as about "students not coming prepared to class" (Teacher 4). The latter, rather than just a behavioural issue, might also result from certain families' low socioeconomic status, as previously mentioned. The educators were also concerned that it is generally difficult to "engage students" (Teacher 3) and control some "inappropriate behaviours" (Teacher 6), such as not turning on the camera. Overall, students' engagement "has been rough (Teacher 7) to the point that Teacher 7 felt that "I don't know what to do anymore [to] try to engage students."

This issue is partly related to another acknowledged difficulty, namely the overall ***lack of knowledge and abilities in online teaching***, which was addressed both in the interviews and the teacher-researcher reflections. "It looks like educators, specifically more veteran educators, struggle with implementing technology and digital resources," stated the teacher-researcher. Virtual teaching, in general, is "not transparent with educators" (Teacher 2), and teachers suffered especially in the early months of virtual teaching when they were still "learning new technology" (Teacher 5) and "changing and inventing on the fly (Teacher 6).

The ***lack of institutional and governmental*** support made adjusting to this new mode of teaching much more challenging. Some teachers expressed concerns that the school boards did not provide enough physical resources and that "the government wasn't as supportive as I thought it would be" (Teacher 2). Others, on the other hand, believe that there is a lack of training. Although most of the teacher participants responded to being content with their training, some believed it was insufficient. The unpredictability of the pandemic and lack of support result in a sense that virtual teaching contributed to an ***overall stressful*** experience. In terms of stress, three teacher participants mentioned that having parents nearby may be wary, to the point that Teacher 11 felt "overwhelmed by the parents." Another cause of stress might be the workload, as several teacher participants stated that while teaching online, "you always had to have three backup plans" (Teacher 7) and that one must "over-plan" constantly (Teacher 2).

In the online teaching environment, four teacher participants believed it was ***difficult to replicate physical classes***. Many things are "not the same as [in] the classroom," according to Teacher 7, such as incorporating inquiry, play and doing "science experiments" (Teacher 4). Although, as argued previously, four teacher participants expressed concern that it is ***difficult to build connections with students or support them individually***. It is challenging to work with "kids that require hands-on learning" (Teacher 8) and to "build connections with students" (Teacher 7). It is also challenging to understand non-verbal cues, as Teacher 11 pointed out, which makes building relationships with students more challenging. Another problem, according to three teachers, was that pedagogical documentation differed from in-person classrooms, stating that "documentation was tougher" (Teacher 7) and, therefore, ***difficult to keep documentation***. Thus, coupled with other discussed challenges, it makes the task of monitoring student development more complex. Finally, two teacher participants raised concerns about not enough interaction and collaboration with other teachers, noting that they "felt isolated" and there is no sense of community with educators between classes" (Teacher 2).

3) Challenges of both virtual teaching and learning

Four challenges affected both students and teachers because they entailed external factors that impacted both groups (see Figure 5). For instance, ***technological failures and limitations*** were the most cited difficulty in both the teacher interviews and the teacher-researcher reflections. A prevalent issue was that "technology doesn't work" (Teacher 10) and that "poor-quality internet connection and students having poor internet connections makes online teaching very difficult" (Teacher-researcher reflections). Several technological failures were communicated, but the underlying theme of these dialogues was that having to depend on technology and internet speed is what makes online teaching and learning difficult and stressful.

Another major issue affecting both students and teachers is the ***lack of parents' involvement and support***. The critical role of parents has been evident as previously stated. Parents play a vital role in children's education, especially in virtual learning, and "family cooperation" (Teacher 6) is a crucial factor that can make or break the success of online education. "Different commitment levels of parents" (Teacher 3) make a significant impact, and "if you have parents that do not read everything provided, …their children are not prepared" (Teacher 1).

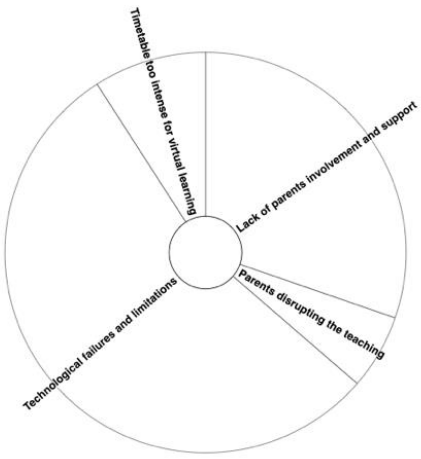

Fig. 5. Challenges of both virtual teaching and learning.

Two teacher participants raised concerns that some parents tell their children the answers or correct them whenever they say anything wrong. Finally, three teacher participants brought up the problem of the ***timetable being too intense for virtual learning.***

B. FDK Teachers' Digital Screen-Based Technological Tools in Virtual Pedagogical Practices

The overall curriculum framework resources used by kindergarten teachers are 'The Kindergarten Program', with some references to the 'Growing Success' and 'How Does Learning Happen?' documents. The physical devices or materials include laptops, phones, tablets (i.e., iPads), whiteboards, professional studio spotlights, cameras, and desktop computers, and the digital resources that were mostly used are Microsoft Teams, Google Drive, Google Docs, Google Meets, Google Slides, YouTube, Pinterest, Facebook, Twitter, Instagram, and virtual organizers. Students and families were provided digital resources for learning through their learning platforms (i.e., D2L, Google Classroom) from school boards, including TVO mPower, Mathletics, Raz-Kids (e.g., Headsprout), Epic, PebbleGo, educator created interactive games (i.e., Boom cards, PowerPoints, Google Slides), online websites or games (e.g., ABCya, Teach Your Monster to Read, Lalilo, Kodable) and educator created choice board play-based activities. The devices and digital tools or resources are involved in facilitating learning or supplementary items to reinforce the learning in kindergarten.

One of the responsibilities of an educator is to document students' growth and learning in the classroom. With learning occurring remotely, these responsibilities have changed to a shared responsibility between educators and parents. Educators disclosed various ways to document learning, including pictures, videos, portfolios, anecdotal notes, individual meetings, observations, screenshots, audio recordings, checklists, assessments and weekly reports by the parents. The submissions mentioned above were sent to educators by parents through a board-approved learning management software. Some submissions did involve student agency in their learning by providing audio recordings with their submissions.

C. Factors for Effective Virtual Pedagogical Practices

On several occasions, the teacher participants explained what they do to facilitate effective virtual learning and reflected on various appropriate pedagogical practices for virtual teaching. Ten themes were emerged using the teacher interviews and the teacher-researcher reflections.

Teachers' ***creativity and adaptability in teaching*** were the most discussed facilitator of effective teaching and learning. This theme centered on teachers' efforts to compensate for the limitations of the virtual environment by adapting lessons flexibly to emulate in-person classrooms and ensure students' growth and development. Figure 6 encapsulates these diverse initiatives by teacher participants: use of play and appealing to children's interests, small groups and short lessons, the use of break-out rooms, adjusting the mimics and voice, engaging community helpers, replicating classroom environment and dynamics, and inquiry-based learning, screen sharing, collaborative learning, and assigning virtual names.

The theme of ***making the most of the available technology and software*** is partly related to ***creativity and adaptability in teaching***. Here, the teachers identified several physical devices and virtual resources they utilize in teaching. The physical devices or materials include laptops, phones, iPads, whiteboards, professional studio spotlights, cameras, and desktop computers, and the digital resources that were mostly used are Microsoft Teams, Google Drive, Google Docs, Google Meets, Google Slides, YouTube, Pinterest, Facebook, Twitter, Instagram, and virtual organizers. Given those resources mentioned above, it should come as no surprise that ***access to digital resources, internet and technology*** is another factor that contributes to successful and practical teaching that teachers discussed and that to utilize the available resources fully, a teacher requires "a really good computer" (Teacher 2) and a fast internet connection. Teachers need access to the above-mentioned technological resources and the ability to teach in virtual classrooms. Therefore, ***institutional support and professional development opportunities*** are also required. Although most

teacher participants appeared to be content with the help received from their school board, some expressed concerns and considered that more should have been done to support teachers in virtual classrooms.

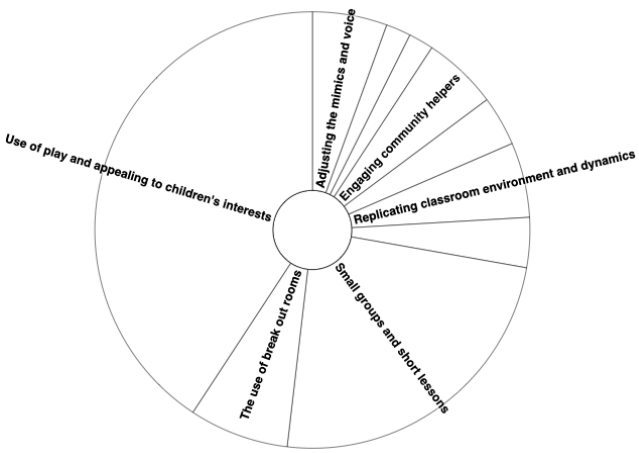

Fig. 6. Teachers' creativity and adaptability in teaching.

Although competent use of technological resources is a component that contributes to the quality of virtual teaching and learning, several teachers pointed out that a ***balanced use of technology*** is also necessary. "Digital technology is [only] the medium" (Teacher 10), and "it shouldn't be the only tool used" (Teacher 6). As a result, digital technology should be utilized "always in moderation" (Teacher 7) and "there should be a balance using technology and physical items" in the virtual classroom (Teacher 1). ***A structured way to monitor and keep documentation*** is another factor that reflects the previously discussed challenges with monitoring the students and obtaining pedagogical documentation. The teachers mentioned an assortment of ways to keep documentation, including pictures, videos, portfolios, anecdotal notes, individual meetings, observations, screenshots, audio recordings, checklists, assessments, and weekly reports by the parents.

This analysis leads to another factor of successful virtual education emerging throughout this analysis: ***engaged and supportive parents***. Those teachers who positively evaluated their experience with virtual teaching frequently commended the "motivated parents, engaged in their children's learning" (Teacher 1). As previously stated, "parents' support is needed" (Teacher 10), and Teacher 8 felt "lucky that my parents are very responsive, and we communicate on many platforms." These quotes, in turn, emphasize the significance of ***regular communication with the parents*** since it is the teacher's responsibility to "guide parents through the online learning platform and make sure they know where to go" (Teacher 1). Setting "clear expectations for families at the beginning" (Teacher 6) is also necessary to ensure that parents support the student's learning and do not obstruct the teaching. To educate parents and "keep communications open and transparent" (Teacher 1), teachers commented on this topic and mentioned several methods of communication with parents, including direct emails, newsletters, and specific communication platforms (i.e., Microsoft Teams and Google Meets). Furthermore, collecting and considering parent feedback was discussed to abstract "honest opinions" (Teacher 6) and ensure that the teachers "don't waste time" (Teacher 10) creating resources or distributing resources that parents do not use. Overall, teacher participants agreed that "as much dialogue [as possible] between educators and families" is required (Teacher 11).

Further, our teacher participants indicated that technology can be used for multimodal pedagogical documentation and learning opportunities. They unanimously and strongly agreed that they used technology to collect information that showed students' learning progress at an individual or group level over time. However, there was less agreement that students should see their group or class's learning journey in a visualized format with the help of technology.

V. Discussion and Implications

We explored the experiences of kindergarten educators teaching in virtual kindergarten classrooms. As our findings indicate that the educators in the study generally demonstrated a positive attitude towards technology in kindergarten or early childhood education as demonstrated in other countries such as Australia, Belgium, Chile, China, Greece, Israel, Malaysia, Portugal, Singapore, Slovakia, Sweden, Turkey, and the United Kingdom [8], [9]. However, the results from this study revealed that attitudes, beliefs and experiences towards virtual learning, digital technologies and digital resources varied. This result aligns with some prior research that reported a wide discrepancy in attitudes and beliefs educators behold towards the integration of technology in kindergarten and early childhood settings [9], [38]. These attitudes and beliefs continue out of the physical classroom and into virtual remote learning.

The first research question asked about the teacher participants' attitudes and beliefs toward digital screen-based technologies and digital resources, including the benefits and challenges of teaching and learning in virtual kindergarten classrooms. From the interviews, they were adamant and in agreement that if technological devices and resources were used in brick-and-mortar classrooms, and especially now in virtual classrooms, they need to be used appropriately in a meaningful and purposeful manner. With the pandemic forcing many school boards to adapt and provide virtual learning, the teachers needed to become creative and adapt to teaching by making the most of the available technological devices and harmonizing learning opportunities approach with child-centered pedagogy such as play-based learning.

The teacher participants acknowledged the benefits of virtual learning and teaching for students and teachers. The benefits for students included being in the comfort of their own home, convenient and efficient, choice in the mode of learning that best suits students' needs, better for students with anxiety, more opportunities for parental involvement, individual attention from teachers, and a less distracting environment. The teachers also indicated the need for more time for 1-to-1 meetings with students. Research in differentiated instruction has also highlighted the positive impact of pedagogical practice on improving student performance with virtual learning [50]. The benefits for educators teaching virtually were convenient and efficient, good for mental health and a sense of safety, good for work-life balance, and accessible communication to individual children and parents. In addition, they indicated

that choice in the teaching mode could benefit teachers.

Despite these benefits of virtual teaching and learning for educators and students, our study showed that technological failures and limitations, lack of parental involvement and support, intense timetables for virtual learning and parents disrupting the teaching could challenge virtual teaching and learning. Seguin *et al*. [51] also show that virtual learning may not be suitable for all learners, and screen time should be monitored as the pandemic has exacerbated screen time. Although the current study did not directly address the issue of screen time, both benefits and challenges could lead to a necessary condition for teachers' pedagogical decision-making [14].

Our findings to the second research question show that with the previous research literature, many research endeavours (e.g., 'The Kindergarten Program') were outdated with what physical devices and digital resources are currently utilized in FDK classrooms, particularly now with the emergence of virtual teaching [52]. This study provided all stakeholders with a preliminary update on current digital screen-based technological devices and digital resources used in FDK classrooms and how they were used to promote play-based learning, particularly in the virtual milieu. Future research should consider the effectiveness of digital screen-based devices and software to support diverse children's interests, experiences, and needs. For instance, online learning may not be suitable for all learners. Future research should also look into which personality traits are more apt for virtual remote learning (i.e., the HEXACO model or Big 5 model) [53], [54]. Moreover, researchers and health professionals need to consider the ramification of excessive screen time and its effect on gross motor skills, fine motor skills, self-regulation skills, specific neuro-level anatomy, brain development, and overall healthy development of the child [5].

With learning not occurring in the confines of a classroom but in students' homes, the educators relied on parents to document student learning through their school board's approved software platform (i.e., D2L, Google Classroom or Drive). Previously within the classrooms, teachers would use an assortment of pedagogical documentation approaches (whether paper or pencil or with the use of technology) to document, assess, and communicate kindergarten students' growth and learning [31], [55]. These approaches would include anecdotal observations, anecdotal written notes, checklists, assessments, student artifacts, photos, and videos [56]. In the current study, educators incorporated the highlighted approaches mentioned above. The educators also added formal and informal assessments, audio recordings of students by educators or from students via submissions, and quotes from students' responses or sharing their learning during synchronous blocks as other options specifically for virtual kindergarten. However, as highlighted by DeLuca and colleagues, our findings also show that "there is a lack of systematic documentation of assessment" [56, p. 474). Future research on teacher data literacies could help teachers document, store, and access student growth and learning to make learning visible to all stakeholders (e.g., students, parents, and school boards) [33].

The third research question asked how to support successful technology integration into virtual pedagogical practices. Teacher participants in our study have identified that the localized success of virtual classrooms heavily relies on the support and collaborations between teachers, early childhood educators, and parents. On this basis, they discussed the different adjustments, approaches, strategies, abilities, and resources. Specifically, teachers and early childhood educators must explore practical ways to support parental engagement in virtual teaching and learning to support young children. Given the lack of parental engagement in virtual kindergarten classrooms, further classroom-based research on what is and is not effective in parental engagement is needed to help student engagement in virtual learning.

VI. Conclusion

Virtual learning is not a one size fits all educational experience. American economist Thomas Sowell says, "There are no solutions, there are only trade-offs; and you try to get the best trade-off you can get, that's all you can hope for." To put it differently, in an educational context, all learning modes complete the task in different ways and with benefits, challenges and drawbacks. For example, education in brick-and-mortar schools provides students with all the benefits of in-person learning (e.g., community, more hands-on learning, greater socialization, and more physical activity); however not dynamic enough for real-time responses, such as a pandemic. In contrast, remote learning can provide practical benefits (e.g., greater individual attention, more significant opportunities for parental involvement, greater efficiency) but lacks certain aspects of in-person learning. Thus, educators, parents, and FDK stakeholders must rigorously weigh the advantages and disadvantages of each mode of learning in the context of their specific situations, objectives, desired goals, and, most importantly, if it is best suited for the child.

Despite our contributions to virtual teaching and learning, this study has a few limitations. An explorative case study was selected as a research method when an experimental design was not suited or feasible for this study. From the interviews and informal conversations with educators, many are burnt out from the pandemic and its consequences within their educational vocation. Therefore, this may have impacted the recruitment of participants in this study. Regarding the number of participants in the study and improvement for future studies, a more significant number would yield inferential statistics and possibly produce greater objectivity and generalizability of experiences from educators in Ontario.

VII. Contributions and Recommendations for Practice and Policy

With the possible threat of future global pandemics and the possible necessity to mandate schools to transition to temporary virtual remote learning or future full-time modes of virtual learning, this study suggests the following recommendations based on the findings about virtual teaching and learning for educators, school boards, policymakers, and parents.

A. Educators

Educators have the most arduous task of all. Educators must provide an exceptional educational experience without educators physically in the classroom. Our study suggests and provides a few recommendations from educators and a teacher-researcher that can help educators in the future if they teach virtually or transition to temporary remote learning. 1) Harness inner creativity and adaptability in teaching. Make the most of what teachers have, keep it simple, and adapt lessons flexibly to emulate in-person classrooms to ensure student growth and learning. 2) Collaboration with a teaching partner. Create an honest, transparent, and cohesive relationship to provide the best educational experience for students. 3) Create a structured timetable incorporating whole groups, small groups, 1-on-1 meetings, and breaks with dance, music, and movements embedded into the learning. Providing students with a structured timetable with different group settings and embedding dance, music, and movement into synchronous teaching will provide students with an engaging and safe expected routine and mitigate the sedentary aspect of virtual learning. 4) Find harmony with play-based learning activities with technological digital devices and digital resources with evidence-based practices through the play-based learning continuum.

Provide students with agency in their learning through children's interests and inquiry. As always, incorporate students' interest in the learning by asking them what they want to learn about in the classroom.

B. School Boards and Policymakers

Educators have identified that the localized success of virtual classrooms heavily relies on the support and collaboration between teachers, early childhood educators, and parents. However, our study identified that school boards and policymakers fell short of providing educators with the quality tools and training to execute teaching in virtual kindergarten classrooms. Educators require quality internet connection, quality technological devices, digital resources, and quality professional training or workshops. This support will mitigate the overall stressful experience of virtual teaching.

C. Parents and Guardians

It is required for parents and guardians to submit evidence of learning, have their child ready with all the carefully thought-out necessities that educators ask, monitor the child's attentiveness, refrain from interjecting during the lesson, or prompt the child with the answer, provide encouragement or consequences, and most importantly, be part of the learning journey. Remember, education begins and continues at home, not at school.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

We participated in data collection and analysis, including writing and approving the manuscript for submission.

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