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Expanding Definition of Technology in Special Education: Impact of Training on the Adoption of iPad Tablets by Special Educators

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ABSTRACT

The role of technology in special education has increased over the last 20 years. Expedited by the introduction of Apple iPad and its implementation of touch-based input, the perception of technology has grown from a functional role for students with disabilities to a bridge in accessing general education curriculum. However, quality adoption of new technology within the classroom relies heavily on professional development of the special educator. This paper offers a discussion on the expansion of technology in special education, various attributes associated with quality educator training on technology, and the results of a five-year investigation on the formal training of special educators using iPad tablets. Results indicated longitudinal training focused on active learner experiences had a significant effect on the likelihood of special educator iPad tablet adoption and the resulting implementation in the classroom. Recommendations on educator professional training on iPad tablets follows results.

KEYWORDS

Instructional technology; iPad; professional development; special educator training; tablets; teacher preparation

Introduction

Since 2010, touch-based tablets have become ubiquitous education tools in classrooms across the United States (U.S.), particularly in settings serving students with disabilities. Such devices and their native software applications (i.e. apps) have offered new opportunities to many students with various learning, behavioural and communication needs (Coleman, Cramer, Park, & Bell, 2015; Flewitt, Kucirkova, & Messer, 2014; Flower, 2014; Garguilo & Bouck, 2019; Messinger-Willma & Marino, 2010; Ok, 2018; Rodríguez, Strnadová, & Cumming, 2014). Ranging from assisted word processing to complex icon-based communication, tablets have revolutionised the field of special education and reduced the reliance on expensive proprietary technology (Bouck, Satsangi, & Flanagan, 2016; Ok, 2018; Rivera, Hudson, Weiss, & Zambone, 2017). Among the touch-based tablets that populate the market, Apple iPad holds distinction as leader in market share, branding, and the number of native apps, making it ubiquitous in schools across the U.S. (Liao, 2018; Powell, 2014; Young, 2016).

Regardless of new technology, several researchers (e.g. Chen, Looi, & Chen, 2009; Coleman et al., 2015; Miranda & Russell, 2011; Rodríguez et al., 2014; Walsh & Farren, 2018) concluded professional development on technology is necessary to ensure educators deliver meaningful

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incorporation into classroom instruction. Factors such as cost of trainers, timeliness of training, length of training and levels of professional comfort with technology will have a direct effect on genuine adoption and student outcomes (Holden & Rada, 2011; Jimoyiannis & Komis, 2007; Maich & Hall, 2016; Pilgrim, Bledsoe, & Reily, 2012). However, with iPad tablets, professional development becomes paramount as such technology requires entirely new skills (e.g. touch-based input, file management, app curation) and pedagogies (e.g. digital artefact creation, social media interaction, interpersonal communication) that were non-existent a few years prior. Additionally, research demonstrating theoretical models and resulting best practices in education remains emergent at best (Campigotto, McEwen, & Epp, 2013; Garguilo & Bouck, 2019; Ok, 2018; Satsangi, Miller, & Savage, 2019).

To this end, there are numerous opportunities to examine the professional development of special educators and the resulting likelihood of genuine touch-based technology adoption, particularly in settings serving students with disabilities. This paper will review the evolution of technology in special education, examine necessary components that facilitate quality professional development on instructional technology, then discuss the study of special educators' self-rated preparedness on technology incorporation of iPad tablets as a result of formal training. Finally, recommendations that promote the adoption and meaningful integration of iPad tablets in special education settings will follow.

Expanding the Definition of Technology in Special Education

Apple iPad tablets have become emblematic of numerous advances made in technology over the last decade. Key features such as touch-based input (i.e. reliance on finger touch-gestures with no pointing device nor physical keyboard), movement away from legacy technologies (e.g. mechanical hard drive storage; Adobe Flash software, physical peripheral connections), true wireless connectivity and content delivered through native apps rather than websites, have contributed to their expeditious adoption across society. This is particularly true in education where such advances have promoted student engagement, collaboration, social networking and creativity (Dogan & Almus, 2014; Geer, White, Zeegers, Au, & Barnes, 2017; Miller, 2012; Ok, 2018; Pilgrim et al., 2012). Although special education settings have offered some of the more illustrative examples of iPad tablet uses when working with students with disabilities.

As several researchers discussed (e.g. Campigotto et al., 2013; Garguilo & Bouck, 2019; Nirvi, 2011; Ok, 2018; Powell, 2014; Rodríguez et al., 2014; Williams, 2012), many special educators and parents of students with disabilities quickly recognised the potential in iPad tablets and incorporated the device into various aspects of daily life. Examples included the use of iPad tablets as lower-cost augmentative communication devices for students with severe/multiple disabilities (McCrea, 2014), alternate means of literacy instruction for students with reading disabilities (Williams et al., 2012) and transition/community-based instruction for students with developmental disabilities (Hill & Flores, 2014; Kleeberger & Mirenda, 2010; Rivera et al., 2017; Sweeney, 2012; Williams, 2012). To a greater extent, this adoption of iPad tablets expanded the conventional definition of technology in special education as it facilitated transition away from proprietary technology and normalised technology used by students with disabilities outside of school settings.

Legacy Assistive Technology

In special education, the term *technology* became synonymous with devices that increase, maintain or improve functional capabilities of students with disabilities, such as individuals with severely limited speech/language abilities using picture-exchange systems to facilitate interpersonal communication (Friend, 2017; Garguilo & Metcalf, 2013; Hess & Gutierrez, 2018; Ok, 2018). However, the term became used to loosely describe any item or equipment designed or customised to fit student needs (e.g. moulded pencil grip to assist a student holding their pencil), all of which was labelled as *assistive technology* (AT). This broad definition of AT was purposeful as it helped to ensure various devices or products could be included in the individual education plan (IEP) for any student receiving special education services offered under the Individuals with Disabilities Education Act (IDEA; U.S. Department of Education, Office of Special Education and Rehabilitative Services, 2018).

For years, the broad definition of AT operated under IDEA with legislative support from the Assistive Technology Act of 1988 (ATA; U.S. Department of Education, 2018), which secured supplemental financing of technology in special education. However, the 1998 re-authorisation of ATA included a deliberate expansion of technology beyond functional instruction to ensure students with disabilities received increased access to the general education curriculum and signalled greater emphasis on instructional rigour (Coleman et al., 2015; Dyal, Carpenter, & Wright, 2009; Garguilo & Bouck, 2019). This expansion of ATA facilitated classifications of technology into *low tech* (e.g. audio recorders, reading timers, calculators) and *high tech* (e.g. desktop/laptop computers, mobile devices, apps). With these classifications in mind, the remainder of the discussion will focus on AT generally classified as *high tech*, namely consumer hardware/software used in special education settings.

Advancement of Consumer Technology

When ATA was reauthorised in 1998, consumer technology focused on the traditional desktop computer, which served as central hub to emerging digital media (e.g. digital photography, digital video, digital music, personal digital assistants), depository of productivity software (e.g. Microsoft Office), and offered access to the Internet. Instructional technology reflected this state as academic lessons generally emphasised access to electronic sources and creation of simple digital products to elevate the educational experience for students (Davidson, 2004; Minkel, 2002; Stager, 2003). To a lesser extent, special educators targeted the same experience for students with disabilities, though lessons capitalised more on access to the general education curriculum through specialised software titles (Milone, 1997).

However, with the availability of iPad in 2010 and its dynamic implementation of touch-based technology, many schools expressed strong interest in developing new experiences for students in special education settings (Hill & Flores, 2014; Kleeberger & Mirenda, 2010; Nirvi, 2011; Rivera et al., 2017; Sweeney, 2012; Washington, 2012). As McCrea (2014) explained, iPad tablets offered lower cost of ownership, high portability, and reduced training of special educators, all of which, promoted the role AT in the lives of students with disabilities. Students with disabilities could access instructional content

beyond physical books and participate in immersive experiences offered by a lightweight, handheld 9.7-inch screen. Additionally, many of the motor challenges often associated with traditional computers (e.g. manipulating a mouse, horizontal hand-eye tracking of cursor on a vertical plane, two-hand typing on a physical keyboard) were removed through simple tap and point gestures.

In addition to instructional advantages, Therrien and Light (2016) explained iPads presented students with disabilities opportunities to use technology in public without stigmatisation. In U.S. society, iPad tablets have become ubiquitous across settings (e.g. libraries, coffee houses, businesses). This proliferation normalised the iPad by removing the stigma of using technology in public, thus increasing the likelihood students with disabilities who rely on the device for augmentative communication will continue their use outside school (e.g. ordering food at restaurants, communicating with new people in the community). Such instances continue to illustrate the changing definition of technology in the special education (Schaffhauser, 2013).

Special Educator Professional Development

Legacy AT devices were often expensive, cumbersome, and based on proprietary technology that may have required considerable training of educators. The advantage of minimal training was one of the most compelling reasons schools invested in high volume purchases of iPad tablets. However, as Northrop and Killeen (2013) discussed, purchasing or acquisition of technology does not necessarily lead to increased student success. Rather, educator comfort with technology in tandem with their pedagogical knowledge are critical factors in quality technology integration (Anderson & Dexter, 2005; Holden & Rada, 2011; Jimoyiannis & Komis, 2007; Miranda & Russell, 2011). Additionally, these factors are particularly critical in special education settings where disability conditions may complicate genuine integration (Garguilo & Metcalf, 2013; Graham, Culatta, Pratt, & West, 2004; Martin et al., 2010; Ok, 2018; Pilgrim et al., 2012).

To this end, high-quality educator training is central to the resulting integration of technology in the classroom. Martin et al. (2010) discussed several critical components necessary in high-quality professional development, which include *duration, active learning, collective participation* and a *clearly articulated vision of student achievement*. Duration serves as foundation for all subsequent components as genuine of investment of time ensures educators are provided the opportunity to become familiar with technology and understand its place within classroom instruction. In the development of pedagogical knowledge, both active learning and collective participation work in tandem. Active learning allows educators to observe expert modelling, participating in direct instruction, conducting peer observations, and becoming engaged through interactive feedback sessions (Desimone, 2009). Subsequently, collective participation strengthens collegiality amongst educators through team-building activities, which can be advantageous amongst special educators considering the diversity of special education positions/assignments. Finally, a clearly articulated vision of student achievement by the educator ensures the implementation of technology is aimed towards student outcomes and not the adoption of technology for the sake of adoption (Anderson & Dexter, 2005; Holden & Rada, 2011; Jimoyiannis & Komis, 2007; Miranda & Russell, 2011).

Purpose of the Study

As various researchers (e.g. Garguilo & Metcalf, 2013; Graham et al., 2004; Holden & Rada, 2011; Jimoyiannis & Komis, 2007; Martin et al., 2010; Miranda & Russell, 2011; Pilgrim et al., 2012) concluded, the quality of technology integration in education is dependent upon the length and quality of educator professional development, whether the experience occurs in pre-service or in-service levels (Dreon & Dietrich, 2009; Skophammer & Reed, 2014). This holds particularly true in special education settings where genuine technology integration can dramatically elevate the quality of life for students with disabilities (Flewitt et al., 2014; Ok, 2018; Powell, 2014). In order to ensure quality results for students with disabilities, special educators must demonstrate technical proficiency in tandem with pedagogical knowledge.

The current study focused on two of the aforementioned factors affecting educator adoption of new technology, specifically *duration of training* and *type of training* as part of a special educator preparation programme. This study surveyed a sample of licenced educators through a pre-test/post-test instrument based on their experience of formal training on iPad integration when working with students with disabilities. Three research questions guided this study:

> Does the duration (i.e. *length, frequency*) of training on iPad tablet integration influence educator self-rated comfort and proficiency?
>
> Does the type of training experience (i.e. *active learning, collective participation*) influence educator self-rated comfort and proficiency?
>
> What are qualitative educator perspectives regarding the implementation of technology in special education instruction post-training?

Methods

Participants

The purposive sample was comprised of participants enrolled in a graduate programme at an Illinois public university. Each participant held valid general educator licence (i.e. general educator) and were earning state credentials to become special educators in Illinois. As the capstone experience of their graduate programme, participants enrolled in a 16-week practicum-based course hosted in the university children's centre for one semester.

Over the span of several years, beginning August 2011 through May 2016, a total of 72 participants (60 females, 12 males) were successively enrolled in the course, participated in the iPad training, and completed both components of the survey (i.e. pre-test, post-test). At the conclusion of each semester, volunteer participants were contacted and interviewed for additional insight on their professional experiences as a result of the iPad training. The study met all university requirements for formal investigation (See Table 1).

Table 1. Participant demographics.

	n	%
Gender	60	83
Female		
Male	12	17
Racial/Ethnic Identity		
White	63	88
Black or African American	4	6
Hispanic or Latino	2	3
Asian or Pacific Islander	2	3
Other	1	1
School Setting		
Urban	29	40
Suburban	43	60
Type of School		
Public school	55	76
Private school	10	14
Other setting	7	10
Years as Licenced Educator		
Less than 3 years	7	10
3 to 9 years	65	90
10 to 20 years	0	0

Instrument

An independent instrument (i.e. online survey) was developed to examine participant histories addressing their experiences in technology integration for academic instruction using Likert-based and dichotomous-based items. Survey items were constructed to ascertain participant self-rated preparedness in their use of technology (i.e. frequency of technology integration, type of technology integration and outcome of technology integration), self-evaluation of their comfort regarding technology across settings (e.g. home, school), types/use of personal mobile devices (e.g. Apple iPhone, Android-based smartphone, Windows-based smartphone) and any professional development specifically aimed at iPad tablet use in the classroom. The instrument consisted of 40 content items and 10 demographic items. The instrument was then modified to evaluate participant self-ratings as a post-test measurement upon end of semester addressing similar domains as those described in the pre-test form. All quantitative data were collected anonymously with no tracing information to any participant.

Qualitative Interviews

At the conclusion of each semester, the principal investigator (PI) verbally offered all participants the opportunity to volunteer for a follow-up interview to elaborate upon their experience focused solely on iPad training, instructional outcomes for students, and related professional experiences with technology. The interview was conducted using a standard script based on three questions examining their semester experience with iPad training and integration. Each participant was informed the interview would last approximately 7 to 10 min. All participants were asked to respond to the following prompts:

> Could you please describe your comfort with (any) technology as part of academic instruction prior to this course?

How did the training offered in this course affect your integration of the iPad when working with your assigned student?

How does the training experience offered in this course differ from (any) professional development on technology you've received in the past?

Narrative analysis of qualitative responses was employed to identify commonalities and differences amongst participants in order to understand perspectives regarding the implementation of technology in special education instruction after training.

Formal Training (Treatment)

The capstone course serves as a practicum placement for participants enrolled in the special education graduate programme. As part of this requisite course, participants designed and delivered one-to-one instruction for an assigned K-12 student with an identified learning disability. After completing the aforementioned online survey (i.e. pre-test), participants were assigned one university iPad tablet pre-loaded with stock Apple apps (e.g. iWork productivity suite, iMovie), several third-party apps (e.g. ABC Pocket Phonics, My Word Wall, Kidspiration Maps), and one Apple Wireless Keyboard.

Throughout each 16-week semester, participants were offered 10 weekly, three-hour training sessions on iPad tablets focused on device management, navigation, troubleshooting and instructional integration on four Apple apps (i.e. iMovie [digital movie creation], Pages [word processing], Keynote [slideshow], Numbers [spreadsheet]) through a collective participation setting (i.e. small group). Group size varied by semester but averaged six participants throughout length of study. Each training session was conducted by the PI delivering content based on curated materials from various online sources focused on pedagogical practices with instructional technology (e.g. Apple Educator series, Microsoft Educator Community, Edutopia). Each three-hour session offered both PI modelling and collective participation activities focused on pedagogical integration and the resulting digital products (e.g. digital movie, podcast episode, digital musical composition). Additionally, sessions 4, 5 and 6 included participant-led instruction to cultivate personal comfort with the technology.

As part of the pedagogical integration, participants were trained on prioritising student learning goals/objectives in reading instruction, identifying opportunities for iPad tablet use, designing instructional experiences with accompanying evaluation. With the focus on working with students with disabilities in mind, attention was given to skill strengthening in literacy (i.e. reading/writing) as means to access instructional content (e.g. decoding, fluency, vocabulary). Participants identified one short-term literacy instruction goal with supporting objectives for the student, curated various reading curricula/programmes, developed an evaluation plan, then decided upon a student-created digital product (e.g. digital movie, iBook, podcast) encompassing all academic and technical skills. As well, throughout each semester, participants were offered voluntary drop-in sessions with the PI for one-to-one assistance with iPad issues ranging from technical support to pedagogical inquiries. Upon return of issued iPad tablets, participants completed the closing online survey (i.e. post-test) and interviewed with PI, if they volunteered. Description and typical timeline of participant training are offered (See Table 2).

Table 2. Participant training timeline and description.

Week	Training	Delivery
1	Course introduction; Client assignment; Participant pre-test administered; iPad overview; iPad issued	Group
2, 3	Identifying client instructional goal and supporting objectives; iPad navigation; Overview of stock iPad apps (e.g. camera, Safari, Mail, Photos); Peripheral management (e.g. Apple Wireless Keyboard, headphones)	Group, Individual
4	Pages (word processing) and Numbers (spreadsheet) apps overview, sample document creation/management/sharing, troubleshooting steps; Instructional lesson plan editing/submission protocol	Group, Participant-led instruction
5	Keynote (slideshow) and iMovie (video editing) apps overview, sample document creation/management/sharing; Troubleshooting steps	Group, Participant-led instruction
6	Garage Band (voice and music creation), third-party apps (e.g. abc Pocket Phonics, My Word Wall, Kidspiration Maps); Troubleshooting steps	Group, Participant-led instruction
7	Weekly group review, experience/artefact sharing, and troubleshooting; Individual mentoring	Group, Individual
8–10	Group debriefing; Post-test administration; Individual qualitative interviews conducted	Group, Individual

Results

The study purported to investigate pre-test/post-test (i.e. pre-semester training, post-semester training) participants' self-ratings in professional comfort with technology, comfort in the delivery of technology-based instruction with their assigned student, and history of professional development on iPad tablets prior to course training. Survey statements defined professional comfort and technology integration from *very uncomfortable* to *very comfortable*. Each level of comfort was operationally defined and accompanied with examples to ensure participant comprehension of each item/level.

Self-Rating on Professional Training in Pre/Post Semester iPad Training

Paired samples *t*-test was conducted to compare participant self-rating of professional comfort in their use of iPad tablets in *pre-test* and *post-test* conditions based on a semester of training. There was a significant difference in the scores for pre-test (M= 2.90, SD = 1.48) and post-test (M= 4.64, SD = 1.10) conditions; $t(71) = -11.52$, $p = .000$. Finally, results demonstrated no significant differences across gender, race, school setting, or years of licenced teaching experience (See Table 3).

Participant Professional Training on iPad Tablet Integration in School Settings

Participants were offered three dichotomous questions regarding deployment and professional development on iPad tablets within their own school settings. Fourteen per cent of participants indicated iPad tablets were used for classroom instruction at their school,

Table 3. Paired samples *t-test* on participant self-rating scores.

		Pre-Test (n = 72)	Post-Test (n = 72)	t-value	Prob.
Participant	M SD	2.90	4.64	−11.59	0.00
Self-Rating Scores		1.48	1.10		

while 42% of participants indicated iPad tablets were not in use, and 10% were unsure or didn't know. Regarding professional development aimed specifically at iPad tablets, 5% of participants indicated receiving some type of professional development while 57% indicated not receiving any professional development, 4% were not sure. Finally, regarding deployment, 7% of participants indicated iPad tablets were being used in their classroom, while 59% indicated there were no iPad tablets in use. Out of the 72 participants, six indicated they were not currently teaching or employed in a school setting (See Table 4).

Qualitative Interview Responses

Collectively, 15 individuals volunteered to participate. Participant responses suggested general agreement across the three questions. All participants indicated comfort with technology integration was minimal and limited to standard productivity software (e.g. Microsoft PowerPoint, Microsoft Word) or was often employed as part of student remediation in reading (e.g. websites such as Starfall). All participants indicated higher levels of professional and personal comfort when using iPad tablets as a result of the training and were eager to use newly honed skills in their own classroom. As well, all participants found the integration of iPad tablets very beneficial to their assigned student, especially due to the current limitations of their reading/writing skills based on their disability. Regarding the final question on previous professional experiences with technology, all 15 interviewees offered interesting narratives on their professional histories prior to treatment. However, the following participants (i.e. interviewees A, B and C) were selected to highlight unique responses featuring administrator expectations, genuine adoption of technology, and outcomes for students with disabilities.

Interviewee A

Interviewee A was a female general educator in an early childhood classroom (i.e. kindergarten) located in a suburban school district averaging 20 students each academic year over the last 3 years. In the discussion, Interviewee A addressed parent expectations that instructional technology be incorporated into daily instruction. She mentioned one experience with a parent from the current academic year, 'She had the

Table 4. Participant professional training on iPad tablets.

	n	%
School Deployment of iPad Tablets	14	20
Yes		
No	42	58
Not Sure/Don't Know	10	14
Not Currently in Classroom	6	8
Professional Development		
Received Training on iPad Tablets	5	7
Did Not Receive Training	57	79
Not Sure/Don't Know	4	6
Not Currently in Classroom	6	8
iPad Tablets in Own Classroom		
Yes	7	10
No	59	82
Not Currently in Classroom	6	8

expectation that her child should be using the latest technology considering the reputation of the school her child was attending'. Additionally, the participant elaborated that school administration would consistently allocate any remaining academic year funds to the purchase of technology. In her words, 'If there was any remaining money in the school budget, our principal would spend it all on technology saying that if we didn't spend it all, the district would take it back. And we certainly didn't want to hear it from any parent that we were behind in technology because we didn't spend the money'.

The participant continued, 'Our admin is very aware of parent expectations of technology, so there is a constant barrage of new technology each year. Sometimes even in the middle of the year, we're given new toys to learn and encouraged … EXPECTED to use. I think a lot of it comes from the push by the parents, whether or not it fits the classroom. I know a few teachers who display the tech openly in the classroom, so parents can see it and be satisfied that it's there'. When asked whether this new technology included iPad tablets, the participant responded, 'Absolutely. I know it's the big thing right now and they see it everywhere like stores for transactions and I think the expectation is this better be in my child's classroom'.

Interviewee B

Interviewee B was a male early elementary school (i.e. grades 1, 2) educator in an urban school district averaging 30 students each class over the last 5 years. He noted the cultural/linguistic diversity of her classroom each year and explained his growing appreciation for instructional technology. As he shared, 'Our school has over 65 native languages spoken since we're in the heart of the city. But I noticed that when I really started focusing on instruction in the computer labs, the students all got a better understanding of what we're trying to learn and do. It's like the involvement with technology pulls them in and they wind up helping each other learn'.

Additionally, the participant explained one experience with student with autism spectrum disorder (ASD) in his classroom, 'She has very mild ASD but she's sensitive to working with others. In the computer lab, though, she's up and out of her chair engaging with the other students. She's turned out to be a great helper to everyone and even preps the computers by launching apps, entering websites, or sending things to the printer. It's given her an opportunity to help others and I think that's really allowed the other students to see how social she can be when she's comfortable'. The participant offered additional examples where other students in his class have reached out to the student with ASD as a result of the computer lab experiences.

Interviewee C

Interviewee C was a male high school general educator in a suburban district with emergency state credentials in special education. The participant had recently transitioned from a general education setting to a self-contained special education classroom for students with moderate to severe learning disabilities. The majority of his students carried an IEP with stipulated time in general education settings for the large percentage of the day. As he explained, 'I have about 12 students with IEPs that state they receive

instruction in the gen ed … Which is fine but there's a lot of challenges that come with that when all the students cannot read above a 4.0 level. There's so much of the content that would be out of reach for them if it weren't for technology'. This participant was enrolled in the course in the final semester of the study (i.e. 2016) with iPad integration at his school for more than 2 years.

The participant continued, 'I was not trained in using iPad but I have an iPhone and use it pretty well. It was easy for me to move over to iPad and use it with my students. We use a lot of the accessibility features like *speak screen* and *predictive text* to help with getting to the content and not let the reading and writing get in the way'. He concluded with specific examples of how he used the accessibility features for his students in various general education settings.

However, the closing statement was particularly interesting regarding the use of technology in the lives of students with disabilities. He stated, 'My students don't have any issues with using an iPad when they're around their other kids in the regular ed classroom. I know this because I did my student teaching in a classroom years ago and there was one student who had *Alphasmart* on his IEP. He never wanted to use it. All the other kids were using the computers and he felt he stood out. I don't see this with iPad because everyone is using it. It's not out of place'.

Discussion

Technology in special education has expanded since the passage of ATA in 1998, transitioning from an assistive role to increasing accessibility of general education instruction. This expansion is critical as advances in technology have positively contributed to education, particularly in the lives of students with disabilities (Flewitt et al., 2014; Ok, 2018; Powell, 2014). Unfortunately, the acquisition of technology for the sake of acquisition remains a persistent practice in education as the new technology oftentimes exceeds the current professional skills of educators. As several researchers (e.g. Garguilo & Metcalf, 2013; Graham et al., 2004; Holden & Rada, 2011; Jimoyiannis & Komis, 2007; Martin et al., 2010; Miranda & Russell, 2011; Pilgrim et al., 2012) concluded, quality professional development for educators has a significant effect on the adoption and genuine integration of technology within special education.

Although not surprising, *duration* and *type of training* may greatly increase the likelihood of technology adoption by special educators often resulting in high-quality instructional integration for students with disabilities. As demonstrated by post-treatment self-rating scores, participants were evidently more comfortable and proficient in the pedagogical use of new technology. When paired with some of the qualitative data ascertained through post-treatment interviews, the disconnect between technology acquisition and instructional integration was apparent. In many ways, findings from this study confirms previous conclusions by researchers (e.g. Desimone, 2009; Dogan & Almus, 2014; Holden & Rada, 2011; Jimoyiannis & Komis, 2007; Martin et al., 2010; Miranda & Russell, 2011; Northrop & Killeen, 2013; Pilgrim et al., 2012) on the persistent challenge in authentic technology integration, all of which can negate educational benefits.

Limitations and Future Research

As with all pedagogical training, quality educator preparation is critical in the development of instructional skills to ensure positive student outcomes in the classroom. Data from this study provided additional evidence on the importance of professional training amongst educators and their integration of technology, especially when working with students with disabilities. These findings are critical considering the growing acquisition and reliance of consumer-level technology in special education and the brisk pace in which technology advances. It should be noted in the 5 years of this study, Apple iPad has been updated six times with four different variants (i.e. iPad, iPad Air, iPad mini, iPad Pro) entering the consumer market.

Nonetheless, this current study presented several clear limitations. In conjunction with the purposive sampling, future research that includes larger sample populations across teacher preparation institutions will increase the generalisability of such results. Secondly, future implementations of the study would benefit from additional examination on training being offered to in-service special educators in schools. While the purposive sample of participants in this study was currently teaching in K-12 settings, an examination of educators in schools who are in the process of technology adoption for an upcoming academic year would be advantageous.

Findings from this study offered a small glimpse into educator perceptions on technology based on self-ratings, all of which can be affected by various factors. Factors may include personal ownership of certain devices (e.g. iPhone ownership versus Android-based phones), preference for user-interface (e.g. iOS versus Android OS) and history of professional training during their initial educator preparation. As well, organisation-based factors (e.g. technical support offered by district personnel, acquisition of necessary accessories) could have an effect on the continued use of technology should repair or replacement be necessary.

Finally, it is important to assess participant bias in the study. Considering the study was conducted as part of a requisite graduate course, it would be thoughtful to evaluate any influence on participant responses when working towards final course grades. However, participant bias was minimised through anonymous quantitative data collection and conducting qualitative interviews on a volunteer basis. Both limitations and recommendations from this study should guide educators in their consideration of technology before acquisition as prudence will help to ensure more meaningful student outcomes.

Recommendations

Amongst the all various pedagogical practices in special education, the use of technology for instructional purposes continues to evolve and separate from traditional perceptions of assistive technology. The line between special and general education settings continues to blur as conceptualisations of *least restrictive environment* grow to incorporate more general education settings. The professional development of special educators should not only include preparation of traditional assistive technology but the genuine integration of consumer technology to bridge access to general education curricula.

Table 5. Recommended online resources.

Source	Description	Web Location
Apple Teacher Online Training	A free, self-paced professional learning programme designed for educators. Lessons progress from device features to instructional integration.	apple.com/education/apple-teacher/
Microsoft Educator Community	Free online community hosted by Microsoft with instructional lessons on all products, including native apps (e.g. Microsoft Office 365) for Apple iPad.	education.microsoft.com
Google Education (K-12 Solutions)	Google-created digital tools focused on K-12 classroom instruction. Free online resources include lesson plans and training for all Google apps.	edu.google.com/k-12-solutions
iPads 4 Teaching	Website promoting the use of iPad to support pedagogical practices offer professional development options educators.	ipads4teaching.net
Edutopia	Foundation offering K-12 educators free online resources to develop and deliver instruction through the strategic use of technology.	edutopia.org
Teach Thought	Free, online resources for educators addressing various learning/behavioural approaches for students in K-12. Content includes lessons, videos, podcasts.	teachthought.com/technology/resources-for-teaching-with-ipads/
TED-Ed	Non-profit organisation offering free online digital library of original animated videos, interactive lessons, and inspirational content for both educators and students.	ed.ted.com

Based on the feedback offered by participants throughout this study, several common themes became apparent to the PI, which stand as recommendations and lessons learned regarding technology integration across special education. Recommendations include:

> Role modeling by instructional leaders is critical to facilitate encouragement for educators who may be apprehensive to new technology. Throughout each semester of the study, participants relied heavily on the role modeling offered by the PI, particularly on the use of screen-casting live demonstrations of full-featured apps, such as Apple iMovie.
>
> Acquisition of devices that bridge differential skills can expedite technology adoption. As mentioned earlier, each participant was issued their iPad tablet with one Apple Wireless Keyboard. Participants with limited dexterity in typing on touch displays appreciated the use of a physical keyboard, especially in situations where longer documents were involved (e.g. lesson plans, score reports) as the use of the wireless keyboard bridged traditional skills with new technology.
>
> App curation and guidance by the special educator is critical to genuine integration of technology. Participants noted how apps without educator supervision can quickly devolve into *drill and kill* experiences for students. Some of the third-party apps included on the iPad tablets operate on student input and students with limited reading skills quickly resorted to random trial and error screen tapping to advance the app without reading prompts, thus negating educational value from the experience.

Considering the periodic updates of Apple and third-party apps, sources of training were continuously refreshed each semester to ensure participants received current content. Several of these online resources have proven reliable and consistently updated with relevant information used in participant training throughout this study. As part of the recommendations, a table containing reliable resources, descriptions and their web locations have been made available (See Table 5).

Conclusion

As mentioned in the literature review, technology in special education has historically been viewed more for assistive purposes and/or augmentative communication. However, there is growing interest in the use of touch-based technology for instructional purposes as a result of its mobility, low cost, and ease of use. These attributes are critical as they advance adoption of technology amongst populations of students with disabilities.

In the past, devices employed in special education were expensive, based on proprietary technology, and required considerable time in training for all individuals (i.e. parents, teachers, students themselves), though all changed with the introduction of consumer technology employing touch-based input. The results from this study confirmed conclusions from previous research, quality educator professional development is essential to genuine technology integration for student learning.

Although new technology such as iPad tablets have created new learning experiences and increased the quality of life for students with disabilities, educators remain critical to their integration in the classroom. This integration is only possible when educators are comfortable and knowledgeable with said technology and is only attainable through high-quality professional development. With all this in consideration, quality training on technology integration should be recognised for the potential it

offers students with disabilities and included as part of comprehensive special educator preparation.

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