CrossMark

Using an Exploratory Professional Development Initiative to Introduce iPads in the Early Childhood Education Classroom

Michelle Vaughan[1] · Courtney Beers[1]

Abstract The purpose of this study was to investigate the incorporation of iPads into the early childhood classroom through an exploratory teacher professional development initiative. Eighteen early childhood educators participated in a 6-month study targeting teacher professional development and pedagogical innovation. This study included built-in opportunities for teacher collaborative discussions and support in their team meetings, as well as basic technology training on the use of an iPad in a classroom. A thematic analysis was conducted using constructed codes from teacher interviews and focus groups, as well as artifact collections of notes from teacher bi-monthly meetings. Results indicate that teachers used technology in three innovative ways: as an efficiency solution, as a bridge in virtual parent communication, and as curriculum enhancement or replacement. The researchers of this study argue that using the iPad as curriculum is the next area of professional growth for early childhood teachers.

Keywords Professional development · Technology integration · iPads · Instructional technology · Mobile devices

✉ Michelle Vaughan
mvaugha3@fau.edu

Courtney Beers
cbeers@fau.edu

[1] Florida Atlantic University, 777 Glades Road, Boca Raton, FL 33431, USA

Introduction

Both educators and researchers acknowledge the benefits that a technologically rich learning environment can provide for young children. As a result, desktop computers, digital cameras, projectors, and Smartboards are slowly making their way into early childhood classrooms (Aronin and Floyd 2013; Hinostroza et al. 2013; Saine 2012). The release of the Apple iPad adds fuel to this conversation. This easily portable mini-computer is already a staple among many American households. The multimodal functionality of the iPad, as Kucirkova (2014) states, allows "users to use texts, pictures, and sounds" (p. 1), which unquestionably interests children. However, recent studies indicate that children's exposure to and use of technology in the form of electronic toys, smartphones, or mobile devices, is more likely to occur at home than in the educational setting (Parette et al. 2010). While children's activities at home are becoming more technologically-based, their school-based experiences are becoming even more detached from such capabilities (Melhuish and Falloon 2010).

The reason for the divide in these experiences could be a result of the challenges of both technology integration and practices for the early childhood sector. Teachers' access to technology and to professional development has increased in the last several years (Blackwell et al. 2015). Yet, Blackwell et al. (2015) report that there remains "no differences in the frequency with which educators used [technology] devices" (p. 1). This may be because a typical single professional development devoted to learning such a complicated skill, as technology integration, is hardly adequate. As Bowman (2011) proposes, teachers need "more than an extensive knowledge component; they also need a time and place to develop practice skills" (p. 57). But, for early childhood educators, low work wages and

Springer

everyday constraints such as limited staffing (Whitebook and Sakai 2003) and lack of planning time, compounded with multiple daily tasks, such as child documentation and parent communication, leaves little time for teacher in-service training.

Technology in Early Childhood Learning

Recent research supports mobile devices as a useful tool in early childhood education and, with proper scaffolding, they can have a positive impact on student learning (Neumann and Neumann 2014). However, as many children enter school, they are asked to put away their technological devices and are guided towards more traditional learning activities (Parette et al. 2010; Prensky 2008). When they leave the child care environment, children are once again greeted by an assortment of interactive technology-driven tools. Common Sense Media (2013) recently published a large-scale, nationally representative survey and found that 75 % of all children age eight and under, have access to some type of "smart" mobile device at home and 38 % of children under two have used a mobile device to access media content (compared to 10 % in 2011). Thus, a concern in the field is that trying to change children's access to technology is like "swimming against the tide" (Geist 2012, p. 33), and some researchers suggest we should instead try in earnest to bridge the technology gap between the real world and school settings (Saine 2012).

The reason for the divide in technology use is somewhat complex. Some educators believe that the classroom should serve as a place for children to be unplugged. They are concerned that children spend too much time interacting with technology and that this could lead to "visual strain, obesity, and other consequences of sedentary behavior" (Johnson and Christie 2009, p. 285). Indeed, at the time of data collection for this study, the Academy of American Pediatrics recommended that young children over the age of 2 spend less than 1–2 h per day interacting with screen-based media as well as directly discouraged children under the age of 2 from any screen viewing (American Academy of Pediatrics 2011). In 2015, the American Academy of Pediatrics provided a list of evidence-based practices for parents related to the appropriate use of technology with children. Instead of relying on the "turn it off" philosophy, the authors advocated for parents to "foster digital citizenship" (p. 1) with their children. Their advice to parents included role modeling the use of technology, co-engaging in technology use, and providing children with time in which they can be unplugged from these technology tools (Brown et al. 2015).

The latest recommendations from the American Academy of Pediatrics fits well with Plowman and McPake's (2013) argument that children are not, as previously described, "digital natives" (p. 28) and that they can, in fact,

become overwhelmed by the complexity of technology if not guided towards appropriate application. Proponents of technology in early childhood believe that, just like everything else in life, teachers and children must learn to find a balance in their daily use of these tools (Johnson and Christie 2009). There is even evidence to suggest that the use of the iPad or other technology devices, in the appropriate manner, can improve children's cognitive, academic, and social proficiencies as it employs them to use multiple skills within a single and complex context (Beschorner and Hutchison 2013; Johnson and Christie 2009). If, as some propose, children benefit from early training in the language and practices of technology just as they would any other life skill, then it would seem that the early childhood classroom would be an appropriate setting to begin such preparation.

Early Childhood Educators' Attitudes and Beliefs Toward the Use of Technology

Teachers' attitudes and beliefs towards the use of technology are impacted by factors such as training and education, social economic status, and age.

Training

Children's access to technology is "contingent upon teachers' skills in using and integrating technology" (Chen and Chang 2006, p. 170), and research shows that many early childhood teachers fail to incorporate technology into the classroom (Blackwell et al. 2014). Even more so, they do not always incorporate technology in student-centered and developmentally appropriate ways (Blackwell et al. 2014; Parette et al. 2010). The degree to which early childhood teachers' report positive attitudes towards technology has also declined in the last several years. Blackwell et al. (2015) state:

> Despite increases in professional development and perceived levels of support, attitudes toward the value of technology for early childhood education slightly declined from 2012 to 2014. This may be a reflection that with increased exposure to technology, educators gain a more realistic view of the potential that technology has to aid learning, along with discoveries that some types of technology may actually be a hindrance to their classroom practices. In other words, their expectations did not meet the reality. (p. 12).

On the other hand, Chen and Chang (2006) report that attitudes towards and practices with technology in the early childhood classroom are related to teacher training. According to the researchers, teachers with a greater history of computer use demonstrate higher degrees of confidence, which then translates into more advanced computer applications.

Training in the use of computers or any other type of technology is unevenly divided across the early childhood sector. Perhaps this is due to differences in teacher educational attainment. Early childhood teachers are not necessarily required to gain a college degree or even curriculum training in their position (Bowman 2011). Hinostroza et al. (2013) found that early childhood teachers have the least amount of technological competencies compared to their primary and secondary teaching peers. Other researchers note that early childhood teachers with a Graduate degree have greater access to tablet computers than teachers with a High School or Bachelor's degree (Blackwell et al. 2013). Therefore, when early childhood teachers have received little preparation for technology in general (Aronin and Floyd 2013; Petko 2012), they find it difficult to apply it appropriately within their pedagogical repertoire (Melhuish and Falloon 2010).

Social Economic Status

Children from middle-income households have less access to technology in early childhood classrooms than do children in childcare centers and public schools that serve lower or upper-income households (Blackwell et al. 2013, 2014). Furthermore, Blackwell et al. (2015) reported that educators of low-income children had more access to new technologies in 2014 than educators of middle- or high-income children, and that there was very little difference as a result of income between "how frequently educators with access to each technology reported using the technology" (p. 8). Such evidence points then not to a lack of monetary funds, but rather to other long-held teacher beliefs regarding the appropriateness of technology in early childhood. Teachers of children from lower-income households may believe their students have less access to technology at home and therefore are more willing to find time to incorporate it in the classroom. In contrast, teachers of students from middle-income households believe that these children have plenty of access to technology at home and so there is less need for it in the classroom (Blackwell et al. 2014). Teachers of children from middle-income households may then fail to understand how technology fits into the life skills preparation curriculum (Plowman et al. 2012).

Age

Age may also play a role in the use of technology in the classroom. According to the research conducted by Saluja et al. (2002), the average teacher age of 3- and 4- year - old children was estimated at 39 years old, with teachers working in for-profit centers having the youngest average age of 35 and public school teachers having the oldest average age of 42. While younger teachers tend to display higher levels of confidence in the use of technology than do

older teachers, Blackwell et al. (2014) found that older teachers incorporate technology into the curriculum more often than do younger teachers. The researchers suggest this is a result of the level of comfort older teachers have in general with the curriculum, giving them a better platform in which to integrate technology. Ultimately though, a lack of exposure tends to continue older teachers' ill-favored views of technology as it relates to young children's learning, and as Blackwell et al. (2014) state, "teacher attitudes toward and confidence using technology plays a critical role in their use of technology in the classroom" (p. 88).

Theory Related to Professional Development for Teacher Change

Professional development aimed at the integration of mobile devices into classrooms is a young field, and research on effective professional development models in early childhood programs is also an area of study that needs more empirical research (Sheridan et al. 2009). Support for professional development decisions made in this study is built on well-researched theories on adult learning and teacher change in order to maximize its impact. This study uses the term "exploratory professional development" to describe a context where teachers are encouraged to make individual attempts at integrating new technology directly into their classrooms in real time (as opposed to in a workshop). Without a focus on a prescribed product or outcome they are trying to achieve, the goal of professional development is simply to make pedagogical changes. In 1986, Guskey originally presented a model that specifically defined a view of teacher change, particularly through the process of professional development programs. With a focus on three major types of change, a change in practice, beliefs and attitudes, and the learning outcomes of students, he studied the possible sequence in which these changes may occur. Guskey (2002) revisited this model almost two decades later and suggested a change in teacher beliefs and attitudes occurs after a change in practice, making an impact in student learning the last change in his model. Guskey's seminal work in the field of professional development reflects the importance of creating time and space to allow teachers to make changes in their practice and experiment with new pedagogies. Additionally, collaborative discussions prove to be an effective form of professional development as teachers can discuss their hesitation, excitement, and progress towards integrating technology.

Further support for the design of this initiative comes from the landmark work of Chin and Benne (1969). They theorized three types of planned change strategies: Empirical-rational, normative-reeducative, and power-coercive. Each strategy enacts change by using a different type of approach coupled with a different change agent. The

empirical-rational approach is based on using research and development of models for change to enact and analyze change, while the power-coercive change strategy attempts to effect change through collective action strategies such as the use of political institutions to achieve change. Most important to this study, is the normative-reeducative strategy in which naturalistic techniques are used that focus on providing autonomy for those individuals in the system as well as cultivating growth for all members. Applied specifically to the classroom, "within this normative-reeducative change approach, the assumption is made that change is enhanced through deep reflection on beliefs and practices" (Richardson and Placier 2001, p. 906). As previously mentioned, a critical component to change within this model is dialogue with other teachers. The theory presupposes that the most dramatic form of change takes place when both members of the dialogue are attempting to shift their practice or beliefs and can function as a support network for each other. Within this model, the direction for change comes from the individuals within the process, the teachers themselves who are collaborating with their peers. This model is important to the study because of its emphasis on change as both an individual and group process. This initiative is built from the idea that exploring new technologies in the classroom and dialogue with peers can simultaneously address the change in practice and beliefs and perceptions about mobile integration and the technological skills of early childhood educators.

Technology and Professional Development

Learning to teach with technology, specifically in early childhood education, requires collaboration and support through a personalized learning process (Gimbert and Cristol 2004). Buchanan et al. (2013) identified two key barriers to the adoption of new technologies: structural constraints that may exist and the perceived usefulness of the tool. This also supports the technology acceptance model (Davis 1989), a widely used framework to understand the range of individual use of technology, which suggests it is the perceived usefulness in addition to the perceived ease of use of a tool that predicts its acceptance. Parette et al. (2013) present a collaborative professional development model called technology user groups that aims to overcome some of the traditional barriers to implementation by providing time to practice new skills, on-site support, and creating a learning community of early childhood professionals focused on technology integration. The goal of the current study was not to define a new model for technology integration or to test an existing model. Rather, building off of the existing literature and the literature surrounding change theory and professional development (Guskey 2002; Hall and Hord 2011), this case study sought to further our current

understandings of how collaborative, supportive professional development initiatives can be a positive venue for technology professional development. The following research questions were defined for this project:

1. How do early childhood educators respond to an exploratory professional development initiative?
2. What are the contextual challenges that early childhood educators face as they learn to integrate new technology?
3. What does innovative practice look like using iPads in early childhood classrooms?

Method

This exploratory study captures the results of a professional development initiative in a private, faith-based child development center. In the Fall of 2013, the governing board of the center voted to purchase one iPad for each classroom within the school and provide teachers with initial training to familiarize them with the functions and tools of the iPad. Teachers received their iPads (one for each teaching pair) at this initial training in January. The training was conducted by an Apple consultant and covered basic functionality of tools (e.g., settings, camera, app store, and music). Teachers also received a twenty-dollar iTunes gift card to purchase applications for use.

Purposefully, teachers were not given a specific directive on using their iPads in the classroom, as the researchers sought to document how professional development aimed at technology integration could guide teachers to use this technology in an exploratory manner. The director insisted that they "needed to use it" but how they used the iPad was at their discretion. Teachers were asked to be mindful of the computer guidelines the school already had in place (limiting the amount of time individual students used a computer during the school day) and applied those same limits to individual student iPad use. Teachers were instructed to discuss and document how they were attempting to use the iPad in biweekly team meetings. Notes from those team meetings were shared with the researchers and used as data in this study. This initiative was designed to be an exploratory phase of iPad use for the teachers with built-in opportunities for collaborative discussions and support in their team meetings. At the conclusion of the school year and this initiative, the teachers and director would make decisions about how the iPad would play a role in their curriculum for the following school year.

The research took place in the spring of the 2014 school year (January until June). A total of 18 female teachers participated in this study. Teachers' educational levels ranged from a high school diploma to a master's degree.

An iPad was provided to each teaching pair in the child development center's ten classrooms. An Apple consultant was hired by the school to conduct a 2-h basic training session that took place during a staff meeting for the teachers. Those teachers absent from the training session were asked to meet with their co-teaching partners to review any missed information. Of the 20 teachers employed by the child development center, 18 participated in this study. Two teachers did not participate because they were hired after the study had begun. Lastly, the director of the child development center was also serving as a teacher in one of the classrooms, so her responses to interview questions reflect both roles.

Data Collection and Analysis

Data were collected in three ways for this research study: (1) an initial interview with each teacher from the early childhood center as well as the center's director; (2) two focus groups at the conclusion of the study; and (3) artifact collection of notes from teacher biweekly meetings. A basic qualitative methodological approach was used to answer the research questions posed by the investigators of this study. A qualitative approach was appropriate because the researchers collected data in "a natural setting sensitive to the people and places under study" (Creswell 2013, p. 44), and then analyzed this data for emerging themes. Although the researchers were the main instruments for data collection, the meaning of the experience derived from the participants' perspectives (Creswell 2013).

For this basic qualitative study, interviews were used to obtain teachers' perspectives of their experiences during this professional development initiative (Bogdan and Biklen 2007; Patton 2002). The researchers were interested in understanding the descriptive data that emerged from the teachers' stated opinions, feelings, and conceptions of integrating this new form of technology into the early childhood classroom (Merriam 2009). The interviews were semi-structured, the nature of the questions being mostly open-ended, and probes were used for follow up comments or questions (Merriam 2009). Document analysis of teacher biweekly meeting notes served as a method of triangulation, as these artifacts provided specific examples of the ways in which iPads were used by the teachers throughout the initiative. In meeting notes, teachers were asked to share examples of how they had used the iPad since the last meeting, both positive and negative experiences, and list something new they were planning on trying before the next meeting. This encouraged teachers to share their own experiences and gain ideas from others as well.

Qualitative data gathered from focus groups were used as another avenue for triangulation as well as for member checking. Patton (2002) suggests that focus groups can present an opportunity for participants to hear the opinions and reflections made from other participants, those who experienced a similar reality. Participants can then choose to agree or present a counter argument to the statement. For this study, the researchers reported their initial findings, and the teachers in the focus groups were able to agree, disagree, or provide further examples to clarify the reality of the situation.

First, each teacher was interviewed in January, with interviews lasting no more than 30 min in length. The protocol contained 10 questions, with researchers asking additional clarification questions as needed. The interviews focused on the teachers' prior experience with technology integration and their professional development experience with iPads up to that point in time (research question 1 and 2). Teachers were asked to talk about what they learned from their training, their thoughts about how they planned to use the iPad, and how their students had responded to the introduction of the tool. The interviews were audio-recorded, transcribed, and coded using a pre-determined list of codes that aligned to the research questions (see Table 1). These codes were based on findings from a previous study conducted by the researchers that investigated the use of iPad integration among faculty within one University's department of education (Vaughan et al. 2015). The codes were applied to this study due to the similarity in research questions and protocols used. While a "pre-figured" coding scheme was used, it is important to note that researchers were also open to additional codes that may have emerged through the analysis of the data (Creswell 2007). Initial coding was conducted individually by two researchers and then reviewed as a collaborative team to ensure accuracy. To assist researchers in identifying trends in the data, frequency of codes was examined although it is important to note that "a count conveys that all codes should be given equal emphasis" (p. 152) and in this analysis, the counting of codes was used to determine teacher interest and assist researchers in collapsing codes into themes that would address the research questions.

Second, two 30-min focus group sessions were conducted at the beginning of June. Each teacher was an active member of one of the two focus groups. The focus group sessions were meant to provide the teachers with an opportunity to share their perspectives on the nature of innovative teaching practice, the role that the school and team collaboration played in that emerging practice as well as teachers' reflections on the iPad initiative itself and the contextual challenges that they faced with iPad and technology integration (research questions 1, 2 and 3). The focus group sessions were transcribed and coded using the initial five themes from the interview data analysis as a guide.

Lastly, the researchers collected and analyzed notes from biweekly team meetings reflecting on their iPad integration and App use. These artifacts were collected

Table 1 Alignment of predetermined code list to research questions

Code list	Research questions
Challenges (CH)	RQ 2
Examples of use (EU)	RQ 1, RQ 3
Initial impressions (II)	RQ 1, RQ 2
Professional development (PD)	RQ 1, RQ 2, RQ 3
Time (TT)	RQ 2, RQ 3

Table 3 Frequency of codes used in analysis

Code list	Frequency
Challenges (CH)	25
Examples of use (EU)	56
Initial impressions (II)	26
Professional development (PD)	25
Time (TT)	23

from January until June of the 2014 school year, and content analysis of these artifacts were conducted using the same codes and then added to the results. Following initial analysis of all the data, the codes were examined for frequency. Table 1 provides a list of codes used in the initial stage of analysis as well as the research question to which each code was aligned. Alignment of codes to research questions allowed the researchers to organize the findings.

Table 2 provides a list of the initial codes, a description of when the codes were applied, and an example for each code. The coded data from this study were organized to form "more abstract units of information" (Creswell, p. 45) until a "comprehensive set of themes" (p. 45) emerged.

Discussion of Results

The results of this study are based on the themes seen across and within the codes after analysis by the researchers, and these common themes were used to answer the three research questions: the nature of exploratory professional development, contextual challenges, and innovative practices.

Looking at the frequency of codes is helpful to indicate where teacher emphasis may lie within this initiative, but it does not necessarily indicate importance or a hierarchy

(Creswell 2007). For example, the code "examples of use (EU)" was coded most frequently in this study and issues of "time (TT)" was coded least frequently, however, the existence of a code does not convey the depth of the response or acknowledge that that passages within the same code may represent contradictory ideas. Table 3 provides the frequency with which these codes were applied to data during the analysis process. Three "aggregated" (Creswell 2013, p. 186) sub-themes also emerged regarding what innovative practice with an iPad looks like in an early childhood classroom: As an efficiency solution, as a bridge in virtual parent communication, and as curriculum enhancement or replacement.

Exploratory Professional Development

The researchers of this study found that teachers reported on both their experiences with the training session as well as on their collaborative use of the iPad, and these responses answered Research Question 1 regarding how early childhood educators respond to such a professional development initiative. All teachers reported that the professional development provided by the Apple consultant (or via their co-teacher if they were unable to attend) was helpful to their learning. However, those who were already proficient in the use of an iPad reported that they were familiar with some of

Table 2 Descriptions and examples of codes used in analysis

Code	Instances when the code was applied	Example statement
Challenges (CH)	A teacher expressed feelings of worry or discontent related to the initiative or to the use of the iPad in the classroom	I just feel like it's a big responsibility so I haven't taken it [the iPad] home yet. I leave it in the office so I know where it is
Examples of use (EU)	A teacher's statement related to how she integrated the iPad into her instructional practices or the classroom curriculum	Blogging, pictures, visual aids. I've done some lesson planning on it [the iPad]
Time (TT)	A teacher addressed the amount of time the iPad added or subtracted from her daily work efforts	If you need a song, the first thing you should think of is, let me look on the iPad for it; not let me search 20 classrooms to see if someone has it
Professional development (PD)	A teacher discussed the Apple consultant session, her own exploratory process with the iPad, the assistance she received from her colleagues, or the collaboration she experienced with her colleagues	Yeah, I thought it was neat, I definitely learned something. I don't learn from somebody telling me. I learn from doing and playing with. I sent out shared pictures by accident, they [the other teachers] were like 'oh, you shared pictures on some cloud' and I was like 'great'…I didn't know I did it
Initial impressions (II)	A teacher commented on her initial judgments of the initiative or the iPad in general	I was kind of interested to see how a 2-year-old would take to an iPad and how you would really implement it

Table 4 Teacher reported use of ipads in classrooms

Reported use of iPads	Number of teachers who reported this use
Parent communication	12
Information resource and visual aid	10
Photographs/camera	8
Lesson planning and team sharing	7
Music and exercise	5
Youtube videos	5
Facilitation of children's social skills	4
Skill building apps/games	4
Documentation and note taking	3
Daily transitional tool	2
E-books	1

One response was recorded per teacher. Findings based on interviews, meeting notes, and focus groups

the topics from this session and requested more information about specific applications they could start to use in their classrooms. In addition, this initiative was designed for each teaching pair to share an iPad for their classroom, making collaboration an essential component of its use. All teachers reported using and sharing the iPad with their teaching partner as well as discussing how they were implementing it into the classroom at their biweekly team meetings. In at least three documented instances, teachers reported that they felt their co-teacher was more technology-proficient than them and helped them with tasks such as creating group email lists for parents and attaching pictures. Table 4 shows how teachers used the iPad over the course of this study. Application use was not reported as high as other uses for the iPad, but a few specific Applications were recorded, such as Writing Wizard for handwriting practice and popular character-based puzzle Applications (characters dependent on age group and interest).

The exploratory nature of this professional development was unique to this early childhood setting, as these teachers do not normally experience choice in their school-run professional development sessions. Teachers did not report that they felt mandated to use the iPad in any particular way and instead used team meetings to hear about the innovations of their teammates and to suggest changes. Despite a wide range of technological abilities and differing levels of comfort with the iPad, every classroom experienced significant integration of technology. With no set mandates for implementation, within 3 weeks of the iPad training, all classrooms were using their iPads to send pictures and notes to parents in place of weekly blogging on their website. The combination of collaboration and choice seemed to greatly impact the integration of the iPad. The researchers of this study found that teachers did not simply "add-on" technology to their existing routine; instead, they used it to replace traditional tasks and to try new strategies. This growth from dialogue and from the

purposeful time set aside for reflection (in the form of documentation of ideas and integration attempts at the team meetings) aligns with the professional development for teacher change literature discussed earlier.

Contextual Challenges

The second research question addressed contextual challenges that teachers may face with iPad integration. In this study, teachers unanimously reported that the inconsistency of the wireless network at the school site was a barrier to implementation. While every teacher was able to connect to a Wi-Fi network somewhere in the school, connection was slow or spotty in classrooms farthest from the hub. This issue took weeks to address and greatly inhibited the use of applications that would allow teachers to search instantaneously for videos or information that the students were discussing as well as music applications.

> The problem is that we don't really have WIFI on this side of the building, which I know they are working on… so it's really difficult to email anything or to get online to look for videos. I had a kid yesterday that I realized that he can listen to music on the headphones but we really just couldn't even get [the internet] going… we used to have a listening center where they can read books or listen to music and it's been broken since almost the beginning of the year and we have never gotten another one.

Teachers were still able to use their iPads to capture pictures and videos of students and primarily used the iPad for that use in the early weeks of the initiative. Teachers did not report feeling unsupported by their administration or parents in this initiative, although two teachers discussed their concern about their own technology proficiency as a barrier to implementation in their initial interviews.

Innovative Practice

At this particular school site, teachers did not initially have school email nor did they communicate via email with parents, making this jump in virtual communication quite innovative. Moreover, through analysis, it was determined that teachers used technology in three uniquely innovative ways (RQ 3): As an efficiency solution, as a bridge in virtual parent communication, and as curriculum enhancement or replacement.

Technology as an Efficiency

One of the first ways teachers used their iPads was to gain efficiency in their work tasks and also in their work day. One teacher mentioned the efficiency as related to organization:

> Because I find that it's a lot more efficient like, if I didn't have the iPad I would probably be using a paper binder… organizing things that way…kids' files and things like that. But, with this, I think it's so much easier because you don't have to print pictures out necessarily, you can add it to a file. It just feels more organized and more together.

The initial universal application of the iPad by teachers used was the replacement of weekly blogging on the school website with weekly emails from their newly created cloud accounts. One of the teachers explained the process of blogging as it worked at their school:

> We would have to blog, upload videos or photos, and it would work sometimes or not depending on the website. Sometimes they were too big (photos), and you'd have to resize them and finally get it on there and then it ran in an html format so if you couldn't get it to work properly, it was just painful.

Within the first month of the initiative, every teaching pair had made the choice to substitute weekly blogging for emails to parents. These weekly emails contained pictures and videos taken on their iPads. In a previous school survey, only 50 % of parents reported reading the school blogs thus this change also drastically increased the amount of information the parents received concerning their child's school day. In addition to reaching more parents, teachers reported a time savings of up to an hour using the iPad to email parents in place of blogging.

Furthermore, six out of the 10 classrooms also used the iPads to replace or modify the daily communication sheets sent home to parents. Previous school policy had teachers complete a daily communication sheet that included information about their child's school experience (i.e. book read during circle time, topic of study for the day, fine

motor skills that were worked on). One of the teachers explained how using iPads to send this information resulted in more quality time with her students.

> Plus, really the benefit is that it gives us more time with the kids because, by the time, we have 13 kids, we have to write 13 (daily) sheets, which is three questions and, for me, it takes a good hour to write them and pack them up. Now that it takes 5 min, after lunch we can play, I'm very happy.

Another teacher commented, "It takes 5 min and then we are having more conversation, more meaningful conversation with the kids at lunch instead of quickly writing things down." This gain in efficiency during the school day has a direct impact on the amount of time children spent engaged in conversation and activity with their teachers. In this instance, the implementation of technology resulted in more quality time with a teacher, not less.

Technology as a Bridge

As previously mentioned, before the iPad initiative, teachers did not have an email address associated with the school and did not have email communication directly with the parents. When teachers received their iPads, they also created an email address associated with their iPads. They were able to create group email lists to reach parents and parents also could now contact their child's teacher directly. A teacher remarked:

> Some of the stuff, I could send into a group email. Say yesterday, the fire truck came to visit us, "here are some pictures" and then also just add a checklist of what they ate…like a teeny checklist of "they need diapers, they need wipes" like a reminder checklist.

This new line of communication became a bridge, connecting teachers to parents in a timely way. In addition, because the school operates on a flexible schedule, offering both before-care and after-care outside of the school day, there are parents who rarely interact with their child's main teacher due to work schedules. These parents had most of their interaction with the before-care and after-care teachers, until the implementation of a weekly or daily emails from teachers. One teacher described this new interaction, "the parents love it (emailed pictures), they get to see it how it's happening…they're not the greatest pictures in the world, but the parents still like to see their children be active throughout the day…they love it." Another teacher described this as the most significant benefit of this initiative. "I think the biggest thing that has been a real help for us so far is the communication piece with parents. Now that we have all the parents' email addresses, we're

able to have more frequent and consistent communication." During one focus group session, several of the teachers stated that the iPad was useful for presenting documentation to parents at conferences:

> I used them for my conferences and it made my life a lot easier. Instead of bringing notes and things like that, I had every kid doing something different whether it was his cutting skills or writing skills. Things like that. Parents like that.

Another teacher agreed, "It's totally different, us telling them what we do and seeing their kids doing it.

In some cases, iPad use also served as a bridge between students. One teacher reported that specific students in her class had difficulty creating friendships with classmates. When she introduced the iPad and worked with the class to teach them how to use it, the students began to engage authentically with their peers. While perhaps an isolated incident, for these children, the iPad was a tool to help connect with peers and develop the much-needed social skills appropriate for their age. The teacher described how this worked in class.

> We have two kids in our class; they don't like to socialize, but the minute we bring the iPad out, it's all of our kids interacting. They are helping each other; they are showing them different things. They are learning from their friends…you know; they are trying to bring them along.

This use of technology is not necessarily specific to the iPad, email communication and other technology tools may be able to pay the same role. However, in this environment, the user-friendly nature of the iPad allowed for communication to be done quickly and without detracting from other tasks. For students, because the iPad is portable and can be placed in the center of a small group of children, they were able to collaborate more authentically.

Technology as Curriculum

Teachers in this study showed a significant amount of growth in their use of technology to communicate with parents and document student learning. While this technology use impacts the way teachers do their job, it does not necessarily change the way they teach. A smaller group of teachers used the iPad in a way that replaced or enhanced parts of their curriculum. An example of replacement occurred when teachers used the iPad to replace books or music. A teacher explains, "we use it all the time for music because our CDs are scratched…I have songs that go with books but they are so old and to replace the book is $20 but to google it is free." Another teacher explained how the iPad can be used to supplement her curriculum in a more timely way.

> It's a huge educational tool. Instead of having to go to the library, which cuts into my personal time…it's nice to be talking about ladybugs and just pull up a picture of a ladybug and show it to the kids. It's instant; there is no gap.

The availability of instantaneous information fits nicely with the quick pace of an early childhood classroom. Some teachers used the iPad to enhance their curriculum and provide students with a multisensory experience. For example, while studying the solar system, a teacher used the iPad to show students how planets rotate and orbit. To provide further depth, she used audio clips to have students experience the distinct sounds each planet makes in space. Another teacher commented:

> We actually were just learning, did an author study, on Eric Carle, and we were talking about the pattern of the book and how Eric Carle loved nature. So, we took the iPad and went for a nature walk and each child was able to find something in nature that they wanted to take a picture of and then we are making a class book with photographs. So, they were actually using the iPad themselves to see how it was a different way to make a book and to …you know… have their own work that is different than their writing or their drawing.

Teachers also reported using their iPad to conduct research for their lesson plans and "look up" questions students asked in class.

Early childhood educators differ from their K-12 teaching peers in curriculum development. Unlike the often uniform and scripted curriculum of the older grades, early childhood educators have maintained more independence in lesson planning and daily routines. Such flexibility has also led to what Leana and Appelbaum (2009) refer to as job crafting, that is, the individual shapes their work environment and practice according to "his or her own preferences and competencies" (p. 1172). Noticeably, the teachers in our study took a similar initiative with the iPads, incorporating them in a way that best suits their needs and the needs of their students, and yet still seeking more innovative practices. A teacher stated her preference to meet her students' interests, stating,

> My kids love music and this morning they were singing "Life is a Highway" and beating on the drums. It would be nice to go on and quickly pull up the song, show them different versions of the song. We do a lot of sign language in our class and there are

a lot of YouTube videos on there already done …. so we can show them.

In fact, teachers frequently asked the researchers for more information about which Apps they could and should be using with their students.

> We did a Yoga App, because I'm really into yoga with my class. So, I have a Yoga App where they can pick the move they want and then it tells you all about that move. So, that's kind of where they've interacted with it. I don't really have games on there. I don't really think they should be playing games on there the whole time unless it's with one-on-one interaction with me.

Looking toward the future, using the iPad as curriculum may be the next area of growth for early childhood teachers.

Recommendations

For this group of early childhood educators, technology integration in the classroom occurred through just one platform: the iPad. The purpose of this professional development initiative was not to integrate iPads into the classroom per se, but rather to understand how new forms of technology could successfully and effectively be introduced to early childhood educators. Specifically, how could teachers use technology in meaningful and productive ways and also be encouraged to continue to develop as a technology user—past the initial professional development phase? The researchers of this study found that when teachers were supported and empowered in this exploratory process, technology integration became less of a daily curriculum requirement and increasingly became a source of assistance and value. The combination of choice (in how to implement) and support (in the form of a co-teacher) was critical to overcoming traditional technology implementation obstacles like varying levels of technology proficiency and comfort. Beyond the ease with which teachers could communicate with parents or organize their daily notes that came from the use of the iPad, teachers also found that the iPads could be used in developmentally appropriate ways to supplement their classroom material and to build upon their current curriculum collection (source of books, music, pictures, ideas and facts, and videos). Technology as part of the curriculum then is not integrating specific times during lessons for children to have access to technology, but instead finding ways to integrate technology into the lessons in a more authentic and meaningful manner.

Future studies should follow the progression of a professional development initiative similar to that which was documented in this study in order to understand how early childhood teachers can develop with new technology as it changes over time. Classroom observations studying the instructional practices surrounding iPad integration is needed to understand *how* iPads are most effectively used with young children to support their growth and development. Teachers expressed interest in identifying which Applications are most useful in developing young children's skills. While advertising on preschool iPad Applications is plentiful, it would be helpful to understand which Applications maximize the functionality of the iPad and help teachers explore content in a novel way. Lastly, the long-term effects of iPad use with early childhood students should be researched with perhaps a greater focus on the impact on their social-emotional development, and further explorations concerning the appropriate use of iPads with early childhood students should be conducted.

Limitations

There are several limitations that should be taken into consideration when interpreting the results of this study. This study used a small sample, thus restricting the generalization of results. In addition, this study relied on the self-report from teachers, and although teachers worked in pairs and both reported the same iPad use, there is a validity risk, as the researchers did not use classroom observations as part of the study. While some teachers reported their concerns about integrating the iPad into the classroom, all teachers were willing to try to work with the iPad and many were excited. Similar studies should be repeated with varied populations of early childhood educators to validate results.

References

American Academy of Pediatrics. (2011). Media use by children younger than 2 years. *Pediatrics, 128*(5), 1040–1045.

Aronin, S., & Floyd, K. K. (2013). Using an iPad in inclusive preschool classrooms to introduce STEM concepts. *Teaching Exceptional Children, 45*(4), 34–39.

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.

Blackwell, C. K., Lauricella, A. R., & Wartella, E. (2014). Factors influencing digital technology use in early childhood education. *Computers & Education, 77*, 82–90. doi:10.1016/j.compedu.2014.04.013.

Blackwell, C. K., Lauricella, A. R., Wartella, E., Robb, M., & Schomburg, R. (2013). Adoption and use of technology in early education. *Computers & Education, 69*, 310.

Blackwell, C. K., Wartella, E., Lauricella, A. R., & Robb, M. (2015). *Technology in the lives of educators and early childhood*

programs: Trends in access, use, and professional development from 2012 to 2014. Northwestern School of Communication. Center of Media and Human Development. Retrieved from http://www.fredrogerscenter.org/wp-content/uploads/2015/07/Blackwell-Wartella-Lauricella-Robb-Tech-in-the-Lives-of-Educators-and-Early-Childhood-Programs.pdf.

Bogdan, R. C., & Biklen, S. K. (2007). *Qualitative research for education: An introduction to theories and methods* (5th ed.). Boston, MA: Allyn & Bacon.

Bowman, B. T. (2011). Bachelor's degrees are necessary but not sufficient: Preparing teachers to teach young children. In E. Zigler, W. S. Gilliam, & W. S. Barnett (Eds.), *The pre-k debates: Current controversies & issues* (pp. 54–57). Baltimore, MD: Paul H. Brookes Publishing Co.

Brown, A., Shifrin, D. L., & Hill, D. L. (2015). Beyond 'turn if off': How to advise families on media use. *American Academy of Pediatrics News, 36*(10), 54.

Buchanan, T., Sainter, P., & Saunders, G. (2013). Factors affecting faculty use of learning technologies: Implications for models of technology adoption. *Journal of Computers in Higher Education, 25*(1), 1–11. doi:10.1007/s12528-013-9066-6.

Chen, J., & Chang, C. (2006). Using computers in early childhood classrooms: Teachers' attitudes, skills and practices. *Journal of Early Childhood Research, 4*(2), 169–188. doi:10.1177/1476718X06063535.

Chin, R., & Benne, K. (1969). General strategies for effecting changes in human systems. In W. Bennis, K. Benne, & R. Chin (Eds.), *The planning of change* (2nd ed., pp. 32–59). New York, NY: Holt, Rinehart & Winston.

Common Sense Media. (2013). Zero to eight: Children's media use in America 2013. Retrieved from https://www.commonsensemedia.org/research/zero-to-eight-childrens-media-use-in-america-2013.

Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches.* Thousand Oaks, CA: Sage.

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches.* Thousand Oaks, CA: Sage.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. doi:10.2307/249008.

Geist, E. A. (2012). A qualitative examination of two year-olds' interaction with tablet based interactive technology. *Journal of Instructional Psychology, 39*(1), 26–35.

Gimbert, B., & Cristol, D. (2004). Teaching curriculum with technology: Enhancing children's technological competence during early childhood. *Early Childhood Education Journal, 31*(3), 207–216.

Guskey, T. (1986). Staff development and the process of teacher change. *Educational Researcher, 15*(5), 5–12.

Guskey, T. (2002). Professional development and teacher change. *Teachers and Teaching: Theory and Practice, 8*(3), 381–391.

Hall, G. E., & Hord, S. M. (2011). *Implementing change: Patterns, principles, and Potholes* (3rd ed.). Boston, MA: Allyn and Bacon.

Hinostroza, E. J., Labbé, C., & Matamala, C. (2013). The use of computers in preschools in Chile: Lessons for practitioners and policy designers. *Computers & Education, 68*, 96–104. doi:10.1016/j.compedu.2013.04.025.

Johnson, J. E., & Christie, J. F. (2009). Play and digital media. *Computers in the Schools, 26*(4), 284–289. doi:10.1080/07380560903360202.

Kucirkova, N. (2014). iPads in early education: Separating assumptions and evidence. *Frontiers in Psychology, 5*(715), 1–3. doi:10.3389/fpsyg.2014.00715.

Leana, C., & Appelbaum, E. (2009). Work process and quality of care in early childhood education: The role of job crafting. *Academy of Management Journal, 52*(6), 1169–1192.

Melhuish, K., & Falloon, G. (2010). Looking to the future: M-learning with the iPad. *Computers in New Zealand Schools, 22*(3), 1–16.

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

Neumann, M. M., & Neumann, D. L. (2014). Touch screen tablets and emergent literacy. *Early Childhood Education Journal, 42*(4), 231–239. doi:10.1007/s10643-013-0608-3.

Parette, H. P., Hourcade, J. J., Blum, C., Watts, E. H., Stoner, J. B., Wojcik, B. W., & Chrismore, S. B. (2013). Technology user groups and early childhood education: A preliminary study. *Early Childhood Education Journal, 41*(3), 171–179. doi:10.1007/s10643-012-0548-3.

Parette, H. P., Quesenberry, A. C., & Blum, C. (2010). Missing the boat with technology usage in early childhood settings: A 21st century view of developmentally appropriate practice. *Early Childhood Education Journal, 37*(5), 335–343. doi:10.1007/s10643-009-0352-x.

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (2nd ed.). Thousand Oaks, CA: Sage.

Petko, D. (2012). Teachers' pedagogical beliefs and their use of digital media in classrooms: Sharpening the focus of the 'will, skill, tool' model and integrating teachers' constructivist orientations. *Computers & Education, 58*(4), 1351–1359. doi:10.1016/j.compedu.2011.12.01.

Plowman, L., & McPake, J. (2013). Seven myths about young children and technology. *Childhood Education, 89*(1), 27.

Plowman, L., Stevenson, O., Stephen, C., & McPake, J. (2012). Preschool children's learning with technology at home. *Computers & Education, 59*(1), 30–37. doi:10.1016/j.compedu.2011.11.014.

Prensky, M. (2008). Turning on the lights. *Educational Leadership, 65*(6), 40–45.

Richardson, V., & Placier, P. (2001). Teacher change. In V. Richardson (Ed.), *Handbook of research on teaching* (4th ed., pp. 905–947). Washington: American Educational Research Association.

Saine, P. (2012). iPods, iPads, and the SMARTBoard: Transforming literacy instruction and student learning. *New England Reading Association Journal, 47*(2), 74.

Saluja, G., Early, D. M., & Clifford, R. M. (2002). Demographic characteristics of early childhood teachers and structural elements of early care and education in the United States. *Early Childhood Research & Practice, 4*(1), n1.

Sheridan, S. M., Edwards, C. P., Marvin, C. A., & Knoche, L. L. (2009). Professional development in early childhood programs: Process issues and research needs. *Early Education and Development, 20*(3), 377–401. doi:10.1080/10409280802582795.

Vaughan, M., Beers, C., & Burnaford, G. (2015). The impact of iPads on teacher educator practice: A collaborative professional development initiative. *International Journal of Technology in Teaching and Learning, 11*(1), 21–34.

Whitebook, M., & Sakai, L. (2003). Turnover begets turnover: An examination of job and occupational instability among child care center staff. *Early Childhood Research Quarterly, 18*(3), 273–293. doi:10.1016/S0885-2006(03)00040-1.