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Use of Electronic Storybooks to Promote Print Awareness in Preschoolers who are Living in Poverty

Amelia Moody, PhD

University of North Carolina Wilmington

E-mail: moodya@uncw.edu

Lori Skibbe, PhD

Michigan State University

E-mail: skibbelo@msu.edu

Michele Parker, PhD

University of North Carolina Wilmington

E-mail: parkerma@uncw.edu

Allison Jones, PhD

University of North Carolina Wilmington

E-mail: jonesar@uncw.edu

Abstract

The present study examined the extent to which teachers who provided print referencing strategies using electronic storybook (e-book) readings had students with greater emergent literacy skills compared to students who only had access to traditional storybook reading sessions. Letter knowledge, early decoding and print concepts knowledge were examined in 20, four- year- old children living in poverty. In the control condition, ten children completed 15 minutes a day of traditional storybook reading instruction, using a direct instruction curriculum. Children in the intervention group (n=10) completed an additional e-book reading paired with adult directed print referencing strategies twice a week over the course of six weeks. Children exposed to e-books paired with adult directed print referencing strategies scored significantly higher on a measure of print concepts knowledge than those in the control group, although gains in letter knowledge and early decoding were equivalent across the two groups. Results suggested that the pairing of traditional instructional methods such as print referencing strategies with current technological tools that enhance engagement, such as e-books, may offer benefits to young children who are developing their awareness of print concepts.

Current efforts are underway to provide young children who are at risk for later academic difficulties with evidence-based early literacy instruction through school-based activities that promote socio-emotional and academic growth opportunities (Barnett, Bell, & Carey, 2002; Justice & Kaderavek, 2004). These opportunities are important for children even before they enter into kindergarten, as those who experience developmental risk in preschool are more likely to struggle with academic achievement throughout early childhood than children without any known risk factors (Skibbe, Grimm, Stanton-Chapman, Justice, Pence, & Bowles, 2008; Brizius, & Foster, 1993). In particular, children whose developmental risk is associated with poverty often exhibit underdeveloped print skills, which has led some professionals to advocate for interventions targeting this area of literacy explicitly (Justice & Ezell, 2001).

One effective means by which to boost literacy achievements for children at risk for reading difficulties is through the use of storybook reading interventions (e.g., Bus, Belsky, van IJzendoorn, & Crnic, 1997; Kaderavek & Justice, 2005; van Kleeck, Vander Woude, & Hammett, 2006; Wasik, Bond, & Hindman, 2006; Scarborough & Dobrich, 1994). These types of interventions can be effective for children exhibiting typical development (Justice & Ezell, 2004; Van Kleeck, 1994) as well as those with developmental risk factors (Hargrave & Sénéchal, 2000; Justice & Ezell, 2002; van Kleeck et al., 2006; Wasik et al., 2006). Although studied less often than traditional paper formats, the digital version of a storybook, often referred to as electronic storybooks or e-books, can also be used to embed explicit targets into a storybook reading session (McKenna & Zucker, 2009). E-books offer children the opportunity to experience

storybook content in a technology-based format and are being used more commonly in schools across the United States.

The number of e-book sales in the United States has increased by 223% in the last year (IDPF, 2012). Although there is a definite push for the integration of technology in schools (USDOE, 2000), a recent technology survey observed that, on average, elementary schools had far fewer e-books in their schools (29%) than high schools (64%). However, it is likely that the prevalence of e-books in early childhood settings will increase, making it critical for us to examine how e-books relate to children's learning within the classroom. Although e-books accounted for only 2.8% of the estimated \$8 million textbook market in the U.S. in 2010, the U. S. Department of Education recently released their "open source multimedia production tool for creating accessible e-books" for all children in efforts to ensure children from all income levels have access to e-books (U.S. Department of Education, 2012). Thus, it is important to understand how to tailor these technological tools in order to maximize possible benefits for children living in poverty, as these children are more likely to struggle when learning to read than their more affluent peers (West, Denton, & Germino-Hausken, 2000).

Children living in poverty often have limited access to reading materials, be it electronic or a traditional paper format. For example, low-income schools often have limited libraries (Duke, 2000), poor access to books at home (Feitelson Rita, & Goldstein, 1986), and fewer community reading resources (Neuman & Celano, 2001). Research suggests that this lack of resources can be detrimental to children's reading achievement (McQuillan, 1998; Lance, Hamilton-Pennell, Rodney, Petersen, & Sitter, 1999). Although limited research is available on poverty and e-books, preliminary evidence suggests that

children at-risk for reading difficulties can benefit from some of the supports provided by electronic storybooks (e.g., Shamir & Schlafer, 2011; Zucker, Moody, & McKenna, 2009).

E-books can incorporate many features that benefit young children's reading development. As one example, e-books often incorporate a read aloud function which offers greater independence for struggling readers (Parham, 1993; Trushell, Burrell, & Maitland, 2001), without requiring direct adult intervention. When used as a tool to promote early literacy development, e-books can track print to enhance the development of print, offer dictionary options to build vocabulary, provide decoding supports using text-to-speech software (McKenna, Labbo, Reinking, & Zucker, (2007), and offer increased exposure to text (Trushell, Burrell & Maitland, 2003; de Jong & Bus, 2003).

The options incorporated within e-books have proven to be beneficial for young children. E-books have been shown to promote child engagement (de Jong & Bus, 2002, 2003; Fisch et al., 2002; Talley et al., 1997; Moody et al., 2010), boost vocabulary (McKenna, Cowart, & Watkins, 1997; Korat, 2010), facilitate communication (Fisch et al., 2002; Moody et al, 2010; Verhallen, Bus, & de Jong, 2006), and improve comprehension skills (Doty, Popplewell, & Byers, 2001; Greenlee-Moore & Smith, 1996; Korat, 2010; Matthew 1996; 1997).

One of the most important ways that e-books can benefit young children is through the inclusion of print referencing strategies (Shamir & Schlafer, 2011). Print referencing strategies refer to the techniques that can be used during storybook reading to draw children's attention to the meaning and function of print using either nonverbal or verbal

cues (Justice & Ezell, 2004; Storch & Whitehurst, 2002). For instance, children can follow print as it is highlighted and track it from left to right on the screen, which teaches children print directionality (Parham, 1993). In sum, e-books provide additional opportunities for children to be exposed to print in ways that can enhance their emergent literacy skills.

In addition to the beneficial features noted above, many e-books offer digital features that can actually hinder learning, such as entertaining games and animations. Some of these features, such as ‘hot spots,’ direct children to focus on the storybook without attention to print. For example, when reading an e-book, the child receives visual and auditory feedback when clicking on a word or character and, as a result, can navigate through an entire story while receiving only minimal exposure to print. Features such as these serve to distract children from the text and emergent literacy supports that are usually provided when reading a book (Kamil et al., 2000; Labbo & Kuhn, 2000; Trushell et al., 2001; Zucker et al., 2009).

Some groups of children may be particularly susceptible to distractions within e-books that take children’s attention away from print. Specifically, children living in low-income environments are often uninterested in reading (MacGillivray, Monzó, & Arzubiaga, 2001). They are also more likely to exhibit attention and engagement problems (Novotney, 2010) as well as low self-regulation (Blair & Diamond, 2008; Buckner, Mezzacappa, & Beardslee, 2009). These behavioral characteristics may make children living in low-income environments even more susceptible to distractions when working with electronic books independently.

One possible way to counteract the potential drawbacks of e-books is through the use of adult-directed storybook reading. At least in traditional storybooks, adults can help promote emergent literacy skills by modeling appropriate vocabulary and discussing the key concepts in the storybook (van Kleeck et al., 2006; Wasik et al., 2006; Whitehurst et al., 1988). For example, adult readers can point out letters, discuss print, and ask and answer questions about the storybook to keep children engaged in the storybook (Whitehurst & Lonigan, 1998). As young children gain increased exposure to e-books, it is important to also consider whether adults can be as effective in enhancing emergent literacy skills using this technology. A few studies examining the use of adult mediated e-book experiences are emerging (Moody et al., 2009; Verhallen et al., 2006) and findings from these studies suggest that the presence of an adult during e-book reading activities can enhance emergent literacy skills more readily than readings without an adult.

Unanswered questions remain about how effective e-book use is when paired with quality emergent literacy instructional techniques. The current intervention study examines whether the addition of shared e-book readings that incorporate explicit print-referencing techniques increases children's print-related knowledge. We examined children's print-related knowledge using three measures: letter naming, print concepts knowledge, and early decoding skills. The children involved in this study were participating in federally-funded center-based programs, and exhibited eligibility for these programs because of environmental disadvantage.

Methods

Participants

Participants were 20 4- to 5-year-old children (7 boys, 13 girls) enrolled in four public preschool classrooms for children at-risk for academic difficulties due to poverty. All 20 children were reported to be typically developing by their classroom teachers; specifically, no child had diagnosed hearing loss, cognitive impairment, speech/language impairment, or attentional difficulties. Children ranged in age from 54 to 64 months at study entry ($M = 59.8$ months, $SD = .49$ months). The majority of children were Caucasian ($n = 13$), although African Americans ($n = 5$), and Hispanics/Latinos ($n = 2$) were also represented. Families reported that all children spoke English as their primary language. The children's parents reported a mean average yearly household income of approximately \$28,000. Maternal education in this sample varied greatly. Two mothers reported some high school education, four held high diplomas, seven earned associate's degrees, three had some college, two held a bachelor's degree plus some additional credits, and two held master's degrees.

General Procedures

Children were randomly assigned to either the control group or the intervention group. Children in the intervention group ($M = 58.4$; $SD = 2.72$) were significantly younger than those in the control group ($M = 61.2$; $SD = 2.66$) ($t(20) = 2.30, p = .03$). For both groups, this study utilized a pre-post design in which each child participant ($n = 20$) completed 10 e-storybook readings in a randomized order of presentation including *Living Books* titles, "The Tortoise and the Hare" (Aesop, 1993), "Arthur's Birthday" (Marc Brown, 1994), "Arthur's Teacher Troubles" (Marc Brown, 1994), "Grandma and Me"

(Mayer, 1992), and “Little Monster at School” (Mayer, 1994). Books were created for children three- to six-years of age and titles averaged 725 words over 23-40 pages.

All children received traditional storybook reading instruction using a direct instruction storybook reading program for 15 minutes per day by a teacher. In addition, the intervention group received approximately two e-book readings a week for six weeks in addition to the traditional curriculum provided by the teacher. Sessions ranged from 15 to 20 minutes, depending on the length of the book (*Range = 23 - 40 pages*). Over the course of the program, children in the intervention received a total of 180 minutes, or 3 hours, for the intervention. Books were presented in a randomized order. During each intervention session, adults and children read one e-book, which had two print references embedded within it. E-books were read in the play mode and researchers followed scripted print referencing targets and provided reflective feedback (e.g., “point to a letter”, “This is a capital letter”). All sessions were completed in a quiet classroom in the school with one- to- one instruction from trained researchers.

All reading sessions were videotaped to document procedural reliability in the field; 15% of the reading sessions for each researcher who read to children were randomly selected and scored using a researcher developed fidelity observation tool created by the authors (see Appendix A). Results yielded an overall fidelity of 96% to the scripted procedures.

Measures

Children’s print-related skills were measured one week before the beginning of the intervention and within one week following the intervention using the following measures: letter-word identification, letter knowledge, and print concepts knowledge. All

were administered in English in a quiet setting within the preschool program setting by trained examiners.

To measure print-related skills, the upper-case alphabet ability knowledge task of the Phonological Awareness Literacy Screening: PreK (PALS; Invernizzi, Meier, & Sullivan, 2004) was administered along with the letter-word identification subtest from the Woodcock Johnson© III Tests of Achievement (WJ-III; Woodcock & Mather, 2001). As part of the PALS-PreK: upper-case task, children are asked to name each of the 26 individual, upper-case letters of the alphabet, which were presented in random order on a single printed sheet. One point was awarded for every letter correctly identified, for a total of 26 points. Interrater reliability of this measure is reported as .99 (Invernizzi et al., 2004). The letter-word Identification scale of the WJ-III requires children to name letters on a page, followed by reading words aloud. This subscale of the WJ-III demonstrates a reliability of .94 in the norming population. According to the manual, this task demonstrated excellent reliability ($\alpha = .91$) and fall scores were positively and significantly correlated with spring scores ($r = .82$). In the present study, children's performance is reported using *W* scores, the Rasch-based scores included in the testing manual.

To measure print concept skills, the Preschool Word and Print Awareness measure was administered (PWPA; Justice & Ezell, 2001; Justice, Bowles, & Skibbe, 2006). The PWPA examined children's knowledge of 14 print and word concepts as a child reads *Nine Ducks Nine* (Hayes, 1990) with an adult while asking a targeted series of questions (e.g., show one letter on the page). Scores on this task could range from 0 to 16. See Table

1 for descriptive information about this sample's early literacy performance prior to the onset of the intervention.

Table 1.

Pre-test and Post-test Means (Standards Deviations) by Gender, Age, Print, and Name Writing

Treatment	Gender (m/f)	Age (month)	Print Concepts Knowledge		Letter Knowledge		Early Decoding	
			Pre	Post	Pre	Post	Pre	Post
Control	4/6	58.4	7.50 (3.27)	13.70 (3.16)	15.90 (9.62)	19.60 (8.58)	335.60 (28.24)	354.50 (25.31)
Intervention	3/7	61.2	8.50 (3.27)	10.00 (2.91)	17.60 (8.37)	20.10 (8.85)	346.30 (37.98)	363.20 (24.60)

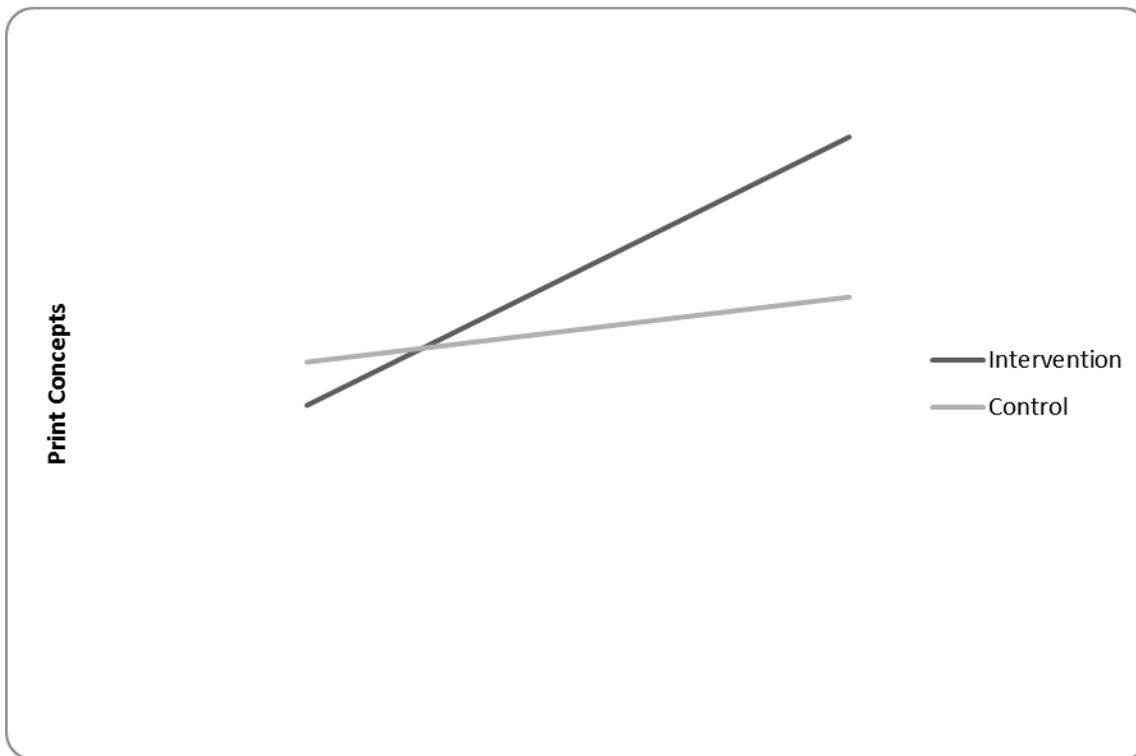
Results

Results of the study suggest that the print concept knowledge of children in the intervention group ($M = 7.50$; $SD = 3.27$) did not differ significantly from those in the control group ($M = 8.50$; $SD = 3.27$) before the onset of the intervention, ($t(20) = -.68, p = .50$). Similarly, before the intervention, children's upper case letter knowledge did not significantly differ between the intervention ($M = 15.90$; $SD = 9.62$), and control groups ($M = 17.60$; $SD = 8.37$), ($t(20) = -.42, p = .68$). Finally, W scores from the pre-test of the

Woodcock Johnson III for the intervention ($M = 335.60$; $SD = 28.24$) and control groups ($M = 346.30$; $SD = 37.98$) indicated no significant differences ($t(20) = -.72, p = .48$).

Table 1 includes descriptive information regarding children's performance on the literacy measures for both time points tested. For each of the three outcome variables, an ANOVA was calculated with group (intervention or control) included as a fixed factor and pre-test scores included as a covariate. Children receiving the intervention made significantly greater gains on the measure of print concepts knowledge ($F(2, 17) = 16.02, p < .01$). See Figure 1.

Figure 1. Pre- and Post- Scores for Print Concepts Knowledge



receiving the intervention did not make greater gains in the area of letter knowledge ($F(2, 17) = .78, p = .39$) or early decoding ($F(2, 17) = .11, p = .74$). See Figures 2 and 3.

Figure 2. Pre- and Post- Scores for Letter Knowledge

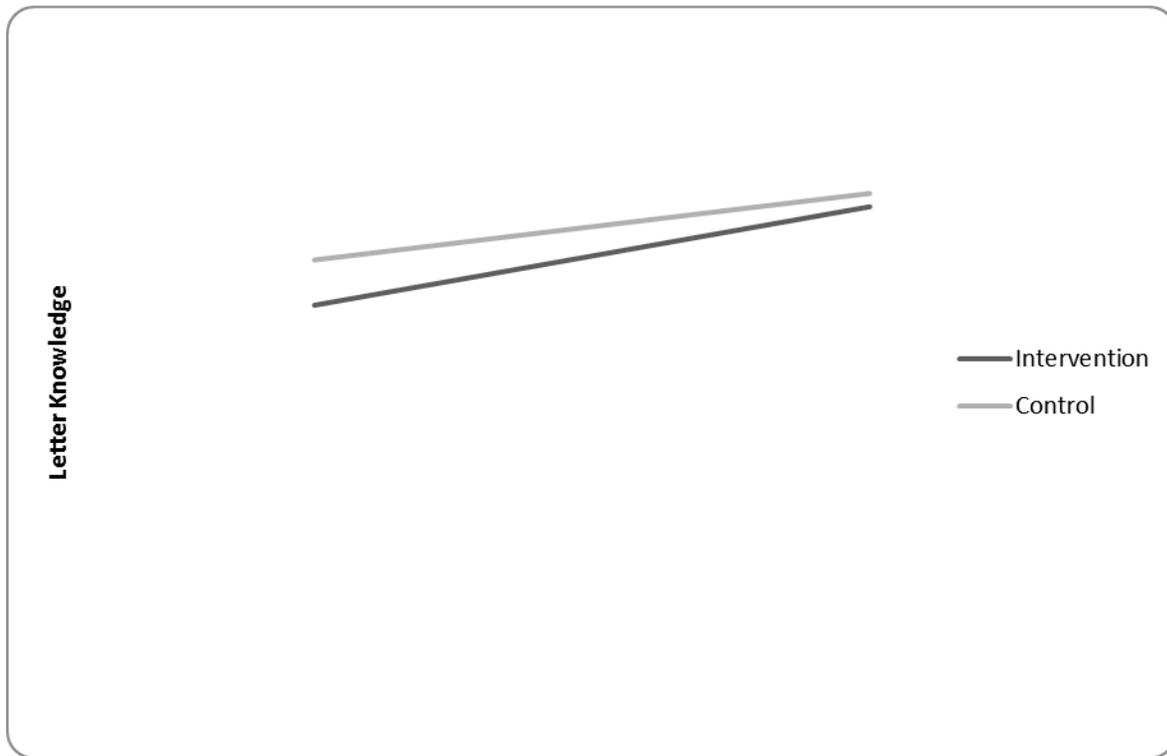
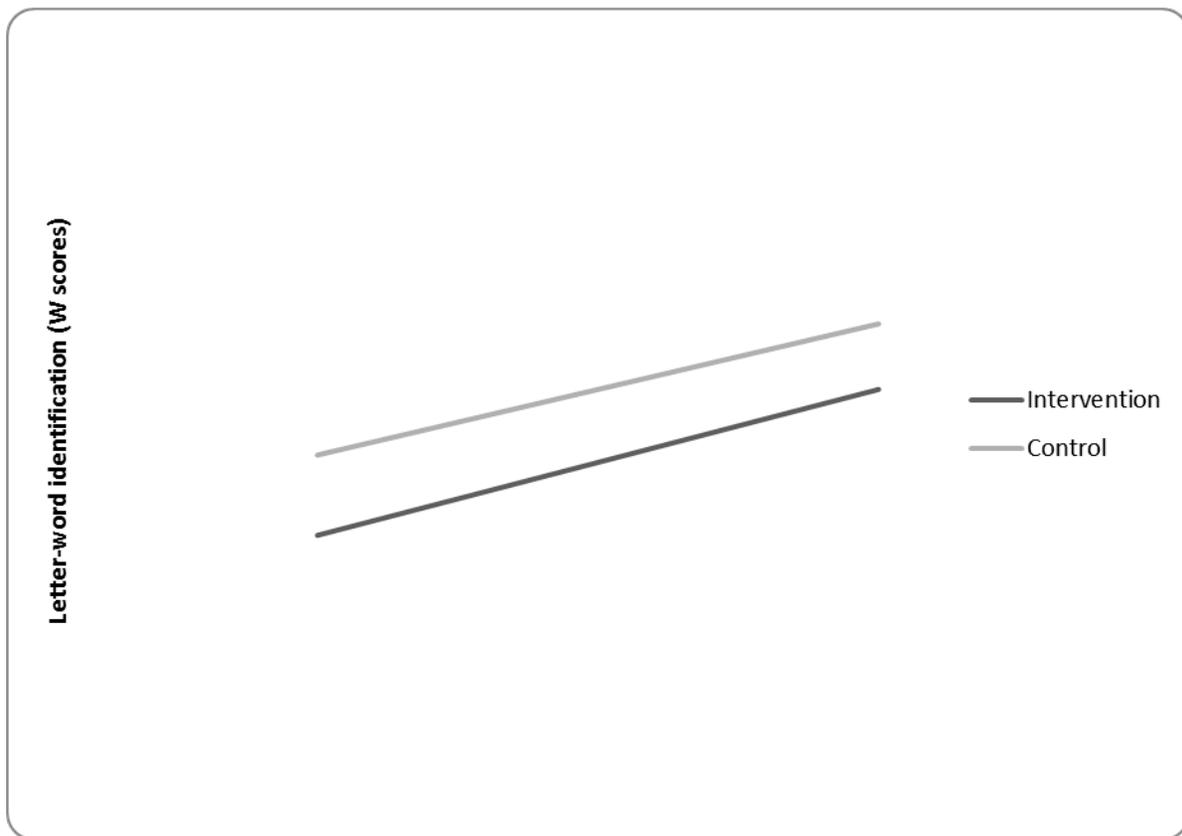


Figure 3. Pre- and Post- Scores for Early Decoding



Discussion

This study investigated the ways in which teachers can influence children's understanding of print using e-books. Findings indicated that children exposed to e-books paired with adult directed print referencing strategies scored significantly higher on a measure of print concepts knowledge than those in the control group. Results suggested that the pairing of traditional instructional methods, such as print referencing strategies, with current technological tools, such as e-books, may offer benefits to young children who are developing their awareness of print concepts. These benefits, which did not extend to letter knowledge or early decoding, were found using a low-intensity intervention program, which lasted a total of 3 hours spread over six weeks.

E-books provide children with opportunities to listen to the storybook while interacting with text, animated features, and exploring characters and illustrations (de Jong & Bus, 2003). Participants were attending federally funded preK programs designed to reduce disparities in early development for children reared in economically-disadvantaged homes. Establishing the ways in which children can gain emergent literacy experiences using 21st century technology tools in schools is currently an important goal in educational policy and practice. Possible benefits may include: 1) The use of adult mediation to ensure e-book tools are paired with evidence-based instructional strategies; 2) The use e-books to further support emergent literacy skills when paired with traditional instruction. In the next sections, we briefly discuss the major findings related to the impact of using e-book reading to enhance print concepts knowledge.

Results suggest that low exposure to adult-directed e-book readings may offer significant benefits for increasing print concepts knowledge in preschool children at-risk due to poverty. Current evidence suggests that e-books can increase reading engagement in young children (see de Jong & Bus, 2002, 2003; Fisch et al., 2002; Moody et al., 2009; Talley et al., 1997). Our research suggests that, similar to traditional storybook reading activities (Justice et al., 2009; Lonigan & Whitehurst, 1998; McGinty, et al., 2012), e-books can also increase children's opportunities to gain some critical emergent literacy skills, including print concept knowledge.

Similar to previous work (e.g., Justice & Ezell, 2001, 2004), adults provided explicit print referencing strategies during the storybook reading sessions analyzed as part of the current intervention program. Research examining the use of print referencing strategies during storybook readings indicates greater gains than traditional storybook

reading without explicit instruction (Zucker, Justice & Piasta, 2009; Piasta et al., 2012).

Our findings indicate that e-books can also be used to foster gains in print concept knowledge, which is important, as educational researchers suggest that using technology as a tool to enhance instruction and learning is critical (Means & Olson, 1995; Owston, 1997; Valdez et al., 1999).

While there may be some benefits to supplementing traditional storybook reading activities with the use of e-books, educators need to pay particular attention to ensure that they are targeting specific skills during those activities. Note that our intervention utilized print referencing skills explicitly and benefits for children did not extend to their letter knowledge or early decoding skills. To achieve gains across more literacy skills, it is likely that more intensive and broadly focused techniques would need to be utilized. For example, in the beginning stage of reading, children are often unable to link letter sounds with letter symbols (Ehri, 1994) and activities that build phonological awareness such as rhyming, blending and segmenting, recognizing odd sounds, and adding and deleting syllables may be needed to assist in the development of early decoding skills (Torgesen, Wagner & Rashotte, 1997). For letter knowledge, tasks such as alphabetic matching and naming may prove beneficial (Moats, 2005). In sum, it is likely that our intervention was not sufficiently broad to support gains in areas outside of print concept knowledge.

Limitations

Several limitations are of note in the present study. Children lived in low-income environments and were fairly homogenous with respect to race/ethnicity, disability status, and socioeconomic status; thus, results may not generalize to other populations of children (e.g., Anderson, 1995). In addition, the size of our sample likely limited our ability to

detect effects on the literacy measures studied. It is possible that we would have uncovered additional benefits of the program had we included more children in the program. Finally, researchers delivering the intervention followed scripted instructions, similar to a direct instruction curriculum. While similar scripted programs can be found in preschool classrooms, such practices can negatively influence the level of socio-emotional engagement in storybook reading activities and thus influence academic performance (see Morrison, Rimm-Kaufman, & Pianta, 2002; Pianta & Harbers, 1996). Although observers reported that children seemed engaged during the e-book sessions and they were encouraged to actively participate in the book reading session, we did not measure children's engagement explicitly, so we do not know how the program related to children's behavior relative to a traditional format. Finally, our program was not tailored for individual children, a practice that has been suggested for adult led interactive e-book experiences (see La Paro, Pianta, & Stuhlman, 2004; Moody et al., 2009). Future programs should consider how to incorporate individually targeted strategies when reading books with children.

Conclusion

E-book technologies offer a low cost, technological tool that can be easily be integrated into centers or daily reading programs to reinforce critical emergent literacy skills. Results from the current study suggest that this technology, when used with adult support, can promote print concepts knowledge for children at-risk for poor reading outcomes using a low-intensity intervention in as little as six weeks. Educators and other professionals are encouraged to consider this technology when working to promote the early literacy skills of young children.

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Appendix A

Reader Observation Fidelity Checklist

Book Title	
Storybook	Arthur's Teacher Trouble ____ Arthur's Birthday ____ The Tortoise and the Hare ____ Arthur's Teacher Troubles ____ Grandma and Me ____ Little Monster at School ____
Child Assent	
Reader obtains child assent	Yes ____ No ____
Reader follows script	
Reader followed the script	Yes ____ No ____
Reader uses correct number of prompts	
Reader uses correct number of prompts	Introduction ____ (1) Title Page ____ (2) Page 1 ____ (2) Page 2 ____ (1) Page 3 ____ (1) Page 4 ____ (1) Page 5 ____ (2) Page 6 ____ (2) Page 6 ____ (2) Page 7 ____ (1) Page 8 ____ (1) Page 9 ____ (1) Page 10 ____ (1) Page 11 ____ (2) Page 12 ____ (1) Page 13 ____ (1) Total ____/____
Session Length	
Report the total reading time	____ Minutes ____ Seconds

**Technology literacy assessments and adult literacy
programs: pathways to technology competence for adult
educators and learners**

Cynthia Digby
Lecturer for Department of Organizational Leadership,
Policy, and Development in the
College of Education and Human Development
University of Minnesota
E-mail: digb0001@umn.edu

Alison Bey, M.ED
ESL Instructor
E-mail: Alison.l.bey@gmail.com

Abstract

This case study was conducted to consider digital literacy programs for lower literate adults in Minnesota. Two programs were considered, the Northstar Digital Literacy Program, and the Learner Web system. Both are being used at regional sites in Minnesota to target digital competency and literacy education for adults. Interviews were conducted with a current educator at one site, with a coordinator for these two programs who has been involved since the programs began, and, experiences of the authors acting in the capacity as tutors for these programs were included for considering practical experiences in the learning environments. This paper's effort is a brief environmental scan of challenges and possibilities for this emerging area of adult education, and should not be generalized. Emphasis is placed on digital literacy teaching and learning; considering assumptions educators might make about their students access to, and knowledge of, technology use; how technology could be further integrated into literacy education; and, on assessments and higher level technology competence (being able to type or send an email are important skills, but in today's society more skills are needed to succeed in college or work).

Introduction

Adult Basic Education (ABE) has been increasingly impacted by technology in recent years as educational institutions, workplaces, and government programs in the United States have shifted more of their information and services into digital spaces. These services, which used to require filling out a paper form or a telephone call have shifted into online spaces and now require technology tools to access and use. Citizens require technology access then in

addition to knowledge and the skills necessary for working in digital spaces in order to be self-sufficient and participate fully in today's society. This case study addresses some of the emerging concerns and possibilities with ABE and technology literacy efforts for adults in Minnesota. While ongoing technology infrastructure improvements over the past few years is making it increasingly possible for many to have limited free access to computers and the use of the Internet, these opportunities address only part of digital divide concerns. Broadly, digital divide refers to one's access to and use of technology. Disparities for our citizens who lack the literacy and digital competencies necessary to make effective use of digital options remains an ongoing challenge of the digital divide.

Two areas of digital competencies are of specific interest for this paper: basic technology competence - such as being able to fill out a form online or navigate a web page or website, and cognitive technology competence - such as the ability to apply critical thinking and one's reading comprehension skills to strategically use technology for seeking out and understanding information. Filling out an online form and having the reading comprehension skills necessary to understand information may be beyond the reach of adults who do not meet the U.S. Congress definition of literacy from 1991, "an individual's ability to read, write, and speak in English, and compute and solve problems at levels of proficiency necessary to function on the job and in society, to achieve one's goals, and develop one's knowledge and potential" (National Literacy Act of 1991, Sec. 3). Literature indicates that many lower-literate adults lack even the most basic of technology skills, let alone have the literacy proficiency necessary to realize the Internet's full potential. We will highlight several of these studies later.

In 2012, a digital assessment project and, in 2007, a web-based software system were developed to address several recognized education gaps. Both are in use at regional sites in

Minnesota to target digital competency and literacy education for adults. These are the Northstar Digital Literacy Program and the Learner Web system. The Northstar Digital Literacy Program at their own pace. The Northstar assignments require learners to demonstrate computer and online tasks hands- on and in real-time as opposed to only abstractly learning these skills (Vanek, 2013). For instance, in the assignment about email, learners need to compose an email to be able to pass the module. An additional program, Learner Web, is also available at no-cost for the learner. These learners are provided free computer access, self-guided online learning modules, and, instructor or tutor support for developing their literacy and digital learning (Castek, Reder, Withers, Pizzolato & Pendell, 2013; Vanek, 2013). Learner Web is currently in use across five states and in four cities in Minnesota. Combined, these two projects complement each other and are showing promise in furthering digital competence and literacy goals. Since the Northstar and Learner Web programs were developed by ABE educators, researchers, and others who work closely with ABE populations, these are suited for addressing literacy needs of this learning audience.

Digital literacy program opportunities can play a crucial role as a first step for understanding technology literacy needs and for leveraging this information to better target a starting point for developing a learner's technology literacy. As this is an emerging area of teaching and learning in ABE, it is not fully evident which digital literacy program options are useful for the diverse populations ABE serves. For this local program scan, emphasis will be placed on exploring the potential of two digital literacy programs currently in use at three sites in Minnesota for developing technology literacy: the Northstar Digital Literacy Project and Learner Web. Co-authors for this paper have served as tutors for these digital literacy pilots in

Minnesota and used research efforts from an *Advanced Assessment in Adult Literacy* course to further investigate digital competency assessment and possibilities in adult literacy overall.

Literature Review and Background

Recent research indicates a positive correlation between adult education and technology education for: developing multiple literacies, program recruitment, and encouraging learner retention in adult literacy programs. Several indicated that technology can be an educational aid for literacy development (Davies, 2011; Judson, 2010; Kotrlik & Redmann, 2005; Munteanu et al., 2013; Park & Woldeab, 2012; Reder, 2012; Reder, 2013; Strawn, 2008). Cullen and Cobb (2011) also found that adults interested in ABE are more likely to attend literacy programs when they include a technology education component. In addition to this, Weber's (2004) research indicated a possible problem for ABE programming that does not include technology education, since learners were found to be more likely to drop out of literacy programs when their needs for technology were not being met. Moreover, there is research indicating that many adults, who have yet to obtain their General Educational Development (GED) exam and are not enrolled in GED classes at an ABE site, are still using online resources to self-study for the GED tests (National Institute for Literacy, 2008). The GED is the standard high school equivalency test in the United States. The National Institute for Literacy (2008) conducted a study on the interaction between adults' literacy skills and their ability to study online independently. The Institute found that even learners at the lowest levels of literacy could engage and learn with online educational resources, and were eager to do so to continue their academic goals. All of these studies suggest that including a digital literacy component can support ABE goals in a variety of ways.

A possible challenge for using technology in ABE programs concerns anxiety. Specifically, technology anxiety; in which many initially resist the object and subject in question

due to fear and uncertainty. This phenomenon can be contrasted with approaching objects and subjects with a sense of curiosity and further desire to explore. Technology anxiety can occur for both the adult learners in a program and for the adult educators, tutors, and facilitators in a program who lack the training to understand and support technology-enhanced teaching and learning in their classrooms (Kotrlik & Redmann, 2005; Park & Woldeab, 2012). Some adult educators have made progress with including lower risk technology options in their adult education programming through basic keyboarding or Internet offerings available in their organizations. Research shows a possible gap with integrating technology into core instructional ABE areas, such as reading and math however (Kotrlik & Redmann, 2005). When thoughtfully incorporated into instruction, including technology as part of instruction can help develop subject areas, as well as lessen technology anxiety for both educators and learners. It can be argued that ABE reading and math can be taught successfully without a technology enhancement. There are several data-driven reasons for integrating technology into all instructional areas though. For ABE for instance, it is important to note that the GED moved to an online-only format beginning in 2014. Approximately 674,000 started the GED tests, and approximately 400,000 passed the GED tests in 2012 (Snyder & Dillow, 2013). The shift from paper only tests to the new online-only test will create challenges and anxiety for anyone needing to access the GED site and take the online tests who lack the proficiencies necessary to use a computer, navigate computer programs, or fill out online forms. On the plus side, there have been recent successes with the use of Learner Web's self-paced system for addressing these types of literacy gaps with adult learners at all sites.

Knowing about technology and its use, as well as understanding how to support ABE learners feeling comfortable using technology to accomplish specific learning objectives,

especially for inquiry and problem-based assignments, is still finding its way into ABE's vision. Existing options that are appropriate for adults with lower literacy levels are limited due to this being a relatively new area for ABE. So, taking a step back to consider parameters of technology literacy helps identify where programming might better support technology literacy. A review of the literature provides several areas for programs to examine.

Davies (2011) considered technology literacy in terms of the learners recognizing what technology is capable of, their being able to use it, and their ability to make appropriate decisions about which technology application to use. Ideally, to achieve minimal technology-literacy levels, it is useful for ABE programs to consider assessments that capture the evaluation of quality of use, wisdom of use, and the ability to make technology decisions in practical and authentic situations (Davies, 2011). This can include programs finding level-appropriate assessment options which can measure how much technology competence their learners already have, while being able to track progress the learners are making along with other literacy-level assessment information that is currently mandated for federal funding. Van Deursen and van Dijk (2010) were able to capture what some of these levels look like.

In 2010, van Deursen and van Dijk conducted a study on Internet skills and the digital divide in the Netherlands. 93% of households had access to the Internet at the time of the study. This is a very high percentage of the population compared to other developed countries. For instance, the United States showed approximately 72.5% of households had Internet access in 2010. Having Internet access does not mean computer access nor an understanding of technology use however, but it does provide evidence of efforts to address part of the access concerns with a possible digital divide. The van Deursen and van Dijk (2010) study involved testing participants on four sets of skills related to digital literacy. The first was operational skills, such as being able

to save a file, bookmark a website or fill out a form online. The second was formal Internet skills, which center on the ability to navigate and orient oneself on the Internet, search and browse through results and surf between webpages. The third set was information skills, or the ability to find needed information using the Internet. Finally, the fourth set tested was strategic skills, or the person's ability to use the Internet to complete goals. Strategic skills were assessed by asking participants to book a trip as cheaply as possible or to compare one political party's positions to another party. Operation and formal skills are discussed as medium-related skills and information and strategic skills are considered content-related skills. The 109 participants in the van Deursen and van Dijk (2010) study received two assignments for each skill set mentioned above, with eight assignments total. While 93% of Dutch households had access to the Internet, only 11% of the study participants could complete all eight assignments. The two main predictors for higher level Internet competence in the van Deursen and van Dijk (2010) study were age and education-level. The participants' amount of Internet experience was only a small predictor of performing better on the operational skills assignments. The self-reported weekly time spent on the Internet revealed a negative correlation in relation to how quickly participants could complete an assignment. The results can perhaps be explained due to people learning to use the Internet by trial and error versus formal instruction and therefore not knowing more efficient ways of accomplishing a task (van Deursen & van Dijk, 2010). A common example of a time efficiency issue would be a learner typing a web address into the search engine box, instead of the address bar, which eventually leads to a site, but through increased steps and time. For learners unfamiliar with computers and computer programs who may have had the knowledge needed to pass a paper and pencil exam on a particular topic, an additional barrier exists when the learner does not know how to efficiently navigate computer tools and spends too much time

on processes. Failure to pass a formal exam in a digital space could be misconstrued as a knowledge-based issue when it is a process issue. Likewise assuming that youth in ABE programs will be efficient in digital spaces due to their growing up with technology can also be an error. We will consider this next.

Li and Ranieri (2010) conducted a study in China with teenage participants which indicated mixed results when compared with the van Deursen and van Dijk (2010) study. These participants could be considered “digital natives,” a term used to describe people who are of the generation that grew up with technology. This can be contrasted with so-called “digital immigrants,” which can refer to someone who is older and learned technology later in life or who was raised in a country without the technology exposure of more developed countries (Prensky, 2001). Of the participants in this study, 87% had a computer at home and 78% had Broadband Internet access. Their average length of computer ownership was five years. Li and Ranieri (2010) tested the study participants using the Instant Digital Competence Assessment (iDCA) tool. Due to the students being young, having high literacy rates and their having Internet access at home, it would be assumed that they would perform well on the iDCA assessment. However, the overall performance of these digital natives was at the “pass” level, versus good or excellent levels. These findings suggest that the students’ performance for the assessment was not significantly influenced by length of computer ownership, Internet access at home, or frequency of Internet use. Instead, like van Deursen and van Dijk (2010), they found the highest predictor of achievement to be the participant's education. The highest variance of assessment scores for these Chinese students was the school they attended. This could imply that certain schools are teaching more content-related skills through technology enhanced venues that also focus on reading comprehension and critical-thinking skills.

There are also studies which indicate that gains in technology literacy lead to gains in other academic-competency areas. Judson's (2010) study with fifth- and eighth-graders in Arizona considered gains in technology literacy along with gains in other content areas (reading and math, for example). Prensky (2006) suggested that youth today are digital natives "fluent in the digital language of computers, video games, and the Internet" (p. 9). It could be assumed that these younger learners would be confident with using technology due to their interactions with video games, computers and the Internet. Becker's (2000) research, however, found that schools use computers for word processing more than anything else, leading to questions about students using technology as consumers versus students using technology as creators. In other words, it could be that they can play videogames, send text messages and scan webpages for information to add to a report, but they may not be able to use technology for higher-level skills such as problem solving, analyzing the information or for making a decision. Judson's (2010) findings were that broad-based gains in technology literacy were linked to gains in language arts. He further suggested that language arts may have an advantage over mathematics or reading. Even if schools are mostly using computers for word processing, technology use is already integrated into language arts instruction and learning, unlike in reading and math classes. If this is the case, what other possible technology tools might be leveraged to lead to gains in other content areas? Returning to lower-literate adults often lacking foundational skills needed for digital literacy and the basic literacy skills like reading comprehension, which also impacts digital literacy potential, research suggests that opportunity to improve depends on one's location. Norris and Conceição (2004) considered technology access aspects in low-income, inner-city communities. They suggested that while access to technology is growing overall, there is no place where the access gap is wider than in inner-city, low-income communities. For instance, in 2004, only 22.8% of

urban, female-headed households had Internet access, versus 42.3% of the urban area in general. European Americans were also more likely to own computers than African Americans. Moreover, different ethnicities accessed the Internet for different purposes. For example, 61% of European Americans reported using the Internet for news, versus only 15% of African American adults. African Americans were more likely to report using the Internet for entertainment purposes versus information-seeking purposes. While the landscape of the Internet and the population's access to technology has changed greatly since 2004, minority and low-income populations still seem to be lagging behind in digital literacy (McCain, 2009, Strawn, 2008). Norris and Conceição (2004) identify possible obstacles such as approximately 87% of Internet content is written in English at a standard literacy level. A standard literacy level can be too high for lower-level literate adults. Their study also identified cultural concerns that may be affecting Internet usage such as the Internet being a product of dominant, white-male culture. The Internet may not be an obvious source when seeking information for marginalized populations then who may prefer making a phone call or seeking information through other sources, such as asking their community members. The Connected Nations 2012 Residential Survey reports that 70% of U.S. homes now have broadband access. However, only 43% of low-income populations have broadband access. 82% of the U.S. population owns a computer at home, compared to 59% of low-income homes. 71% of African Americans own a computer, and 58% have broadband access. Since 2004, the rates of broadband access have shot up across populations, but low-income and minority homes still lag behind the average.

Zarcadoolas, Blanco, Boyer, and Pleasant's (2002) study on the ability of low-literate adults to find and understand Internet content indicated that low-literate adults were generally not using the internet because they did not know how. When participants were asked what they

would like to use the Web for if they knew how, they identified (in descending order): health information, school and/or homework, parenting information, job search, news, information about their home country/other countries, entertainment and email. The prevailing reason they were not currently using the Internet for each of these purposes was due to a lack of knowledge about how. In contrast to the Norris and Conceição (2004) study, this implies that lower-literate adults may not be choosing to use the Internet mainly for entertainment, instead, they may primarily use their home computer for entertainment because it is the only thing they know how to use their computer for. Entertainment websites may be easier to access and navigate than more information and content-heavy websites. As part of Zarcadoolas et al. (2002) study, the participants were asked to complete tasks such as finding information about a specific health condition at www.healthfinder.gov or about weather conditions in a specific region using www.weather.com. They were then assessed on their ability to: decipher large amounts of information, stay on task to accomplish their goal, and to navigate around and between websites. Common difficulties included not being able to locate information on a webpage that required scrolling down, troubles using navigation buttons like the back button, entering web addresses in the correct bar, and spelling errors that prevented them from accessing the information needed. None of the participants routinely scrolled down or could use graphic links without a text label. Many also made the assumption that a website did not have information they needed when they had misspelled a search term and were unable to recognize their spelling mistakes. The Zarcadoolas et al. (2002) findings indicated that literacy education is important for digital competence. While the tasks for the research study had an operational basis, participants found these tasks difficult due to lower basic literacy skills like spelling, and, due to lower critical

thinking skills needed to prompt one to scroll down for more information or to use the back button to return to a previously viewed page for needed information.

Cullen and Cobb's (2011) study of a needs assessment in a library technology literacy program indicated similar findings to previous studies included here. Lower-literate adults lag behind in operational computer skills which can put them at a disadvantage for reaching higher level cognitive technology literacy. The adults in the Cullen and Cobb (2011) study were challenged by similar tasks as those used in the Zarcadoolas et al. (2002) study. Participants also struggled with identifying links, zooming (such as on a map feature), using the back button, entering web addresses and scrolling down past the screen view. About 50% of the participants in Cullen and Cobb's (2011) study had Internet at home, but 85% said they rely on someone in their home to help them when they need to use their computer. Therefore, while access may in fact be available, how to use the computer for their needs was a challenge.

Finally, an exploratory study of a mobile application designed for low-literacy adults in literacy programs in Canada indicates that there are additional reasons for incorporating technology into ABE programming (Munteau et al., 2013). Several students in the study mentioned that they preferred using a mobile application, Alex©, to look up words online over using a traditional paper dictionary since it provided faster and easier access in the classroom and at home, and, saved them significant time completing homework over using traditional paper dictionaries for searching for words, spelling, or definitions. One goal of this project was to increase independence and encourage their learners to use the literacy resources, including a provided mobile device, beyond their schoolwork. An indicator of success for their efforts was one student, who liked reading the newspaper but was embarrassed by his lack of literacy who began reading the newspaper and doing his ABE homework on his provided mobile device at a

coffee shop where he “felt socially accepted, since the shop is typically frequented by college students who use laptops and mobile devices while studying there” (Munteau et al., 2013, section 4.3.4). In addition, their teaching ABE learners through integrating and providing mobile devices led to a student mentioning doubting his ability to study for these tests using the device in class and finding confidence in his study abilities. Empowering these literacy learners with technology tools and programs that they could more easily use seemed to develop confidence and provide independence. Comments from their participants suggest that traditional support materials, like a paper dictionary call attention to their lower-literacy, and also hindered their ability to easily and efficiently seek unknown words, spelling, and definitions (similar to challenges when lower-literate learners misspelled words in a website and could not locate needed information from the Zarcadoolas et al study). The ability to look up information on their mobile device rather than needing a paper dictionary was a plus since learners could more discretely do their literacy homework using the mobile device at work, home, and in public.

While barriers to computer and Internet access and knowing how to use computers and programs in meaningful ways continue to be a challenge across populations, lower literacy can add additional layers of challenge for some, as the literature mentioned here has indicated. Understanding these challenges and barriers can provide data-driven ideas for supporting adult literacy goals, including possible assessments and programs. We will consider the programs next.

III. Learner Web and the Northstar Digital Literacy Projects, and digital literacy concerns mentioned in the literature

Learner Web was originally designed to address learning gaps for high school dropouts. Longitudinal research data showed these dropouts were interested in continuing their academic

goals of high school completion and had been trying unsuccessfully to continue their education efforts being stymied by a lack of options. These participants needed options that could both assess and then help them target specific learning gaps for completing high school or passing the GED. Developed as a self-paced learning support system, the Learner Web pilot programs provided computer access and instructor support toward developing literacy and digital competence to address possible opportunity gaps for adult learners. This digital literacy project was implemented at a public housing computer lab site, and a workforce center site that Digby volunteered for during 2011 as a community technology tutor as part of the Minnesota Literacy Council program opportunities. Used to match learning content to the learners' goals, the Learner Web program provided the structured support needed by the learners. As part of our local program scan of these projects for this paper, we also interviewed a digital literacy educator using these two programs at a local library, and a coordinator and content developer involved with Learner Web and Northstar projects since their beginnings. The intent is not to comprehensively cover these programs here, rather to learn more about the background of these programs and better consider how they address or do not address current issues and possibilities in ABE. The Learner Web content has recently been rewritten to match the Northstar Digital Literacy assessment modules. Combined, the Northstar and Learner Web are furthering simultaneous digital competence and literacy goals.

The Northstar Digital Literacy project provides a no-cost to the learner, online assessment which evaluates the basic skills needed for certain computer and online tasks. Currently being implemented at almost 50 literacy partner program sites, the Northstar Digital Literacy assessment is in use at public libraries, workforce centers, adult education sites and non-profits in the Twin Cities and surrounding area approved to issue Northstar Digital Literacy

certificates. Originally sponsored by Saint Paul Public Libraries and the Minnesota Literacy Council, the Northstar assesses medium-related digital literacy skills at partner sites. The Northstar audience is anyone who needs to improve basic digital literacy skills, with at least a mid-level English language literacy (although a Spanish version is also available). It can be a useful tool for individuals to identify areas for improvement, and educators may also use the assessments as pre- and post-tests in conjunction with Learner Web learning plans. The Northstar program initially assesses a learner's ability to: recognize web addresses, sign in to email, fill out online forms, identify and use the address bar, use the Internet navigation buttons, type in a search engine field, use a scrollbar, recognize and react appropriately to pop-ups, as well as their understanding of basic Internet security and internet scams. When a learner is taking the assessment from a sponsored site, upon completion of all modules, the learners can be awarded with the Northstar Digital Literacy Certificate (Northstar Website; Vanek, 2013). This can provide a credential for employment.

The Northstar Digital Literacy Assessment can be compared with the assessment Li and Ranieri (2010) used in the European Union, the Instant Digital Competence Assessment, to provide clarity in terms of the technical and the cognitive assessment dimensions mentioned in the literature review. The technical dimension of the iDCA involves operational and formal Internet skills (van Deursen & van Dijk, 2010) such as identifying tools for a task, knowing how to address pop-ups and recognizing symbols such as icons. The cognitive dimension of the iDCA correlates to information and strategic Internet skills (van Deursen & van Dijk, 2010), such as summarizing and analyzing information, organizing and managing data, identifying relevant information and evaluating information reliability. This cognitive dimension relies heavily on the participant having reading comprehension and critical thinking skills (Li & Ranieri, 2010). The

iDCA may be more appropriate for higher literacy populations as an assessment than the Northstar in that it has certain prerequisites to take the test, such as basic knowledge of computer terminology. The iDCA website states that the assessment is not meant to test skills in the traditional sense, rather it is designed to help the students reflect on their own digital competence and give the teacher direction for future work. This is true of the programs currently being used at the Minnesota sites too. The possible varying levels of digital literacy assessments can assist programs in deciding which option might be more appropriate for the level of their adult learners. Without basic literacy skills in reading comprehension, an adult learner cannot perform well on an assessment if their lower-level language needs are not also being addressed.

A digital literacy educator who teaches classes at an urban public library was interviewed about the use of the Northstar assessment that was piloted at their site. The population served at this library is primarily non-white, including African Americans, and English language learners from East Africa and Southeast Asia. Many of the learners have had exposure to computers and the Internet, including using the Internet for entertainment purposes such as Facebook and Youtube, but not for information-seeking purposes, such as using Google. The literacy educator's observations concur with several studies in our literature review which reference that adults and children frequently use the Internet for entertainment, but that does not necessarily translate to digital competence (Judson, 2010; Becker, 2011; Norris & Conceição, 2004). As Li and Ranieri posit in their 2010 study, frequency of Internet use was not in itself a predictor of performing well on an assessment. These findings are consistent with comments from the site's educator who identified that many of the participants in the library's digital literacy program had Facebook accounts and were familiar with how to view videos in Youtube, yet did not know how to access or use Google. He mentioned that most of the people accessing his computer classes

are members of minority cultures, and they clearly see the advantage and necessity of using the Internet.

The Northstar assessment is not used for intake purposes at this library site, only for evaluating progress. The library's curriculum has been designed, however, to align with the Northstar tests available. So, at the end of each class, learners can test out if they are ready. An advantage of designing their curriculum this way is that there are clear benchmarks for success for the students, as well as reportable and measurable outcomes for their literacy program efforts. As Park and Woldeab's (2012) study suggested, technology anxiety can initially be crippling, but as these adult learners develop some comfort and ease with technology and have a few successes to point to, their interest in, enthusiasm for and curiosity about technology increases. It is valuable that the Northstar program offers clear moments of success for adult learners. One aspect to keep in mind with the Northstar assessment is that it does not explicitly test the ability to complete practical tasks, a key component of digital literacy (Davies, 2011; van Deursen & van Dijk, 2010; Li & Ranieri, 2010). However, this aspect is addressed through instructional efforts since instructors and tutors at this site are taught to integrate the skills that are tested by the Northstar into curriculum. Learners can learn Northstar modules through practical efforts like sending an email or looking up a bus schedule.

An interesting viewpoint expressed about this project at this library site was the suggestion that a traditional classroom environment may not be the best way to teach digital literacy. This educator found that one-on-one interactions seem more effective since it allows curriculum and instruction to be tailored to the individual's needs. This informal learning environment may seem more comfortable and in-line with Cullen and Cobb's (2011) findings that low-literate adults prefer to ask family or friends for assistance when they need to use the

Internet for something. This informal teaching and learning model was used as part of Bey's experience as an AmeriCorps member coordinating the electronic classroom at a public library, and Digby's experience as a community technology tutor at a public housing site and a workforce center. All sites regularly had adults showing anxiety about using computers during the intake process. The anxiety for some increased due to poor spelling and slow typing, as well as perceptions that websites are inaccessible as Zarcadoolas et al. (2002) found. Unlike patrons mentioned at the library site Bey and her interviewee worked at, there were some at Digby's workforce site who stated a lack of interest in learning or trying to use computers to look for needed information on a website if they perceived that trying to use technology would slow them down and be more of a frustration than making a phone call. In several of these cases, the potential learners cited that they were only there because access to unemployment benefits had moved into the online environment and phoning no longer worked to gain access to their benefits (or they perceived this to be the case). Several potential learners mentioned that they had been asking others to help them access their benefit information to initiate a payment through the online system, but their friends and family who had helped could not always be relied on. Therefore they felt pressure to learn how to use computers even though they did not want to. The role of assessment in all situations was important since it helped the tutors and learners consider where to start in the learning process. Educators or tutors can be relied on for informal assessment efforts beyond more formal intake-type assessment opportunities.

A next step beyond Northstar and Learner Web as learners advance could possibly be the iDCA for conducting a needs-assessment and guiding decisions toward continuing content-related skills and addressing more advanced curriculum needs. As technology anxiety decreases for learners, and medium-related skills are mastered, learners may be interested in moving into a

more formal classroom environment to gain more advanced technology skills, perhaps as further support for increasing other literacy skills. An educator could be articulating through real-world experience the findings of more formal research, especially research surrounding the facilitation of Learner Web in classrooms. For lower-literate learners, the Northstar, Learner Web and iDCA programs may be too difficult considering that these were not developed specifically for these populations. The Learner Web digital literacy content was developed for learners who are roughly at TABE 3/CASAS 221, and the Northstar program is more appropriate for learners who are roughly at TABE 4/CASAS 221 (Vanek, 2013). Lower-literate learners can and should be referred to other literacy and technology-enhanced programs when Learner Web or the Northstar options seem too advanced.

It is encouraging to note that several studies found that the lowest-level learners can benefit from computer use to improve their literacy levels (Aro & Olkinuora, 2007; Munteau, et al., 2013; National Institute for Literacy, 2008; Park & Woldeab, 2012). Without these kinds of integrated learning opportunities, these learners risk becoming marginalized as educational institutions, workplaces and government programs in the United State increasingly move services online. Learner Web provides a self-paced, but guided, online learning experience that many lower-literate adults can be independently successful in. Portland State University's latest study (2013) on the use of Learner Web in tutor-facilitated classrooms considered what worked in classrooms to teach lower-literate adults digital literacy. Their findings suggest that face-to-face interaction and personalized supports are still vital for new technology users. So, use of a one-size-fits-all option for online learning where everyone is on the same timeline for the same topics or skills may not be as beneficial for these learners since they start in different places and have different priorities and motivations to develop their technology usage. As, Reder, Vanek

and Wrigley (2012) highlight for Learner Web's features, modules are task-based, and the activities leverage existing Internet sites, such as using the Internet to find specific locations.

Learners control their pace, and make decisions for themselves about which Learner Web activities to explore and complete. The lessons can be completed as often as wanted. Tutors are available at the sites mentioned above to guide the intake process and to provide additional direction and encouragement as needed or if learners show frustration or anxiety about a module activity. They can also quickly address technical concerns if a website or the technology is not performing as expected. Reder, Vanek and Wrigley (2012) refer to this as "just-in-time" or "on-demand" assistance for supporting the learning environment.

With regard to assessing learners coming in to the Northstar or Learner Web projects, co-authors' experiences as tutors supporting the Learner Web and Northstar projects showed that first exposures to digital literacy learning can be challenging or promising depending on the learners. The Learner Web program had an intake process that allowed potential participants the opportunity to learn about the program, complete or work with an instructor or tutor, and, if appropriate, begin setting up an email account and then start using the Learner Web's self-paced program for the learning plan(s) the person was interested in pursuing. These first exposures with the instructors or tutors, to the computers and to the program that we used as part of our tutoring efforts were noticeably a critical time which sometimes resulted in early frustrations and some learners not returning to continue their literacy efforts with the program. Part of the engagement frustrations observed early on seemed to stem from technology anxiety issues or lower-level literacy impeding understanding of the program materials (sometimes related to English language literacy and sometimes to lower-level reading comprehension) as mentioned previously. For others, however, the intake and first exposures to Learner Web and the

instructors or tutors led to early successes and learners then enrolling in the program to continue their Learner Web learning plans. The role of assessment in all cases can help ensure that the adults are tracked correctly into appropriate projects and education options.

Limitations and Implications for Practice

Findings from this study should not be generalized to other populations due to the small sample involved in our local program scan, although issues and possibilities encountered at all sites align with findings from several other studies.

Park and Woldeab's (2012) findings contribute to the theory that low-literate, urban adults want to use technology for information purposes, but might lack the know-how to do so. Park and Woldeab's study is unique in that it is a case study of African immigrants who took a literacy class that involved using technology. Not only were participants in the Park and Woldeab study immigrants to the United States, they were also digital immigrants with limited experience using technology in their native countries. This area, whether all digital immigrants (American-born or not) experience some sort of technology culture shock in beginning computer classes, is an important area for future research. Park and Woldeab's article points to an initial learning hump where technology was scary and intimidating. However, once the women began to learn the basic skills needed (the medium-related skills described by van Deursen and van Dijk, 2010), their learning began to progress rapidly. The initial experience with the Internet caused "shock" but with one-on-one assistance and the community to help each other learn, they were able to use the basic skills needed to operate the computer and Internet and start to make progress in their digital competence. These findings agree with the Munteau, et al. (2013) study which showed that their lower-level literate and immigrant students who struggled with English were "intensive users" (section 4.5) of the mobile application, Alex©. Indeed, where their

students struggled with using traditional support materials like paper dictionaries to complete their homework, in a short amount of time their students highlighted that the technology support materials were easier and saved them significant amounts of time doing their literacy homework. These are promising findings in favor of technology use for literacy education for our low-literate and low English language literate populations.

84% of the participants in the Cullen and Cobb (2011) study said they would be more likely to attend literacy training if computers were involved, but also expressed fear that they might make too many mistakes or fall behind if literacy classes involved technology. Cullen and Cobb encouraged educators to create curriculum that is perceived to be relevant (such as for job search purposes), have adequate one-on-one tutoring available, encourage collaboration between students since most low-literate adults are used to working with others to use technology and including training on basic trouble-shooting (such as what to do if your computer locks up, or how to recognize the results of spelling errors). Digital literacy has the capacity to improve all types of literacy and increase engagement with literacy programs, but if not implemented with low-literate adults' needs in mind, it can lead to higher rates of drop-out, due to frustration with technology's demands. Accurate assessment practices are part of the key to addressing this challenge.

By the year 2016, it is estimated that 70% of jobs in the United States will require information and communication technology (ICT) skills (McCain, 2009). ICT skills are the type of higher-level skills described by van Deursen and van Dijk (2010) as content-related skills and by Li and Ranieri (2010) as the cognitive dimension. As technology becomes less expensive and more readily available, adult educators will need to truly confront how to teach true ICT literacy; the ability to access, organize, interpret, evaluate, create and communicate digital information.

Adult educators have a unique position to increase the population they serve with ICT literacy because, no matter how much technology is made available, people cannot access technology information thoroughly and effectively unless they have the necessary reading, writing, problem-solving and critical thinking skills (Strawn, 2008; Moore, 2011). As Li and Ranieri, and van Deursen and van Dijk, found in their 2010 studies, merely having access to technology does not translate directly to being able to use technology, instead the main predictor of competence is education-related. Adult education programs already excel at helping adult learners improve their literacy skills; the next step is integrating these lessons with technology. iDCA is a possible direction for furthering technology competence once medium-related skills are mastered.

Extending the idea of technology becoming less expensive and possibly being readily available for all in the future, Smythe's (2013) findings indicate an additional concern beyond what has been identified so far. In one of her case study vignettes, one instructor cautioned introducing digital technologies uncritically into literacy programs: "If we introduce the latest 'must-have' digital tools, tools our students will never be able to afford, not only are we being "played" by corporations that make these products, we may also be sending the message that our learners will never be included in a digital culture. Once they acquire one tool, the next will have arrived and they will be once again on the outside" (Smythe, 2013, p. 567). The Munteau, et al. (2013) study included providing their participants with a mobile device. An interesting benefit of this was having a participant who refused to purchase or be seen with a dictionary, actively engaging in reading and doing homework in a coffee shop and feeling socially acceptable due to having similar technology to discretely study there. While the Learner Web and the Northstar programs focus on technology competence, emphasis is placed on using these programs as sites that provide free computer access, and access to tutors, not on competencies

for particular devices. The socially acceptable factor mentioned in the Munteau et al. (2013) study for low-literate adults might be worth looking into further for future studies if technology access and the knowledge and skills necessary to work in digital spaces might encourage students broadening their learning environment or their motivation to study and develop their literacy knowledge and skills. These suggestions make a case for developing and using level appropriate programs that can be accessed on mobile devices to supplement adult literacy development.

Furthermore, to address the shift of the GED testing process in 2014 to computer-based testing, some adult education programs have already begun to help interested students prepare, since their technology competence will be as much a prerequisite for passing the tests as reading comprehension or mathematics. Recently, the Minnesota Dept of Education (MNDoE) has determined that Northstar standards are now state's ABE technology standards. MNDoE is supporting ABE teacher training efforts for how to best integrate the literacy standards into their programming. Learner Web and Northstar can contribute toward addressing some of the opportunity gaps for this learning population, but the extent to which these programs can help these learners prepare for the new GED is an area for future research. Whether these programs can adequately assist this population in accessing and using the online environments of educational institutions (for continued formal education, for instance), workplaces and for government programs is an additional area for future research. It is increasingly important for citizens to have technology literacy in order to more fully participate in society.

Finally, it is important for our adult educators to learn and know how to teach technology with the state technology literacy standards in mind as well. Initial experiences for our learners and educators with technology can cause a lack of interest in use due to frustration and

intimidation. A suggestion for supporting ABE educators interested in this area is for them to go through the training for Learner Web educators/tutors. The training teaches computer skills and know-how on troubleshooting for the program and technology while clarifying the learning plan options that programs may be interested in pursuing for their classes and learners. Further training on using assessments to appropriately tailor technology curriculum to learners, identifying clear benchmarks of success (such as the Northstar certification or completion of the different module areas from Learner Web's assignments), emphasizing group work and collaboration, and, being available for one-on-one tutoring, are key for ABE technology educator and learner success. Traditional classroom approaches may not be the best approach for technology education as mentioned, but adult educators have long been pursuing creative education strategies. The motivation for adult educators is clear: increasing technology literacy efforts appears to draw and retain adults to literacy programs for technology-related practical and personal reasons and these types of programming options also provide a simultaneous way to teach literacy skills.

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Mobile Learning: How Students Use Mobile Devices to Support Learning

Megan K. Foti, MS, DOT, OTR
Assistant Professor Occupational Therapy
The Richard Stockton College of New Jersey
101 Vera King Drive
Galloway, NJ 08205
Phone: (609) 626-6875
Office: K-154
Email: megan.foti@stockton.edu

Jomayra Mendez
Occupational Therapy Student
The Richard Stockton College of New Jersey
440 Maple Ave
Elizabeth, NJ 07202
Phone: 908-248-7994
Email: mendezj1@go.stockton.edu

Abstract

Mobile learning is a trend in higher education that is redefining the manner in which learn takes place and instruction is delivered. The purpose of this exploratory study to begin to investigate whether mobile devices are currently used to enhance or support learning in a graduate level Occupational Therapy program in order to facilitate student achievement. Forty six participants were administered a questionnaire containing Likert scale items and open-ended questions to obtain information regarding frequency and quality of mobile device use among students. The findings indicate that students are using their mobile devices to enhance learning outside of the classroom.

Introduction

Mobile learning, the use of portable electronic devices to access and share information, is a trend in higher education, and is redefining the manner in which learning takes place and how instruction is delivered (Geist, 2011; Miller, 2012). Mobile learning presents students and professionals with the unique opportunity to access information instantaneously regardless of location (Rossing, Miller, Cecil, & Stamper, 2012). This means that learning can occur anywhere at any time through the use of these devices. Devices commonly used are smartphones with the Windows©, LG Android™, or Apple® operating systems; or tablet computers. More specifically, the iPad is currently at the forefront of tablet use accounting for 97% of all tablet-based web traffic in 2011 (Arnet, 2012).

Although the implementation of mobile device use is well documented in elementary and high school education with 1.5 million tablet-pcs currently being used in public school districts, there

is limited research supporting the use of these tools in higher education (Kessler, 2012). However, literature related to device use at the collegiate level is proving to be positive and influential on student learning. For example, Seton Hill University and George Fox University are among the numerous institutions of higher education that have recognized the potential of using mobile devices to enhance learning and have integrated the devices into their curricula (Kolowich, 2012). Current research has validated the potential of these devices as they have been found to facilitate engagement and participation in discussion when used in the classroom setting (Rossing et. al, 2012). Moreover, students report that use of mobile devices allows them to adapt course content to fit their learning style and pace (Rossing et. al, 2012).

Mobile learning devices have also been found to be efficacious in the consumption of information with one of its most notable capabilities being its utility as an e-reader. Students are choosing to buy e-books that they can easily download on their tablets, while professors are choosing to upload excerpts from texts as pdf files and sharing them with students (Geist, 2011). Publishers are seeking ways to stay viable in this new market and looking to exploit the capabilities of tablet-pcs by creating visual interfaces and multimedia built in to their e-books to make learning more interactive (“iPad in Education”, n.d.) This is particularly important as a study by Rossing et. al (2012) found that the visual and tactile learning opportunities presented by these devices made the learning experience more “hands-on”. Similarly, studies have found that tablet-pcs have applications that serve as study aides and productivity tools for students. Not only were students able to use “apps” to help create flashcards for studying, but they were also able to access and edit documents on Google docs for assignments (Miller, 2012). The design of tablet-pcs combines e-reading capabilities with web-browsing, as well as an assortment of applications, or ‘apps’ that facilitate the integration of information by making accessibility

instantaneous (Rossing et. al, 2012). Due to these capabilities and their potential to revolutionize education, these tools are highly relevant to higher education.

In the classroom, the use of mobile devices has been found to contribute to the learning experience and engage students during lectures. Students perceive the tablet PC to be effective in improving their learning environment. Moreover, students report the tablet PC to facilitate their ability to understand key concepts and personalize their learning experience (Schuler et. al, 2012). With regards to group work, a study by Schuler et. al (2012), found that the use of tablet computers helped to create a cooperative learning environment among students. Students were able to share information more efficiently, formulate responses to questions, and increase their sense of accountability. Within the context, accountability for learning is important to foster in graduate students, as they are encouraged to be self-directed learners. Therefore, it is necessary to investigate strategies to integrate the use of mobile devices in higher education, especially in graduate studies.

As collegiate institutions begin to recognize the paradigm shift of mobile device use, redefining the way information is consumed, disseminated, and used, it is essential to conduct more studies in this area (Geist, 2011). Mobile devices will indubitably change the way instruction is delivered in higher education settings, and it is important to investigate and apply these concepts to teaching strategies.

The purpose of this exploratory study is to begin to assess how mobile devices are currently used to enhance or support learning in a graduate level Occupational Therapy program in order to facilitate student achievement. This study will use information obtained from the students in order to provide suggestions on applications and web resources that can be accessed at little or no cost. Specifically, the study will address the research questions: Do Master of Science in

Occupational Therapy (MSOT) students have access to/use mobile devices (cell phones, tablets, etc.)? How is mobile device use among students used to enhance learning in a graduate student program?

Methods

Design

A mixed quantitative and qualitative designed was employed. Through quantitative data analysis, information regarding frequency and purpose of mobile device use was obtained. Qualitative data were collected to obtain information that will aide professors in developing strategies to support and enhance classroom learning through mobile devices.

Instrumentation – See Appendix A

A questionnaire containing Likert scale items and open-ended items was utilized in this study to obtain both quantitative and qualitative information regarding student use of mobile devices in their academic role. The tool contained items adapted from the Rossing et. al (2012) study. The tool was not tested for validity or reliability.

Participants

The sample included forty-six students from a Master of Science in Occupational Therapy program. Participants were both male and female, ranging in age from twenty-one to thirty-eight years old. Participation in this study was voluntary and no costs were incurred on the part of the students as they were not required to buy any additional devices to participate in this study.

Data Analysis

The questionnaire was administered to students before class and they were instructed to take approximately ten minutes for completion. Quantitative data from the questionnaire were analyzed using SPSSv.21 software to compute descriptive statistics and frequency tables.

The qualitative data gathered from the questionnaire were reviewed, reduced, and coded to develop relevant themes. Researchers reviewed the surveys extensively until saturation was achieved. Data that was recurrent in the surveys was highlighted and extracted into a word document. To increase the rigor of the study, the data from the survey were compared one against the other to ensure accurate reduction. The data extracted were then reviewed again to form codes, and these codes were further reduced and analyzed to form themes. The researchers maintained a journal detailing the coding decisions to reduce bias.

Findings

Quantitative Results

Quantitative results revealed that 45 of the 46 student participants reported using their mobile devices for academic purposes. 91% of students reported feeling very comfortable using mobile devices and 97% reported using mobile devices multiple times a week. Mobile devices used by students and types of use are represented in charts 1.1 and 1.2.

Chart 1.1: Mobile Devices Used by Students

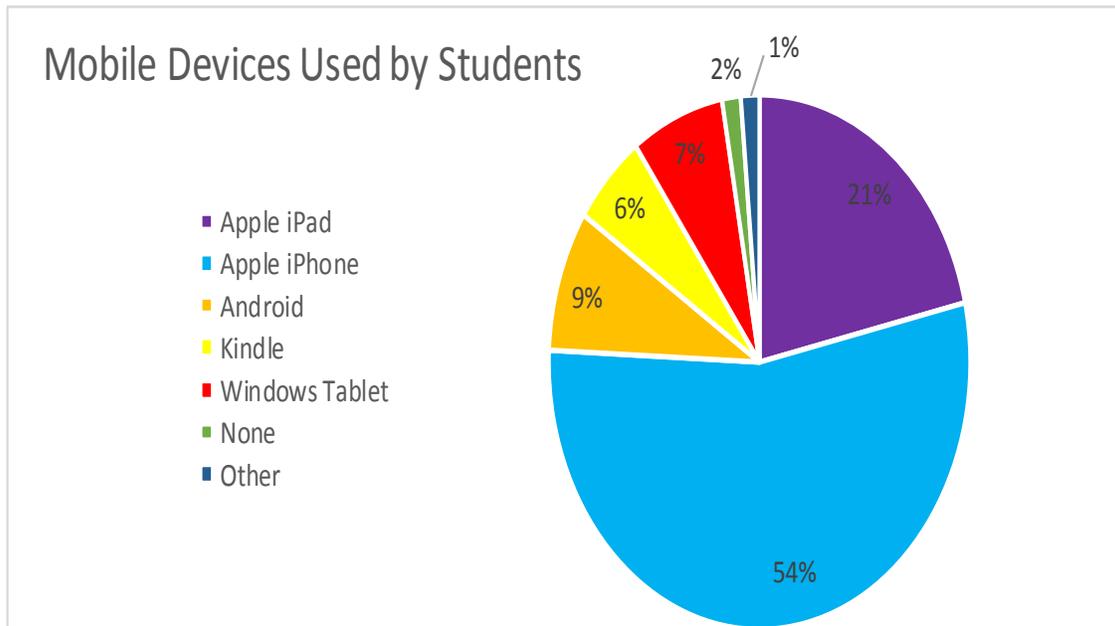
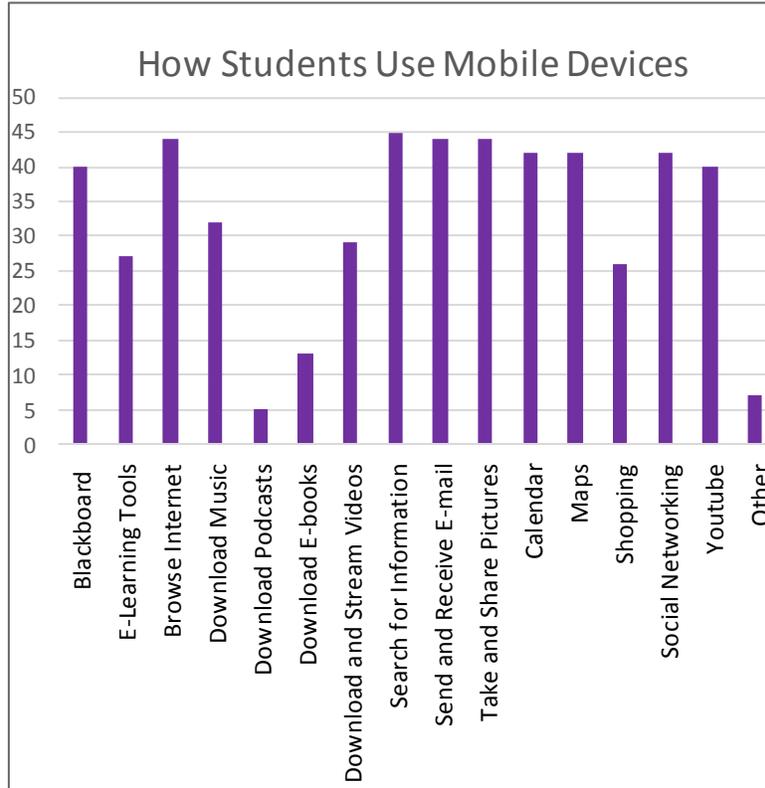


Chart 1.2: Types of Mobile Device Use



Qualitative Results

Qualitative data analysis yielded the following themes: 1) Mobile devices as learning tools 2) Mobile devices support student role 3) Integration of mobile devices into classroom 4) Use of social networks to communicate 5) Convenience and Utility.

The majority of students utilize their mobile devices as learning tools.

Students turn their mobile devices into learning tools through the use of mobile applications, or “apps”. A majority of students reported the use of the Quizlet LLC “app” as a study tool. Quizlet

LLC is a company that creates free study tools that can be accessed through their website or mobile apps. Through the use of Quizlet LLC, students are able to upload course content to create flashcard sets that can be shared and edited by their classmates. Other features include games and quizzes to help students learn exam material.

Apart from Quizlet LLC, applications used to study anatomy were reported to be widely used. Students make use of apps such as Nerve Whiz, Pearson Med Terminology, Medterm Scramble, Stretching HD, Visanatomy, Ess Skeleton, Human Anatomy Atlas, and Visual Anatomy Lite to learn anatomy. The MSOT curriculum requires extensive knowledge of human anatomy and physiology, especially bones, muscles, and nerve innervations. This knowledge serves as the foundation for all of the student coursework, and students are expected to be proficient in it prior to enrollment. In this context, apps prove to be useful resources in that they provide the user with instant access to specialized information in a manner that is faster and more efficient than using search engines. Unlike web resources, apps require fewer selection steps and keystrokes to access information as their content is highly targeted and specific to an area of interest.

Students use mobile devices to support student role.

Through the use of “apps”, students are able to use their mobile devices as communication tools. Applications such as Blackboard enable students to access course content to perform actions such as grade viewing, viewing and posting discussion board threads, as well as uploading assignments and downloading pdf files. Other functions include accessing school e-mail, student bills, and class schedules, among other options.

Students reported using the Google Mail “app” to access their student e-mail in order to receive and send communications to professors and classmates. The ability to retrieve e-mail through

mobile devices enables students to stay informed, especially with regards to changes in deadlines, course syllabi, meetings, lectures, and trainings. Further, instant access to e-mail facilitates prompt response to faculty, thereby improving communication.

Students would like to see mobile devices integrated into the classroom to make learning interactive and dynamic through the use of Apps.

Students surveyed reported a desire to have mobile devices integrated into classroom learning. When asked to provide suggestions on possible methods of integration, results indicated a focus on making learning both more interactive and dynamic. With regards to making the classroom experience more interactive, the use of mobile devices as personal response systems, or “clickers”, was reported. The use of clickers allows students to answer questions synchronously and anonymously during lectures through a live polling system. The implementation of devices in this manner enables participation, which in turn makes learning more interactive.

Further, students suggested the use of online classroom tools and programs to supplement lectures with activities that would allow them to work independently on their devices. Students emphasized the use of these devices to research information during lectures as another possible learning tool. The ability to access scholarly journals to discuss current evidence-based practice and/or stream video content demonstrating clinical performance of evaluations in real-time may open up a dialogue between students and instructors. This makes the learning process more dynamic as students are able to take on have a self-directed role and become active participants in their learning process.

Lastly, specific to the occupational therapy curriculum, students suggested a lecture specific to the American Occupational Therapy Association (AOTA) mobile app bank, which is an online

resource created by AOTA to provide therapists with apps that can be used in clinical practice. One student stated,

“a lesson regarding all or some of the beneficial apps which would be good learning tools for OT. I would also like to learn more about AOTA’s mobile app bank, and where to find it since I have been unaware of it until now”.

Social networks have become a medium for communication outside of the classroom, mainly through Facebook. Students access Facebook through Apps on their mobile devices.

Students report extensive use of social networks, specifically Facebook, to communicate with each other outside of the classroom. Through Facebook, students can create private groups in which membership is restricted by invitation only. The exclusivity provided by these groups gives students a free resource in which they discuss class lectures, share documents, and plan group projects. One student reported that,

“In several groups I’ve been in for projects, we create a Facebook group to send each other information, sources, articles we used or found, and we also send each other documents”.

Moreover, students use these groups to discuss difficult concepts and explain lectures, essentially using this medium as a platform to teach each other. Further, students reported accessing the National Board of Certification for Occupational Therapy (NBCOT) Facebook page that regularly posts questions related to the occupational therapy licensing exam they will have to take to become practitioners.

The convenience and utility of mobile devices in the classroom.

Student reports were divided with regards to preference of using laptops versus tablet computers. Those who favored tablet computers cited that they are easy to store, light weight, and more

portable than laptop computers. Those who preferred the laptops stated that the bigger screen and keyboard made it the better tool for activities such as note-taking, research, and completing assignments. Those who reported using an external keyboard with their tablet computers stated they still preferred their laptops for note-taking. Further, laptops have capabilities to run flash and also come equipped with USB ports; whereas, tablet computers do not.

Discussion

The results from this study reveal that students are using mobile devices for both academic purposes and for support outside of the classroom. These findings are consistent with those of previous studies investigating the use of mobile devices in higher academic settings. Miller (2102) found that the capabilities of these devices encourage learning and engagement. This is evident in students' reports of using their mobile devices to access course content and use 'apps' to support their learning. Notably, these devices played a significant role in students' creation and utility of study materials. Students reported using a variety of human anatomy apps to review muscles and the nerves that innervate them. These findings are consistent with Rossing et. al's (2012) findings that mobile devices can be utilized to facilitate adaptation of the course content to fit students' learning styles and pace. The apps that can be downloaded to these devices provide students with interactive visual representations of the information. The touch screen capabilities of mobile devices allow students to enlarge or rotate images with ease, thereby making learning more hands on (Miller, 2012; Geist, 2011). Moreover, they provide visual representations of anatomy that more closely resemble the structures in the human body. For programs in the field of health sciences that do not include a cadaver lab as part of their curriculum, anatomy apps may be a useful resource for enhancing student learning.

Apart from human anatomy apps, students reported utilizing the app version of the web resource Quizlet LLC which is available for various operating systems. This finding is consistent with that of Shuler et. al (2012), where students reported that tablet computers enhanced their ability to understand key concepts. The Quizlet LLC resource presents students with the opportunity to rehearse and reflect on lecture material in order to extrapolate key concepts that may appear on their exams. The formatting of Quizlet LLC requires students to interpret the information in a manner that is concise and succinct, so as to translate well the creation of data sets. Accurate surmising of information may be indicative of understanding; however, this determination, as well as the effects of Quizlet LLC on academic performance are beyond the scope of this study. It can be confirmed that students are seeking out electronic resources to supplement their in class learning.

The portability of mobile devices coupled with their processing speed made them the preferred medium for accessing Quizlet LLC to study outside of the classroom. Further, students reported sharing their data sets with their classmates; therefore, it can be concluded that the use of mobile devices in this context plays a role, perhaps indirectly, in encouraging sharing and collaboration among students (Miller, 2012; Schuler, 2009). These findings are consistent with Rossing et. al (2012) which found that use of mobile devices encourages participation and engagement among students. Through resources such as Quizlet LLC, students are able to work cooperatively with their classmates by creating study materials that can be shared by all (Shuler, et. al 2012).

To further expand on this idea of sharing and collaboration among students through the use of mobile devices, a discussion regarding student creation of online communities such as Facebook groups may provide clarification. This online resource was used uniquely by classmates to have an open forum where all cohort members could contribute and respond to posts. Posts on the

Facebook group pertained to assignment due dates, clarification of lecture topics, and the sharing of web-based media and videos to teach concepts. The processing speed couple with the easy access to information afforded by mobile devices facilitated the use of Facebook groups. Students would be able to monitor updates and respond to post anywhere from their mobile devices. As stated by Schuler (2009), the use of mobile devices facilitates learning ‘anywhere, anytime’. Furthermore, this finding is consistent with previous studies that found mobile device use increased both speed and cohesiveness in group work (Miller, 2012; Schuler 2012). The current finding not only supports this idea, but indicates that this is also true for mobile device use outside of the classroom.

Previous studies have found the use of mobile devices to be considered fun and convenient (Miller, 2012). This supports findings of the present study where students found mobile devices to be more portable than laptops. However, with regards to use in the classroom the findings were inconclusive. Those who preference a laptop for in class use cited the bigger screen and external keyboards as the reason. Students reported a preference for the laptop when it came to use in the classroom. One student stated that “I like having the physical keyboard for quick typing and while many tablets have this as an add-on, it may be expensive.” Those who preferred the tablet computer for note-taking purposes cited its portability and light-weight characteristics. One student stated “Yes, because it is less bulky and does all the same things.”

The findings of the present study provide valuable information regarding the use of mobile devices by students to support learning outside of the classroom. The findings indicate that students have employed various strategies to ensure their academic success. Most notably, they have chosen to form online communities through the use of social networks with the purpose of reinforcing course content, sharing information, and planning projects. Further, sharing and

collaboration have become methods through which students support one another's academic performance with the preferred medium for achieving this being electronic resources. Mobile devices have been the vehicle through which students have been able to exploit the electronic resources available to them. Their portability and processing speeds make learning anywhere and anytime possible and students are seizing these opportunities.

Limitations & Implications for Further Research

The present study used a convenience method of sampling which resulted in a small sample that contained more female than male participants. This is due to the researchers sampling from an MSOT program, a graduate program that predominately attracts female students.

Further, many MSOT programs, such as the one being studied are cohort programs in which students transition through academic courses together. Therefore, the dynamics of the relationships among these students may differ from that of non-cohort undergraduate and graduate students. This may influence students' willingness to create online communities such as the Facebook groups or study resources through apps such as Quizlet LLC for the purpose of sharing and discussing information.

Lastly, students in graduate programs are expected to be self-directed learners who independently locate resources to supplement their learning. This may be a motivating factor for students to use mobile devices for learning outside of the classroom.

Further study is necessary to investigate whether mobile device use has an impact on academic performance. Also, if these devices encourage or support self-directed learning.

Appendix A

Stockton MSOT Mobile Learning Survey

The purpose of this survey is to provide faculty with information about whether you utilize mobile devices as they relate to your studies in the MSOT program. This survey is for general program development and is voluntarily. However, your participation is greatly appreciated and will be useful in course planning, development, and improvement. Portions of this survey have been adapted from:

Rossing, J.P., Miller, W., Cecil, A.K., Stamper, S.E. (2012). iLearning: the future of higher education? students perceptions on learning with mobile tablets. *Journal of Scholarship of Teaching and Learning*, 12(2), 1-26. Retrieved from <http://josotl.indiana.edu/article/view/2023/1985>.

Tell us about yourself

Circle response indicative of age and gender

Age Group:	21-24	25-30	30-35	40-45
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Gender	Female	Male
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Mobile Device Use

1. Do you own a smartphone or tablet pc that is capable of accessing the Internet (whether or not you use that capability)?

- No, and I don't plan to purchase one in the next 12 months.
- No, and I plan to purchase one in the next 12 months.
- Yes.

2. What tablet/smartphone brand/model do you own?

- Apple iPad
- Apple iPhone
- Android
- Kindle

- Windows Tablet
- None
- Other (Please Specify)

3. How do you use smart phone or tablet pc? Check all that apply.

- Access BlackBoard
- Access other e-learning tools
- Browse the Internet
- Download and listen to music
- Download and listen to podcasts/audio books
- Download and read e-books/print-based content
- Download and view streaming movies/video clips
- Search for information
- Send and receive e-mail
- Use camera to take and share pictures
- Calendar
- Maps
- Shopping
- Social networking
- YouTube
- Other (Please specify)

4. How often do you use your mobile device?

- Never
- Once a week
- Three times a week
- Multiple times a week

5. What is your level of comfort with your mobile device/handheld device use?

- Not at all comfortable
- Not very comfortable
- Fairly comfortable
- Very comfortable

Mobile Learning

6. Do you use the device for academic purposes?

YES NO

7. Do you use any Apps related to your role as an MSOT student?

YES NO

If yes please specify:

8. Do you use any Apps for studying?

YES NO

If yes please specify:

9. Are you familiar with AOTA's mobile app bank for practitioners?

YES

NO

If yes, have you ever downloaded an app based on this site? Please specify:

10. Describe possible ways that you would like to see the use of tablet pcs and smartphones integrated into the classroom.

11. Do you communicate with classmates via social networks? If so, explain.

12. Do you access social networks through your tablet pc or smartphone?

13. Do you use social networks for school related things? If so, please specify.

14. Do you prefer the use of a tablet pc over the use of a laptop in the classroom?
Why or why not?

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