Taking it Outside: Engaging in Active, Creative, Outdoor Play with Digital Technology

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Abstract

This 3-year study followed 14 kindergarten classrooms in Ontario as they used open-ended tablet applications to support outdoor play and learning. Through the creation of slideshows that incorporated their photos, video, drawings, and audio recordings, the children explored their physical and creative activities outdoors, as well as their connections to nature. The educators were initially cautious about safety and solitary and sedentary use of the tablets. However, findings illustrated that children used the tablets safely, both individually and collaboratively, in conjunction with outdoor pursuits such as climbing and dramatic play. Rather than undermining the active, social, and nature-focused value of outdoor play, the use of open-ended apps enhanced these aspects by allowing children to attend to, document, and review their outdoor interests and activities.

Resumé

L'étude, échelonnée sur 3 ans, a observé dans 14 classes de maternelle de l'Ontario l'utilisation de tablettes et d'applications ouvertes en soutien au jeu et à l'apprentissage en plein air. Les élèves créaient des diaporamas en y incorporant leurs photos, vidéos, dessins et enregistrements audio, une façon pour eux d'explorer à la fois des activités créatives et physiques en plein air tout en cultivant leur contact avec la nature. Au départ, les éducateurs s'inquiétaient de la sécurité avec les tablettes et craignaient que leur utilisation favorise le jeu solitaire et la sédentarité. Toutefois, selon les conclusions de l'étude, les enfants utilisaient les tablettes de façon sécuritaire, seuls ou à plusieurs, tout en pratiquant des activités extérieures (grimper, jouer à faire semblant, etc.). Plutôt que de diminuer les bienfaits du jeu en plein air que sont l'activité physique, la socialisation et le contact avec la nature, l'utilisation d'applications ouvertes est venue renforcer ces aspects en permettant aux enfants de fixer leur attention sur les activités en plein air, de montrer ce qu'ils aiment faire à l'extérieur, de consigner leurs expériences et de mieux les comprendre.

Keywords: Early Childhood; Outdoor Play; Nature; Digital Technology; Tablet Applications

Mots clés : petite enfance, jeu en plein air, nature, technologie numérique, applications pour tablette

The benefits of outdoor play for children have been well documented, including physical and mental health benefits (e.g., Herrington & Brussoni, 2015). The benefits of digital technology for children's learning and development are less well known, but there is a growing body of research literature illustrating a wide range of benefits (e.g., Radesky, Schumacher & Zuckerman, 2015; McGlynn-Stewart, MacKay, Gouweleeuw, Hobman, Maguire, Mogyorodi, & Ni, 2017a). However, little is known about how digital technology can enhance the benefits of outdoor play for young children.

This three-year research study (2015–2018) examined the use of tablet applications to support young children's (ages 3–6 years) learning and meaning-making in kindergarten programs in Ontario. The open-ended nature of the apps used allowed the children and educators to engage with digital technology in individualized ways that suited the multiple contexts within early learning settings. The multi-modal affordances of the apps permitted children to create drawings, videos, photographs, audio recordings, and/or combinations of these options in ways that captured their curiosity and intensified their interests in learning. Children archived their work for later reflection, assessment, and documentation. This paper focuses on the use of the tablet applications in outdoor settings, looking specifically at two questions: "How do kindergarten educators experience the use of open-ended tablet applications in the outdoors with kindergarten children?" and "How do kindergarten children engage with open-ended tablet applications in the outdoors?"

Literature Review

Although there is a growing body of research supporting digital technology for early learning (e.g., Neumann, 2016; Radesky, Schimacker & Zuckerman, 2015; Wong, 2015; Blagojjevic et al., 2012) and the importance of outdoor play for young children (e.g., Herrington & Brussoni, 2015; World Health Organization, 2012), little research has been conducted on young children's digitally-mediated learning and play in the outdoor environment, particularly where children are creating and curating the content. Digital technologies (DT) continue to emerge and evolve at a rapid rate and have become prevalent in both formal and informal learning environments for young children. DT popular with children aged 3–6 years include computers, tablets (e.g., iPads), and cellphones. Studies that provide insight into how best to support young children as they navigate the digital world are few. When exploring the use of DT with young children, some researchers express conflicting messages: They suggest caution but also celebrate the active, interactive, and inquiry-based learning potential afforded by DT (e.g., Council on Communication and Media, 2016; NAEYC, 2012; Radesky, Schumacher & Zuckerman, 2015). Evidence about the learning potential of open-ended iPad apps in early learning environments is becoming more prevalent in the literature (e.g., Fleer, 2014; Roswell & Harwood, 2015; McGlynn-Stewart,

Braithwaite, Hobman, Maguire, Mogyorodi, & Park, 2017b). There is growing evidence that educators can use DT to support students as they learn to question, construct theories, and develop skills to foster active global citizenship (Wimmer, Skramstad, & Khan, 2012). In fact, recent research has shown that intellectually challenging screen activities can benefit cognition (Walsh, Barnes, Cameron, Goldfield, Chaput, Gunnell, Ledoux, Zemek, & Tremblay, 2018).

In addition to cognitive benefits, social relationships between children and adults can be strengthened through warm and intentional interactions while using technology (McClure, Shentsove-Dutton, Barr, Holochwost & Parrott, 2015). When children and adults use interactive technology together, there can be great opportunity for learning and bonding (Radesky, Schumacher & Zuckerman, 2015). Technology can also help strengthen the bonds between children and their peers (McClure et al., 2015; McGlynn-Stewart, Brathwaite, Hobman, Maguire, & Mogyorodi, 2018) and, when used in social ways, contribute to improved communication skills (Lavigne, Hanson & Anderson, 2015). Additionally, DT can be seen as a creative tool that children can use to explore and express themselves in varied and multiple ways (Mitchell, 2007) as they seamlessly move between imaginative and concrete worlds—what Fleer (2014) refers to as "flickering" (p. 203).

However, most research investigating children's use of DT has been focused on the use of technology indoors (e.g., Falloon & Khoo, 2014; Roswell, 2017). The few existing studies that have explored DT and children's outdoor play and learning have focused on adults' use of DT to measure children's physical activity (Herrington & Brussoni, 2015; Truelove, Bruijns, Vanderloo, O'Brien, Johnson & Tucker, 2018; Vanderloo & Tucker, 2017) rather than on children's use of it to explore and document their interests, activities, and interactions with the outdoor environment. Prominent authorities (e.g., Canadian Pediatric Society, 2017; U.S. Department of Education, 2016) recommend that DT, when used outdoors, should be employed in ways that are interactive, promote children's interests and expand their explorations of nature and the surrounding environment.

Research clearly illustrates the benefits of outdoor play for young children. Opportunities to develop meaningful relationships with nature during early childhood are thought to promote lasting motivation to engage with natural environments (NAAEE, 2010). When young children's play occurs in natural spaces, it can foster varied types of self-motivated play experiences that promote physical and developmental growth (Herrington & Brussoni, 2015). Managing their play allows children to develop self-regulation skills that can support them as they navigate their options and make decisions (Gray, 2013). Furthermore, child-directed play can foster creativity, confidence, and adaptability (Farmer et al., 2017; Robson & Rowe, 2012).

Despite the documented benefits of self-directed outdoor play, western societal views have normalized the idea of children being in need of protection or less capable than they are (James & Prout, 1997; Mayall, 2000). This may create instances where professional concerns about safety (Sandseter & Sando,

2016) cause educators, who are typically supportive of child-directed pursuits, to create barriers that keep children from making their own play decisions outdoors. When DT is introduced into the outdoor learning environment, these concerns may be magnified. Furthermore, the purposeful and appropriate incorporation of DT into early learning classrooms requires teachers to be skilled in areas such as technical aspects of operating DT, incorporating DT into classroom routines, recognizing what DT learning looks like, and teaching with DT. However, there are very few pre-service or in-service professional learning opportunities on these and related subjects. Further complicating the issue is that the principles of constructivist learning, so familiar to early childhood professionals, are mostly absent from the multitude of mobile applications claiming to have educational value (Goodwin & Highfield, 2012). Open-ended apps—those that allow and encourage children's creative input—are relatively rare. This leaves many early childhood professionals feeling uncertain about the role of DT in their classrooms (Beschorner & Hutchison, 2013). Educators require better support at both pre-service and in-service levels so that they can face the challenges and opportunities of integrating DT in their programs in meaningful ways.

The research literature reports on the many potential benefits of both digital technology and outdoor play for young children. The present research study focussed on the largely unexplored intersection of child-led play with open-ended DT in outdoor environments.

Methodology

This study used a qualitative, case-based research approach, as defined by Merriam (2009) and Punch (2009). The study involved an in-depth examination of a modest sample of teachers. The interviews, focus groups, and observations were largely open-ended, and the themes emerged as the study progressed. The transcripts and observation data were read several times to identify themes, or "codes", related to the research questions. The researchers then developed a table of themes matched to participants and, going through the materials again, recorded where a reference was made to each topic. This table was then used to develop a structure for the report. The emerging themes were continually modified through "constant comparison" (Glaser, 1992) with the data.

This study followed 27 educators in 14 kindergarten classrooms (approx. 300 children aged 3–6) over the course of three school years, 2015–2018. The educators were interviewed and surveyed at the beginning and end of each school year, and they participated in focus groups and workshops on emerging issues in the spring of each year. The educators had not received any professional development on the use of DT in the classroom prior to the study, but they all reported using computers, iPads, and cellphones in their personal lives. The research team provided tutorials on using the iPad apps during the workshops. Each classroom was given three iPads for the children to use. The research team

provided pedagogical and technical support during the school year through biweekly classroom visits, and it made observations during these visits. The interviews were tape-recorded and transcribed. While all of the educators were asked the same questions, probe questions were also used, and additional comments were encouraged. Samples of their kindergarten students' digital slideshows (created on iPads, using the applications 30Hands or Explain Everything) were collected and analyzed.

Findings

Analysis of the data led to several key findings. The educators had concerns that taking the iPads outdoors might detract from the benefits of outdoor play, and they were also concerned about the safety of both the devices and the children. After the educators and the children had increased their proficiency in the use of the iPad apps, and following the establishment of some broad guidelines on outdoor use, the educators began to see a variety of benefits to using DT outdoors. They began to see that the iPad apps provided opportunities for creativity, an enhanced connection with the outdoor world, and motivation to engage in literacy activities.

Educators' Concerns Over the Use of Digital Technology Outdoors

An examination of the educators' interview and focus group comments over the course of the three-year study, as well as an in-depth look at their students' slideshows, revealed that the use of DT in the outdoors increased and intensified over time. Moreover, we saw a marked change in educators' perceptions of the value of children using DT in the outdoor environment. At the beginning of the study, most of the educators questioned whether DT belonged outside and whether it would interfere with the children's learning and safety. In particular, the educators worried that DT would interfere with the active and social nature of outdoor play. Over time, as they witnessed what the children were doing, many came to see the value of DT for learning and for social engagement.

In the pre-implementation interviews, most of the educators either agreed or strongly agreed that using open-ended apps fit in with their idea of "best practice" in kindergarten; yet, when it came to using the devices outdoors, they appeared to be conflicted. Many of the educators expressed concern that the children would be too sedentary and solitary if the devices were readily available during outdoor time. For example, one educator's comment in an interview in the study's first year demonstrated their feeling that using an iPad is incompatible with exercise and socializing:

> Maybe it will take away from other types of play and social interactions. If they're always on an iPad or something like that, when are they going to go outside and get exercise? When are they going to be socializing and making friends? (Educator, Year 1)

Worries such as these led the educators to create rules for outdoor DT use that did not exist when the devices were being used indoors. For example, in some classrooms, children could only use the iPads outdoors if they were standing up; in others, the iPads were only taken outside occasionally. Some educators initially reported that children were indeed being too sedentary while using the iPads outdoors. We addressed these concerns in a workshop in the first year by introducing three guiding principles suggested by Ballentine (n.d.): focus on apps and digital activities that tell stories (e.g., use video, photography, and audio to document experiences); put the real world first (e.g., use apps/activities that enrich the outdoor experience rather than obscure or detract from it); and require movement to be part of the experience. These guiding principles proved to be useful as the educators facilitated their students' use of the iPads outdoors.

In addition to worries about the potential for the iPads to encourage the children to be sedentary and solitary, the educators worried about the safety of both the children and the devices when children were using DT outdoors. The educators voiced concerns that the children might be harmed in some way while using the iPads outdoors (e.g., falling while climbing with a device in hand, getting cold hands if they removed their mittens). They were also concerned about the increased risk of damage to devices that were taken outdoors. While there had been some initial worries about children taking devices near sand or water tables indoors, these fears were not borne out in the early stages of the study, and the educators quickly came to value the flexibility, mobility, and autonomy afforded by these devices indoors. However, in outdoor environments, the educators were more focused on the cost and fragility of the devices. All of these concerns led to restrictions on iPad use related to climbing structures, weather conditions, frequency of use, and children's independent use of the devices.

The Benefits of Digital Technology in the Outdoors: Getting Physical

Three key areas in which digital technology enhanced the outdoor learning experience for the kindergarten children were as follows: physical activity; creative activity; and connections to nature. The children's indoor learning experiences were also enriched by their use of the digital documentation that they created outdoors.

In spite of the educators' initial concerns, the study results indicated that the children's use of DT outdoors encouraged them to practise and enhance their physical skills. For example, the iPads inspired the children to create and videotape dance and gymnastic routines on the playground. After performing and taping their routines, the children would view their recordings and then keep adapting their routines until they were satisfied with the results. One educator reported on her surprise and pleasure at how the use of DT had increased her students' level of physical activity, cooperation, and sustained interest in an activity while playing outdoors: "They were on the monkey bars shooting

a music video. It was interesting how they wanted to cooperate while being outdoors. And now they are doing a dance competition. A lot of them have been practising" (Educator, Year 1).

Early in the study, when the children were less familiar with the apps, they were more likely to be sedentary while they focused on experimenting with the technology. However, once they had more experience, they became more active and engaged with the world around them while using the iPads. As a result of witnessing the early tendency to be sedentary while exploring the apps outdoors, the researchers suggested that the educators wait until the children were comfortable using the apps indoors before taking the iPads outside. We also suggested that they have a conversation with the children about active ways to use the iPads. At the educators' request, the research team created tip sheets about how to encourage active use of the technology in the outdoors. When these practices were in place, the iPads accompanied active physical play rather than replacing it. In fact, DT added value to physical play because it allowed children to reflect on their recorded physical activity, which at times inspired them to re-enact or refine their activity. The recorded activities also added value for the educators. The children's slideshows served as documentation of the children's interests and abilities, which the educators could then use for planning and assessment purposes.

Exploring and Showcasing Creativity

Once the children had had time to engage with the apps and become familiar with their basic functionality, their use of DT during outdoor play was more intentional, collaborative, and creative. Children used the apps' photo and video capabilities to record a wide range of creative activities. In one memorable dramatic play episode, a child combined typical dramatic play (pretending to have an adventure in an imagined landscape) with the creation of a video that was clearly intended for a future audience. In the video, she speaks directly to a future viewer, narrating as she walks in a wooded part of the school playground. As she walks and records the scene ahead of her, she imagines that she is in a "scary" and "creepy" forest. She uses a dramatic voice to draw the viewer in and set the scene, and she ends with a rhetorical question: "We're walking straight. Here's a hill in this dark creepy forest mountain. Look how scary and creepy it is in this forest (deep breath). How much walking do we have to do?" (Kindergarten student, Year 3). In another class, a group of children who were using car tires to play "house" on the playground created a video in which they explained that the tires were their toilets, identifying which "toilet" belonged to which child.

In addition to dramatic play episodes, the children photographed or videotaped structures and patterns they made with snow, building blocks, and other manufactured or natural materials. At times, the children planned to document their creations from the beginning; at other times, they decided to videotape or

photograph their creation after it was completed. Children engaging in creative play outdoors has, on it own, rich learning potential; however, the study showed that there are added learning benefits to children creating and then viewing their own and others' recordings of their creative endeavours. These activities enrich the outdoor experiences because they encourage dialogue, reflection, and further creative activities. Furthermore, the study demonstrated that when the children viewed their world through the iPads' camera lenses, they were offered opportunities to gain different perspectives while they explored their environment. For example, one child, who had recently lost her mother, took a picture of the sky and wrote the words "I love you sky" on the photo. She then recorded herself singing a song to accompany her slide. DT provided an opportunity for this child to express and record her feelings about her mother (whom she thought of as being up in the sky, in heaven) and gave her educators insight into her coping strategies.

Exploring and Connecting to the Outdoor Environment

Children used the apps outdoors as a self-directed means to document their natural environment and capture their personal interests in nature. They documented visuals of plants, insects, animals, and the weather, and they also audio-recorded natural sounds, such as rustling leaves. This documentation was brought back inside for reflection by the children and the educators. The children's documentation created a window into their interests and thinking about nature. For example, one educator suggested that the children use the iPad apps to document signs of spring. She remarked on how viewing the children's perspectives of spring, demonstrated in their photos and videos, had enlarged her own ideas of what could constitute a sign of spring. For example, she said about one photo: "I would have never thought about a piece of feather on the ground as part of spring, so it was really interesting" (Educator, Year 2). Another educator remarked on how taking and reflecting on photographs encouraged the children to engage more deeply with the nature around them and facilitated discussions of nature when back inside the classroom:

> When they've taken pictures of nature outside, I feel like it's something that they might not appreciate as much just by seeing it, because it's captured in the picture, all of a sudden it becomes something more meaningful. Like, they've taken pictures of trees and that's something that they see every day, right? But then it's captured in a picture, and they're able to say "oh look at this" or "this is how the tree is" and we're able to engage in a lot of different conversations. (Educator, Year 2)

In addition to offering opportunities to notice, think about, and discuss aspects of nature, the iPad apps allowed the children to express their feelings about nature. For example, one child used the video function of the app to first pan up the trunk of a tall tree, all the way to the top, and then to pan around to the surrounding trees in the school yard. As she manoeuvred the iPad, she

said, "We are loving the beautiful trees that are changing colours. These are the beautifulest trees that they have in the neighbourhood and the entire world!" (Kindergarten student, Year 2).

The following case study of one of the kindergarten classrooms participating in the present study gives a detailed picture of how the educators transitioned, as a result of what they had witnessed, from feeling concern about the use of DT outdoors to recognizing its wide-ranging learning potential.

Digital Slideshow Analysis: Exploring Two Outdoor Books

Jaya and Carolyn had been team-teaching kindergarten for three years before the project began. Prior the study, these two educators had an iPad and digital camera that they used in the classroom for documenting the children's work, but their students had had limited experience with using educational iPad apps themselves. Although Jaya and Carolyn didn't express their concerns to us in the early years of the study, at the end of the study they revealed that they had been initially concerned for the safety of the three iPads that we had provided for the children to use. However, over the course of the three years of the study, their fears were not realized, and they became very comfortable with the children's independent use of the devices:

> The first year I worried, but that wore off in time. (Carolyn, Year 3)
> There was a time three years ago when we realized, "Why are they giving us these [iPads] to four-year-olds?" I'll be honest. For me, my daughter was four years old and I didn't even let her touch my phone. How are we going to give these kids these apps? So do we follow them around when they pick them up? What if it drops? Those kinds of things start coming to your mind. But now after three years we are at this stage that we say "Yup, go use it and put it back." So the transition from that part of the continuum to this part of the continuum—yes it took a couple of years, doing away with those mental blocks. (Jaya, Year 3)

Jaya and Carolyn were initially much more comfortable using the iPad apps indoors than outdoors. In the classroom, they had the iPads available to the children during open-ended play times and were impressed with the range of learning outcomes that they witnessed in terms of oral, written, visual, and digital literacy. Before they took the iPads outdoors for the first time, they did not speak to the children about how they could or should use the devices during outdoor play. They were concerned when they observed the children beginning to sit and engage in the type of drawing or other activities that were not directly related to outdoor pursuits. Jaya explained:

> Last year we tried to take the iPads during the outdoor exploration. So what the kids did was they would sit by the wall outside and do the iPad, or work on the iPad and their physical activity or the exploration time was like nil. (Jaya, Year 3)

As a result, Carolyn and Jaya began to have the children take the iPads outside less frequently. In the third year of the project, the children initiated two exciting outdoor collaborative projects, mediated by the iPad apps, that changed the educators' perception of the potential for DT in the outdoors. One was a nature book, and the other was a road sign book.

The Nature Book

Jaya described how the nature book project began:

> This year one of the students asked us, "Can I take the iPad outside to take nature pictures?" So we discussed about that in a big circle, "What do you mean by nature pictures? Is it just taking the iPad and running around? Is it just taking the iPad and sitting under a tree and just chatting with your friends?" So we actually discussed that taking nature pictures [means] that you are taking pictures of the flowers, plants, of the changes that you're seeing, or if there is anything you want to see close-up. You can see tiny things, it's like a magnifying glass. So they did amazing things and we actually made a nature book in our classroom. (Jaya, Year 3)

With this child-initiated goal of taking nature pictures, and after having a class discussion of what such a project could look like, the educators no longer witnessed the sedentary behaviour that had worried them earlier. When describing how the child initiated the project, Carolyn said, "It was completely her idea. She did it with a friend. She wasn't sitting down. She was constantly looking for things to take pictures of" (Carolyn, Year 3). This first child inspired others to join her, and soon they had a considerable collection of nature photos on their classroom iPads. One of the children began a trend of manoeuvring the iPad within its green rubber protective case so that the case could be seen at the edges of the photos, creating a framing effect. Other children soon followed suit, and many of the pictures in their digital portfolio had green "frames." When describing this technique, Carolyn said, "He intentionally did that. He is very creative with his photos" (Carolyn, Year 3).

Having the opportunity to take the iPads outdoors motivated the children to closely examine the natural world around them, focus on specific aspects of nature, and capture images to bring back into the classroom for reflection and discussion. This led to two important opportunities for learning—one related to literacy and one to environmental education. The children—"even the reluctant readers who didn't want to write" (Jaya, Year 3)—decided to add writing to each of their photos and to create a book. The creation of the book led to a wider discussion about their responsibility to protect nature:

> So they wrote about it and they talked so much about it and then it led to the discussion about how we need to save nature or how we need to save the planet. It was like a trail of things. We went from one step to another step. (Jaya, Year 3)

The Traffic Sign Book

The second book that the children created using the iPad apps also began with a desire to examine and capture aspects of the outdoor environment. In this case, it was the built environment they were interested in—specifically, road signs—rather than the natural environment. As with the previous book, DT motivated the children to explore the outdoors, capture images of interest, and bring their learning back to the classroom for continued reflection and insights The educators had taken the children on a series of neighbourhood walks and had explained how road signs help keep us safe. The children began to take pictures of the road signs with the iPads. Once they were back in the classroom, they began searching for additional images of road signs on the child-friendly search function within the 30Hands app. After incorporating the images of road signs into a digital slideshow, they drew them on paper to create a collaborative paper book. The educators remarked on how motivating this "real world" cooperative project was, particularly for a group of children who were usually reluctant to read and write:

> We've just found that with the reluctant writers, like this group who are making signs, I cannot explain to you how many pages of signs we have in our sign book. Not only are they drawing the signs but there are using so many signs which say words. They are actually reading "Do not enter," "One way," "No parking," "No smoking." This is the first part of literacy, reading the signs. That's how my daughter learned. (Jaya, Year 3)

In both of the spontaneous, collaborative book projects in this classroom, having access to the iPad apps outdoors enabled the children to become more engaged and knowledgeable about the natural and built environment in their neighbourhood. These authentic leaning experiences provided exciting and meaningful opportunities to practise key literacy skills while enriching their knowledge of, and connection to, the world around them.

Discussion and Conclusion

This research study was limited by a modest sample (27 educators in 14 kindergarten classrooms), albeit with a significant timeline (3 years). However, it led to the following conclusions, which are presented for consideration, ongoing debate, and further research. The results of this study suggest that children's use of DT can be consistent with the goals of outdoor play: It can promote and enhance physical activity, support social and creative approaches to learning, and connect children to the outdoors. Open-ended tablet apps allow children to document and reflect on the outdoors in active, playful, personal, and self-directed ways. By encouraging children to use open-ended apps to observe, document, and reflect on the natural world, educators can help children to focus on elements and processes in nature that may otherwise escape their notice. For

example, the singular lens of a tablet's camera offers a point of view that provides the user with opportunities to capture and preserve unique perspectives (Maguire, 2017). Furthermore, children can use photographs to represent what they know about their own contexts (Dockett & Perry, 2005).

Educators may be nervous that DT will undermine the goals of outdoor play and create safety issues. However, in this study, children engaged actively and playfully with the technology outdoors, and it is interesting to note that no harm came to either the children or the devices during the three years of the study. The findings suggest that, with time and support, educators can come to see the value of DT not only for children's outdoor play but also for their own understanding of children's knowledge and interests. It is important to note that these promising findings occurred under certain conditions: The apps that were used were open-ended; the children were given large blocks of time to play outdoors with interesting structures and materials, and with access to natural elements; the children had sufficient time and scaffolding to become comfortable and proficient with the apps; and the educators established broad guidelines for outdoor use to keep the focus on active, social play. Furthermore, the research team supported the educators regularly as they became comfortable with having DT in their programs. We believe that these conditions were significant factors that led to the wide-ranging and engaged use of DT in the outdoor environment that occurred.

The marrying of digitally-mediated learning and environmental learning may seem an unusual juxtaposition; however, when used in open-ended ways, this study suggests that DT can enhance children's outdoor learning experiences, create opportunities for them to connect meaningfully with nature, and support their literacy development. Both environmental awareness and literacy are critical areas for children's growth, and the results of this study illustrate that they can both be supported by digital technology. Furthermore, educators can use children's digital documentation in order to gain insights into their students' thinking that will help them plan engaging, effective learning experiences.

Notes on Contributors

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References

Ballentine, K. (n.d.). *Balancing technology with nature* [Webinar]. Retrieved from https://naturekidsinstitute.com/webinar-registration9053964

Beschorner, B. & Hutchison, A. (2013). iPads as a literacy teaching tool in early childhood. *International Journal of Education in Mathematics, Science and Technology, 1*(1), 16-24.

Blagojevic, B., H. Brumer, S. Chevalier, A. O'Clair, & K. Thomes. (2012). Touch and Grow: Learning and Exploring Using Tablets. *Teaching Young Children, 6*(1), 18-21.

Canadian Paediatric Society. (2017). Screen time and young children: Promoting health and development in a digital world. *Paediatrics & Child Health, 22*(8), 461-468. DOI: 10.1093/pch/pxx123

Council on Communication and Media. (2016). Media and young minds. *Pediatrics, 138*(5). DOI: 10.1542/peds.2016-2591

Dockett, S. & Perry, B. (2005). 'You need to know how to play safe': Children's experiences of starting school. *Contemporary Issues in Early Childhood,* 6(1), 4-18.

Falloon, G. & Khoo, E. (2014). Exploring young students' talk in iPad-supported collaborative learning environments. *Computers & Education, 77,* 13–28. http://dx.doi.org/10.1016/j.compedu.2014.04.008

Farmer, V. L., Fitzgerald, R. P., Williams, S. M., Mann, J. I., Schofield, G., McPhee, J. C., &

Taylor, R. W. (2017). What did schools experience from participating in a randomized controlled study (PLAY) that prioritized risk and challenge in active play for children while at school? *Journal of Adventure Education and Outdoor Learning, 17*(3), 239-257. Retrieved from https://doi.org/10.1080/14729679.2017.1286993

Fleer, M. (2014). The demands and motives afforded through digital play in early childhood activity settings. *Learning, Culture and Social Interaction, 3,* 202-209.

Glaser, B. (1992). *Basics of grounded theory analysis.* Mill Valley, CA: Sociology Press.

Goodwin, K., & Highfield, K. (2012). *iTouch and iLearn: an examination of 'educational' apps.* Paper presented at the Early Education and Technology for Children conference, March 14-16, 2012, Salt Lake City, Utah.

Gray, P. (2013). *Free to learn: Why unleashing the instinct to play will make our children happier, more self-reliant, and better students for life*. New York: Basic Books.

Herrington, S., & Brussoni, M. (2015). Beyond physical activity: The importance of play and nature-based play spaces for children's health and development. *Current Obesity Reports,4*(4), 477-483. 10.1007/s13679-015-0179-2

James, A., & Prout, A. (1997). *Constructing and reconstructing childhood: Contemporary issues in the sociological study of childhood* (pp. 7-32). London: Falmer Press.

Lavigne, H.J., Hanson, K.G., & Anderson, D.R. (2015). The influence of television coviewing on parent language directed at toddlers. *Journal of Applied Developmental Psychology, 36*, 1-10.

Maguire, N. (2017). Rocks, Grass, and Glass: Exploring Themes of Nature and Optical Lenses in the film *Boyhood*. *Red Feather Journal, 8* (1), 37-49.

Mayall, B. (2000). The sociology of childhood in relation to children's rights. *The International Journal of Children's Rights, 8*(3), 243-259. doi:10.1163/15718180020494640

McClure, E.R., Chentsova-Dutton, Y.E., Barr, R.F., Holochwost, S.J., & Parrott, W.G. (2015). "Facetime doesn't count": Video chat as an exception to media restrictions for infants and toddlers. *International Journal of Child-Computer Interaction, 6*, 1-6. Doi: 10.1016/j.ijcci.2016.02.002

McGlynn-Stewart, M., MacKay, T., Gouweleeuw, B., Hobman, L., Maguire, N., Mogyorodi, E. & Ni, V. (2017a). Toys or Tools?: Educators' Use of Tablet Applications to Empower Young Students Through Open- Ended Literacy Learning. In M. Mills & D. Wake (Eds.). *Empowering Learners with Open-Access Learning Initiatives.* (pp. 101-123). Heshey, PA: IGI Global.

McGlynn-Stewart, M., Brathwaite, L, Hobman, L., Maguire, N., Mogyorodi, E., & Park, Y. (2017b). Inclusive teaching with digital technology: Supporting literacy learning in play-based kindergartens. *Learning Landscapes,* 11(1), 199-216.

McGlynn-Stewart, M., Brathwaite, L, Hobman, L., Maguire, N., & Mogyorodi, E. (2018). Open-ended apps in kindergarten: Identity exploration through digital role-play. *Language & Literacy,* 20(4), 40-54.

Merriam, S. (2009). *Qualitative research: A guide to design and implementation.* San Francisco: Jossey-Bass.

Mitchell, L. (2007). Using technology in Reggio Emilia-inspired programs. *Theory Into Practice, 46*(1), 32-29. http://dx.doi.org/10.1207/s15430421tip4601_5

National Association for the Education of Young Children (NAEYC) & Fred Rogers Center for Early Learning and Children's Media at Saint Vincent College (FRC). (2012). Technology and interactive media as tools in early childhood programs serving children from birth through age 8. Retrieved from http://www.naeyc.org/files/naeyc/PS_technology_WEB.pdf

Neumann, M. M. (2016). Young children's use of touch screen tablets for writing and reading at home: Relationships with emergent literacy. *Computers & Education, 97,* 61-68. DOI: 10.1016/j.compedu.2016.02.013

North American Association for Environmental Education (NAAEE). 2010. *Early childhood environmental education programs: Guidelines for excellence*, Washington, DC: NAAEE.

Punch, K. (2009). *Introduction to research methods in education.* London: Sage.

Radesky, J. S., Schumacher, J. & Zuckerman, B. (2015). Mobile and interactive media use by young children: The good, the bad, and the unknown. *Pediatrics, 135*(1), 1-3. doi:10.1542/peds.2014-2251

Robson, S., & Rowe, V. (2012). Observing young children's creative thinking: Engagement, involvement and persistence. *International Journal of Early Years Education, 20*(4),349-364. 10.1080/09669760.2012.743098

Rowsell, J. (2017). Be the 'I' in iPad: iPads and the children who love them. In D. Harwood (ed.), *Crayons and iPads: Learning and teaching of young children in the digital world (pp. 6-15)*. Thousand Oaks, CA: Sage.

Rowsell, J. & Harwood, D. (2015). "Let It Go": Exploring the image of the child as a producer, consumer, and inventor. *Theory Into Practice, 54,* 136–146. doi:10.1080/00405841.2015.101087

Sandseter, E. B. H., & Sando, O. J. (2016). "We don't allow children to climb trees": How a focus on safety affects Norwegian children's play in early-childhood education and care settings. *American Journal of Play, 8*(2), 178-200.

Truelove, S., Bruijns, B. A., Vanderloo, L. M., O'Brien, K. T., Johnson, A. M., & Tucker, P. (2018). Physical activity and sedentary time during childcare outdoor play sessions: A systematic review and meta-analysis. *Preventive Medicine, 108*, 74-85. doi:10.1016/j.ypmed.2017.12.022

U.S. Department of Education. (2016). *Early Learning and Educational Technology Brief*. Retrieved from: http://tech.ed.gov/earlylearning

Vanderloo, L. M., & Tucker, P. (2017). Physical activity and sedentary time among young children in full-day kindergarten: Comparing traditional and balanced day schedules. *Health Education Journal, 76*(1), 29-37. doi:10.1177/0017896916643354

Walsh, J., Barnes, J., Cameron, J., Goldfield, G., Chaput, J., Gunnell, K., Ledoux, A., Zemek, R., & Tremblay, M. (2018). Associations between 24-hour movement behaviours and global cognition in US children: A cross-sectional observational study. *The Lancet Child & Adolescent Health, 2*(11), 783 -791. doi.org/10.1016/S2352-4642(18)30278-5

Wimmer, J. J., Skramstad, E. & Khan, I. (2012). Incorporating, utilizing, and manipulating new literacies in the classroom. *The Educational Forum, 76,* 438–441. doi:10.1080/00131725.2012.707570

Wong, S. S. (2015). Mobile digital devices and preschoolers' home multiliteracy practices. *Language and Literacy, 17*(2), 75-90.

World Health Organization (2012). Global recommendations for physical activity and health. Retrieved September 20, 2019 from https://www.who.int/dietphysicalactivity/factsheet_young_people/en/