Education and Training in Autism and Developmental Disabilities, 2015, 50(2), 155–171

Incorporating Functional Digital Literacy Skills as Part of the Curriculum for High School Students with Intellectual Disability

David F. Cihak and Rachel Wright
University of Tennessee

Cate C. Smith
Appalachian State University

Don McMahon
Washington State University

Kelly Kraiss
University of Tennessee

Abstract: The purpose of this study was to examine the effects of teaching functional digital literacy skills to three high school students with intellectual disability. Functional digital literacy skills included sending and receiving email messages, organizing social bookmarking to save, share, and access career websites, and accessing cloud storage to download, revise, and upload documents. Results indicated that all students acquired and maintained these functional digital literacy skills. Findings are discussed in the context of teaching essential digital literacy skills to increase greater participation in a digital society.

As the technology wave continues to permeate every aspect of daily life, many organizations struggle to evolve accordingly, and education is no exception. The rapid rise in the use of technology has significantly impacted the way society functions, and educators face many new challenges in teaching students of the digital age. These challenges include the need to reevaluate and redefine previously agreed upon concepts, such as what it means to be literate in today's digital world. The term "literacy" must be expanded beyond its traditional meaning of the ability to read and write to reflect the skills needed to interpret and understand information presented through the existing realm of digital media. The basic principles of traditional literacy instruction must also adapt to match advancements in concepts of literacy accordingly. Adoption of such digital literacies skills is essential for educators to not only keep their students engaged and motivated, but to better prepare them for a technologically-oriented workplace (Collier, 2007). Students with intellectual disability (ID) face this same future, and the same demands of the technologically-oriented workplace, and therefore must be provided explicit instruction that will promote independence and increase opportunities in adulthood.

Correspondence concerning this article should be addressed to David F. Cihak, University of Tennessee College of Education, Health & Human Sciences, A412 Bailey Education Complex, Knoxville, TN 37996-3442. E-mail: dcihak@utk.edu

For students with ID, traditional literacy instruction has primarily focused on teaching sight word recognition and is often isolated from meaningful context (Clendon & Erickson, 2008). Despite what is known about the components of high quality reading instruction, reading instruction for students with ID has traditionally emphasized functional reading skills such as sight words necessary for daily living, safety, and independence as a singular, principal focus (Browder, Wakeman, Spooner, Ahlgrim-Delzell, & Algozzine, 2006; Kliewer, 1998). Shifting perspectives of special educators and improvements in legislature (IDEA, 2004; NCLB, 2002) indicate a more expansive and potentially liberating view of literacy and learning for students with ID. As a result of these changes, educators and proponents of students with disabilities have advocated for access to an instructional program that would promote participation and progress in the general curriculum, including literacy instruction (Jackson, 2005). Although

sight words are an essential component of literacy instruction, comprehension and communication are key skills for students with ID (Browder et al., 2006). A body of research demonstrates that students with ID can successfully acquire, maintain and generalize new literacy skill with systematic prompting and feedback (e.g., Browder, Ahlgrim-Delzell, Spooner, & Baker, 2009; Browder, Lee, & Mims, 2011). Multiple literature reviews establish the use of systematic instruction as an evidence-based practice for teaching academic content to students with ID (Browder et. al., 2006; 2009; 2011; Spooner, Knight, Browder, & Smith, 2012).

Alberto et al. suggested that literacy skills provide individuals with the "ability to obtain information from the environment with which to make decisions, alter the environment, and gain pleasure" (Alberto, Frederick, Hughes, McIntosh, & Cihak, 2007, p. 234). Students with ID must learn strategies that enable them to access the information available from the environment, which may be presented in a variety of media formats in addition to printed text. By incorporating elements of visual literacy (the ability to discern meaning conveyed through images) into the functional literacy curriculum for students with moderate intellectual disabilities, Alberto et al. demonstrated that explicit, systematic instruction of picture and logo reading is an effective strategy to increase students' abilities to interpret meaningful information from the environment. Explicit teaching of basic visual literacy skills provides instruction that is not only functional, but also allows access to information available in multiple settings, including the real-world and online communities. As digital information continues to dominate our lives, visuals and graphics created with new technologies are becoming as common as digital text, and visual literacy is critical for access to and participation in digital environments and communications.

Technology provides students with ID with numerous opportunities to access information that they may not have been able to obtain otherwise. Many types of technological devices are available to teach a variety of types of skills to students with ID, including academic, social-communicative, community, and vocational skills (Browder et al., 2006; Cihak, Kessler, Alberto, 2007, 2008; Davies, Stock, & Wehmeyer, 2002a, 2002b, 2004; Ferguson, Myles-Smith, & Hagiwara, 2005). Devices that have been used successfully include computers (e.g., Coleman, Hurley, & Cihak, 2012; Ramdoss et al., 2011), handheld computers (e.g., Cihak, Wright, & Ayres, 2010; Mechling, Gast, & Seid, 2010), iPads (e.g., Flores et al., 2010; Kagohara, Sigafoos, Achmadi, O'Reilly, & Lancioni, 2012), iPods (e.g., Cihak, Fahrenkrog, Ayres, & Smith, 2010; Kagohara et al., 2011), and mobile phones (e.g., Bryen, Carey, Friedman, & Taylor, 2007; McMahon, Cihak, Gibbons, Fussell, & Mathison, 2013; Taber, Alberto, Seltzer, & Hughes, 2003).

While they are used more and more frequently to teach new skills, computers and mobile technologies are most commonly used to target a specific skill deficit. In their review of the literature regarding the use of technology and mobile devices (e.g., iPad, iPods, mobile phones) for individuals with developmental disabilities, Kagohara et al. (2013) came to several conclusions. Most notably, they concluded that while technology is a viable aid for individuals with developmental disabilities, they are used primarily only as intervention delivery systems (e.g., presenting instructional video, prompting students). Further, research has indicated that students with ID often do not take full advantage of technology (Happestad, 2007; Kling & Wilcox, 2010; Tanis et al., 2012), and that they are less likely to have access to and benefit from technology when compared to students with other disabilities (Wemeyer, Smith, Palmer, & Davis, 2004).

The concept of digital literacy was first introduced in 1997, described as "the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers" (Gilster, 1997, p.1). Many variations in the definition of digital literacy have since emerged, with job-specific applications ranging from the technical aspects of operating in digital environments to the cognitive and socio-emotional aspects of a computer-driven environment (Eshet, 2004). The educational literature uses the term "21st century literacy" to describe this phenomena, applying to "the ability to read and interpret media (text, sound, images), to reproduce data and images through digital

manipulation, and to evaluate and apply new knowledge gained from digital environments" (Jones-Kavalier & Flannigan, 2006, p. 9). Incorporating the current technologies used today with the prerequisite skills potentially required for future technology, 21st century literacies focus on preparing students with the skills needed to participate successfully in tomorrow's workplace and classroom (Collier, 2007). The shift from a print-based to a screen-based society calls for teachers to integrate digital literacy skills into instruction to prepare students for expectations of potential employers; therefore, digital literacy is considered to be an essential life skill (Bawden, 2008).

Digital literacy skills have become an essential part of learning how to function independently in today's society. In addition to the use of technology for traditional instructional purposes (e.g. computer-assisted instruction) to promote academic progress and outcomes, students with disabilities can benefit from technology to support learning in the area of life skills (Wehmeyer, Smith, Palmer, & Davies, 2004). However, a 2005 study surveyed 83 adults with ID regarding their use of various technologies, and found that only 41% of these respondents used a computer, 25% used the Internet, and 11% used electronic organizers; statistics all well below the general population's use of such devices and technologies (Carey, Friedman, & Bryen, 2005). Functional use of common internet activities for communication and information pursuits require a level of functional literacy and a range of cognitive skills including decoding, comprehension, and written expression (Johnson, 2007). A lack of functional digital literacy, the basic skills required for users to operate effectively in digital environments, could soon be the only factor preventing access for all. It is imperative for students with ID to learn functional digital literacy skills to be fully included in educational settings, to increase their access to digital materials, and to access employment opportunities.

Frequently cited as the most common online activity (U.S. Census Bureau, 2010), email has become the dominant form of communication in workplace and educational settings. A working email account is also required for access to many online social communications and networks (e.g. Twitter, Facebook). Multiple cognitive processes are involved when a user engages in online communication in the form of email and other text-based digital messaging services: basic literacy to accurately input intended email address(es), comprehension to create or respond to a message, discrimination between relevant and irrelevant information, and interpretation of the email sender's intent (Johnson, 2007). Interpretation of digital messages requires a different skill set than face-to-face communication, where additional information can be obtained through the speaker's facial expressions and use of gestures (Szewczak & Snodgrass, 2002). In addition, email addresses are becoming increasingly associated with one's online identity. A working email address is necessary to access educational information and communications, complete financial activities (e.g. banking and online purchasing), participate in social networking, and even access newsletters and job opportunities. Yet, in a recent study, researchers found that only 18.7% of people with ID have an email address (Palmer, Wehmeyer, Davies, & Stock, 2012).

A new trend in online media is the use of social bookmarking tools, such as Pinterest, Reddit, and Diigo, which allow internet users to "bookmark" websites for later use. Users then have the ability to view all of their bookmarks at once, providing quick and direct access to saved information. Saved bookmarks can be easily viewed at once as an icon display and organized into desired categories. Users can visually scan for bookmarks they wish to share with other users or social media sites. Frequently used by academic libraries, social bookmarking is a practical tool that can be used to share leisure interests and increase access to employment opportunities through social networking and social media websites (Redden, 2010). In 2011, The National Council on Disability (NCD) found that social networking may be more critical for people with disabilities than for the general population (NCD, 2011). Social bookmarking is an age-appropriate life skill that can be used for educational, employment, or leisure purposes, and therefore, is considered to be a functional skill.

Cloud storage is another functional tool that provides access and availability to users.

The development of cloud storage services has profoundly impacted the availability and accessibility of digital information. Any document, photo, video clip, or other file type uploaded to the cloud may be accessed or shared anywhere on any computer or device using an internet connection. For students with ID, the ability to access files stored in the cloud allows opportunities for increased independence and the ability to self-manage various supports as needed. These supports include communication notebooks, vocational routines and checklists, picture prompts and picture schedules, video models, social stories, and safety skills. Rather than carrying cumbersome devices and supportive tools, users now have digital access to the same supports. Students with disabilities can use a variety of mainstream technologies and readily available devices to access these supports. Many organizations, including educational institutions, are investing in cloud storage as an effective, and cost efficient means of providing access to digital materials, increasingly becoming the only option for user access. Recently, 4 of the top 5 essential apps for college students with ID included cloud storage of files for easy retrieval and sharing (Cooney, 2012).

Despite the increased importance of functional digital literacy, the current research is limited on teaching specific functional digital literacy skills to students with ID. Specifically, no research has been conducted on teaching high school students with ID functional digital literacy skills, namely: (a) receiving and sending emails, (b) managing social bookmarks, and (c) accessing documents through a cloud storage service. The purpose of this study is to examine the effect of using systematic digital literacy instruction to teach these three functional digital literacy skills to high school students with mild and moderate ID. In addition, students' opinions of digital literacy skills were surveyed following the study.

Method

Participants and Setting

Three high school students participated in this study: one male student (Charles) and two female students (Kate and Faith). Participants were selected based on the following: (a) diagnosis of an intellectual disability, (b) no email address, (c) no physical disability which impeded the performance of the skill, and (d) agreeing to participate in the study. Table 1 details characteristics for each student. Charles also had a comorbid diagnosis of autism. In addition, all students participated in a life skills curriculum, which included daily living skills, community skills, and career goals. Further, five students without disabilities worked in the classroom as peer tutors. All phases of this study occurred in the students' special education resource classroom. Students also worked toward communication and social skills goals included in their Individualized Education Plans (IEPs). T1

TABLE 1

Student Characteristics

Students	*Age*	*IQ*[a]	*Adaptive Behaviors*[b]
Kate	16	50	59
Faith	17	40	61
Charles	19	66	43

Note. *a* = Wechsler Intelligence Scale for Children-IV (WISC-IV) full scale standard score; *b* = Vineland Adaptive Scales-II (Vineland–II) standard score.

The setting was a high school special education classroom, which included a special education teacher and teacher assistant. The special education teacher had 10 years of experience teaching students with intellectual disabilities, and the teacher assistant had two. The special education teacher and teacher assistant have worked together for the past two years. The special education teacher implemented all intervention procedures.

Materials

This study incorporated the use of three Dell Vostro 270 desktop classroom computers with Windows 7 operating systems. We created Gmail accounts for email, Diigo accounts for social bookmarking, and DropBox accounts for cloud storage for each of the three participating students. Each of these digital tools are available free of charge. Once accounts were created, the teacher instructed the students to

TABLE 2

Digital Literacy Skills Task Analyzed

Skill	*Task Analysis*
Emailing	
Sign in	(1) Click gmail; (2) type login; (3) type password; (4) click sign in;
Respond to email	(5) Click email; (6) click "Reply"; (7) compose message "answering teacher question"; (8) click send;
Send email	(9) Click "COMPOSE"; (10) type email address; (11) type subject; (12) type message; (13) click "send".
Bookmarking	
Save bookmarks	(1) Find page to bookmark; (2) click Diigo on toolbar; (3) click sign in; (4) click user name; (5) click password; (6) click bookmark; (7) click save bookmark;
Access bookmarks	(8) Click Diigo; (9) click "My Library"; (10) click on saved bookmark.
Cloud Storage	
Sign in	(1) Click Dropbox; (2) type email; (3) type password; (4) click sign in;
Download document	(5) Click folder "Class"; (6) click document; (7) click open; (8) respond to teacher question; (9) click save icon; (10) click save "save as"; (11) click "Yes" to replace existing file;
Upload document	(12) click upload icon; (13) click choose files; (14) scroll Desktop to find document; (15) click on document; (16) click open; (17) click done.

select a password they could easily remember. Students also were provided initially with an index card with their username and password printed in a 14-point font for reference if needed. The index card was made available when the student entered his or her username and password incorrectly. Since these tasks required a username and password, we decided to provide non-contingent access during baseline to increase the likelihood of students performing later skill steps independently. During intervention, students could request the index card if needed during the intervention phase. As students consistently entered their username and password independently (i.e., 3 consecutive sessions), the index card was stored in a locket cabinet for security purposes although students could still request the card at anytime. Additionally, screenshots of each task-analyzed step for all three target skills were created and printed. Screenshots of each motor demonstration step were used as visual prompts and incorporated during general digital literacy instruction.

Variables and Data Collection

Event recording procedures were used to record the number of digital literacy task-analyzed steps completed independently or with teacher assistance. The dependent variable was the number of task-analyzed steps completed independently, which was calculated as the percentage of task analysis steps completed independently, to email, bookmark, and use cloud storage independently. Table 2 lists the task-analyzed steps for each targeted skill. For emailing, students were expected to (a) sign-in to their email account, (b) respond to an email sent by their teacher, and (c) compose and send a new email to a fellow student (i.e., peer tutor). A total of 13 task-analyzed steps were required to independently email. For bookmarking, students were expected to (a) save/bookmark at least one career related website, and (b) access at least one saved website/bookmark. A total of 10 task-analyzed steps were required to independently use bookmarking. For cloud storage, students were expected to (a) sign-in to cloud storage, (b) download a document, (c) revise the document, and (d) upload a document. A total of 17 task-analyzed steps were required to independently use cloud storage.

An independent response was defined as initiating the first step in the task analysis within 10 s and completing each step within 30 s without teacher assistance, except for the

first step of social bookmarking (i.e., find page to bookmark). Although students were required to initiate the task within 10 s, they had 5 min to review and find at least one job related website to bookmark. The additional 5 min was provided only for step one; students were expected to complete the remaining steps (i.e., 2–10) within 30 s. If a student did not independently initiate the first step within 10 s, complete a step within 30 s of initiation, or 5 min to complete step one for social bookmarking, teacher assistances were implemented using a system of least prompts (Ault & Griffen, 2013). The least-to-most prompt hierarchy consisted of the following levels: (a) verbal prompt, (b) gesture, (c) gesture plus verbal explanation, (d) modeling plus verbal explanation, and (e) physical assistance plus verbal explanation. The percentage of steps completed independently was graphed for visual analysis. The special education teacher recorded the data and implemented all instructional procedures for all sessions, and one session occurred per day.

Maintenance data were collected 9 weeks later after the student reach acquisition criteria. Similarly, event recording procedures were used to record the number of digital literacy task-analyzed steps completed independently or with teacher assistance and then calculated as the percentage of task analysis steps completed independently for each student. During the 9 weeks, students continued to use each skill daily.

Design

A multiple probe design across behaviors (Gast & Ledford, 2010) was used to examine a possible relation between digital literacy instruction and the acquisition and maintenance of three digital literacy skills. All digital literacy skills were probed during baseline prior to instruction. After baseline data were stable, the teacher implemented general digital literacy instruction and targeted emailing, while social bookmarking, and cloud storage skills continued to be probed during the baseline phase. Contingent upon the student reaching the acquisition criterion for emailing (i.e., 100% for three consecutive sessions), the teacher implemented digital literacy instruction and targeted social bookmarking, while cloud storage continued to be probed during the baseline phase. Lastly, the teacher implemented digital literacy instruction and targeted cloud storage after the student reached criterion for bookmarking. Acquisition criteria were defined as performing all task-analyzed steps of the targeted digital literacy skill independently for three consecutive sessions.

Procedure

Baseline. Materials for each task were prearranged and readily available to the student. The teacher began all sessions by asking the student to sit at the computer and either "check your email, research career websites, or check your schedule." Students were given 10 s to initiate the first step in the task analysis and 30s to complete each step, except for step one of bookmarking in which students were provided 5 min to review and save/bookmark a website. In addition, no tangible reinforcement was given. The baseline phase continued for a minimum of three sessions or until stability was achieved.

However, the teacher assisted with spelling when students requested and provided the student's username and password on an index card. Since all skills required an email address and password, all students were registered for an email account accessible through a username and password. The students self-selected a username and password. Students were provided with an index card with their username and password printed in a 14-point font and instructed to refer to the card if they forgot their login information. The students' username and password was provided to increase the likelihood of students being able to demonstrate the most digital literacy skills possible. Since a username and password was required to progress to other steps of the skills, we did not want to artificially suppress a student's performance of specific skills that they may otherwise be able to demonstrate.

For email, students were expected to sign-in, and respond to a daily email from their teacher, which included one closed-ended question (e.g., are you going to the community to work today, who won the game, what are you eating for lunch, what's the weather like). In addition, students were expected to compose an email to a peer tutor. Students

were encouraged to email the peer tutor about what they were doing today, what they did over weekend, or plans for the upcoming weekend. Peer tutors' email addresses were previously saved as contacts; therefore, as soon as the student began typing the first letters of a person's name, their corresponding email address appeared.

For bookmarking, students used a common social bookmarking application (i.e., Diigo) and search a statewide jobs website, which provides any job seeker with a list of open positions within a predetermined distance (e.g., 5, 10, 25, 50 miles) of an entered zip code. The students' zip code and a 10-mile radius was preset for all students. Students were expected to review open employment positions, bookmark at least one career website of interest and to access at least one bookmark website.

For cloud storage, students were expected to download an activity posted by their teacher from a common cloud storage website, complete the activity, and then upload the completed work. Students were expected to download a daily schedule task checklist. The checklist included pictures of tasks completed the previous school day and the current day's schedule of tasks that required completion. Each student was expected to download the schedule, self-report by typing a "Y" next to each task indicating they completed it, review the current daily schedule, and upload the new schedule or document to the cloud storage.

Digital Literacy Instruction

General instruction. After the baseline data stabilized, the special education teacher reviewed each screenshot and verbally described each task-analyzed step three times. Then, the teacher demonstrated and verbally explained each task-analyzed step three times. This review and demonstration occurred during one session and lasted approximately 30 min. On the following school day, the teacher implemented a system of least prompts. First, general digital literacy instruction targeted emailing. Contingent on skill acquisition, general literacy instruction was systematically implemented for the second skill (i.e., bookmarking) and then the third skill (i.e., cloud storage).

Emailing. On the following school day, the teacher cued the student to "check your email." Students were given 10 s to initiate the first step in the task analysis and 30 s to complete each step after being cued to "check your email." If they did not independently complete a step within 30 s of initiation, teacher assistance was provided. The teacher administered a system of least prompts (Ault & Griffen, 2013). The least-to-most prompt hierarchy consisted of the following levels, which included a 4-s level between each prompt level: (a) verbal prompt (e.g., "do you see where you need to login?"), (b) gesture (e.g., pointing to login box where to login), (c) gesture plus verbal explanation (e.g., pointing to the login box and providing a verbal explanation), (d) modeling plus verbal explanation (e.g., pointing to the login box, providing a verbal explanation, and demonstrating the correct response), and (e) physical assistance plus verbal explanation (e.g., holding the student's wrist, pointing to the picture prompt, providing a verbal explanation, and physically assisting the student the correct response). Digital literacy instruction continued until the student reached acquisition criteria (100% independence for three consecutive sessions) for emailing including signing-in, responding to an email, and composing and sending an email.

Bookmarking. Following the acquisition of emailing, the teacher implemented one session of the general digital literacy procedures. Afterwards, the teacher cued the student to "research career websites." Similar to emailing, students were given 10 s to initiate the first step in the task analysis and 30 s to complete each step of the bookmarking task analysis, except for step one (i.e., find page to bookmark). Students were given 10 s to initiate the skill and 5 min to complete this skill step; students were expected to complete the remaining steps (i.e., 2–10) within 30 s. If they did not independently complete a step within 30 s of initiation or 5 min for step one, teacher assistance was provided and the system of least prompts was implemented. Instruction continued until the student reached acquisition criteria of saving and accessing at least one

website (i.e., bookmarking) with 100% independence for three consecutive sessions.

Cloud Storage. Following the acquisition of bookmarking, the teacher implemented the general digital literacy procedures for one school day. Afterwards, the teacher cued the student to "check their schedule." Similar to previous digital literacy skills, students were given 10 s to initiate the first step in the task analysis and 30 s to complete each step. If they did not independently complete a step within 30 s of initiation, teacher assistances was provided and the system of least prompts was implemented. Instruction continued until the student reach acquisition criteria of signing-in, downloading, and uploading a document (i.e., cloud storage) with 100% independence for three consecutive sessions.

Social Validity

Following the completion of the study, students completed a social validity questionnaire to assess their opinions regarding the acquisition of digital literacy skills. The research assistant administered the questionnaire to each student individually. It consisted of a 14-item Likert scale, ranging from 1 (indicating strongly disagree) to 5 (strongly agree). The possible scores ranged from 14 to 70. Higher scores indicate greater social acceptance. The research assistant also read each item and response options aloud. Following the 14 items, an open-ended question asked students, "What else do you think?"

Interobserver agreement (IOA) and Treatment Fidelity

The classroom teacher and a graduate assistant independently and simultaneously collected interobserver agreement (IOA). Interobserver agreement data were collected during a minimum of 50% of baseline, intervention, and all maintenance sessions for each student. Observers independently and simultaneously recorded the number of steps each student completed independently. In addition, the peer tutors were instructed to forward the email to the teacher and graduate assistant that was composed and sent by the participating students. Interobserver agreement was calculated by dividing the number of agreements of each student's responses by the number of agreements plus disagreements and multiplying by 100. Interobserver agreement was 100% for each participant's assessment during all phases.

Two research assistants also collected treatment fidelity data during a minimum of 50% intervention and all maintenance sessions for each student. The teacher was required to provide access to the computer and instruct students to email, social bookmark, or use cloud storage. The teacher was observed providing general digital literacy instruction including reviewing screen captions and demonstrating each skill while providing verbal explanations. In addition, the teacher implemented the system of least prompts with a 4-second delay between hierarchical levels. The research assistants calculated treatment fidelity levels by dividing the number of observed teacher's behaviors by the number of planned teacher behaviors and multiplying by 100. The mean treatment fidelity was 88% for Kate, 95% for Charles, and 98% for Faith. The majority of disagreements occurred as a result of not waiting a full 4 seconds before introducing the next level of prompt.

Results

Overall, the students readily acquired each digital literacy skill. On average, students completed few task analysis steps independently during baseline. During digital literacy email instruction, all students independently replied to the teacher's emails, indicating they completed the steps of the task analysis, as well as comprehended the message received. In addition, all students composed and sent a new email to a peer. During digital literacy instruction, students required a mean of 11 sessions to reach 100% independence for 3 consecutive sessions for replying and sending an email (M = 73%), 9 sessions to reach criteria for social bookmarking (M = 77%), and 13 sessions to reach criteria using cloud storage (M = 71%). Each student demonstrated an immediate increase in learning to email and social bookmark with a 100% nonoverlapping data. Kate also demonstrated an immediate increase in learning to use cloud storage with a 100% nonoverlapping data; Faith and Charles' percentage of nonoverlap-

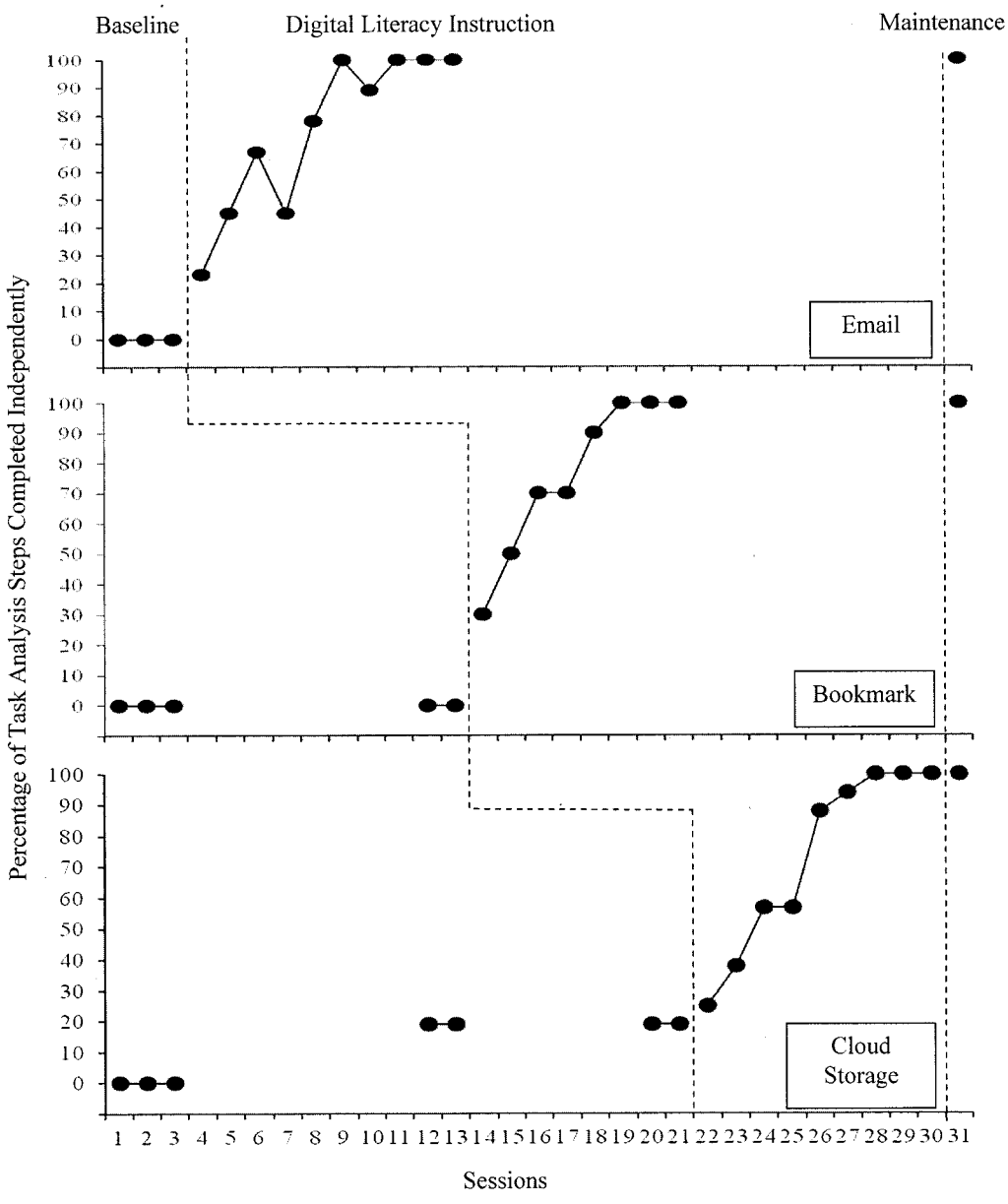

Figure 1. Kate's percentage of steps completed indepdently across digital literacy skills.

ping data for cloud storage was 87.5% and 92%, respectfully. In addition, all students continued to use the digital literacy skills daily and maintained each digital literacy skill nine weeks later.

F1 *Kate.* Figure 1 displays the percentage of task-analyzed steps Kate completed independently for emailing, social bookmarking, and using cloud storage. During baseline, Kate did not complete any of the task analysis steps for emailing or using social bookmarking. She did complete the first two steps for cloud computing independently (i.e., entering username and password). During digital literacy instruction, Kate required 10 sessions to acquire emailing independently for 3 consecu-

tive sessions (M = 75%, range = 23–100%), 7 sessions to acquire social bookmarking independently for 3 consecutive sessions (M = 76%, range = 30–100%), and 9 sessions to acquire cloud storage independently for 3 consecutive sessions (M = 73%, range = 25–100%). Across all skills, she immediately demonstrated an ascending trend and 100% nonoverlapping data. Kate also maintained each digital literacy skill nine weeks later.

Faith. The percentage of task-analyzed steps Faith completed independently for emailing, social bookmarking, and using cloud storage is displayed in Figure 2. During baseline, Faith performed similarly to Kate. Faith did not complete any of task analysis steps for emailing and using social bookmarking, but independently completed the first two steps of cloud storage (i.e., entering username and password). She required 15 sessions to acquire emailing with 100% independence for 3 consecutive sessions (M = 66%, range = 12–100%), 10 sessions to acquire social bookmarking independently (M = 71%, range = 30–100%), and 16 sessions to acquire cloud storage independently (M = 67%, range = 19–100%). Faith immediately began learning how to email and use social bookmarking as demonstrated by 100% nonoverlapping data. Although a general ascending trend was observed for cloud storage, her skill acquisition was more gradual with a demonstration of 87.5% nonoverlapping data. In addition, Faith maintained each skill nine weeks later.

Charles. Figure 3 displays the percentage of task-analyzed steps Charles completed independently for emailing, social bookmarking, and using cloud storage. During baseline, Charles independently completed the first two steps independently (i.e., entering username and password) for emailing and using cloud storage. He did not complete any of the task analysis steps for using social bookmarking during baseline. During digital literacy instruction, Charles required 8 sessions to email with 100% independence for 3 consecutive sessions (M = 79%, range = 34–100%), 10 sessions to independently use social bookmarking (M = 83%, range = 30–100%), and 13 sessions to independently use cloud storage (M = 72%, range = 19–100%). Charles immediately demonstrated an ascending trend and 100% nonoverlapping data for learning to email and use social bookmarking. Charles also readily learned to use cloud storage with a demonstration of an ascending trend and 92% nonoverlapping data. In addition, Charles maintained each skill nine weeks later.

Social Validity

Table 3 displays each student's rating on the 14-item social validity questionnaire. The questionnaire scores could range from 14 to 70 with a higher score indicating greater social acceptance. Kate reported a total score of 66, Faith reported a total score of 63, and Charles reported a total score of 60. Students indicated that they liked all three skills. Emailing and social bookmarking were most preferred by the students, as they indicated that it would be useful to communicate with friends, family, co-workers, and employers. They also indicated that they would continue to use both email and social bookmarking, and would recommend social bookmarking to other students. Kate suggested that she really liked how she can easily find websites about her favorite TV shows. Students were indifferent about the use of cloud computing. Although Kate and Faith indicated some future use of the skill, Charles indicated that he would not continue using cloud storage.

Discussion

The purpose of this study was to examine the effects of teaching individuals with moderate intellectual disabilities to use email, social bookmarking, and cloud storage. All students readily acquired each of these digital literacy skills. All students also readily acquired the skill of entering their username and password, however, they were unfamiliar with most of the other steps to complete each skill independently. With the implementation of digital literacy instruction including the teacher's review of static pictorial screen shots, modeling each digital literacy skill, and proving teacher assistance in the form of the system of least prompts, all students acquired and maintained the functional digital literacy skills. A functional relation was established; experimental control was demonstrated in at least three different series at three different points in time for systematic digital literacy instruc-

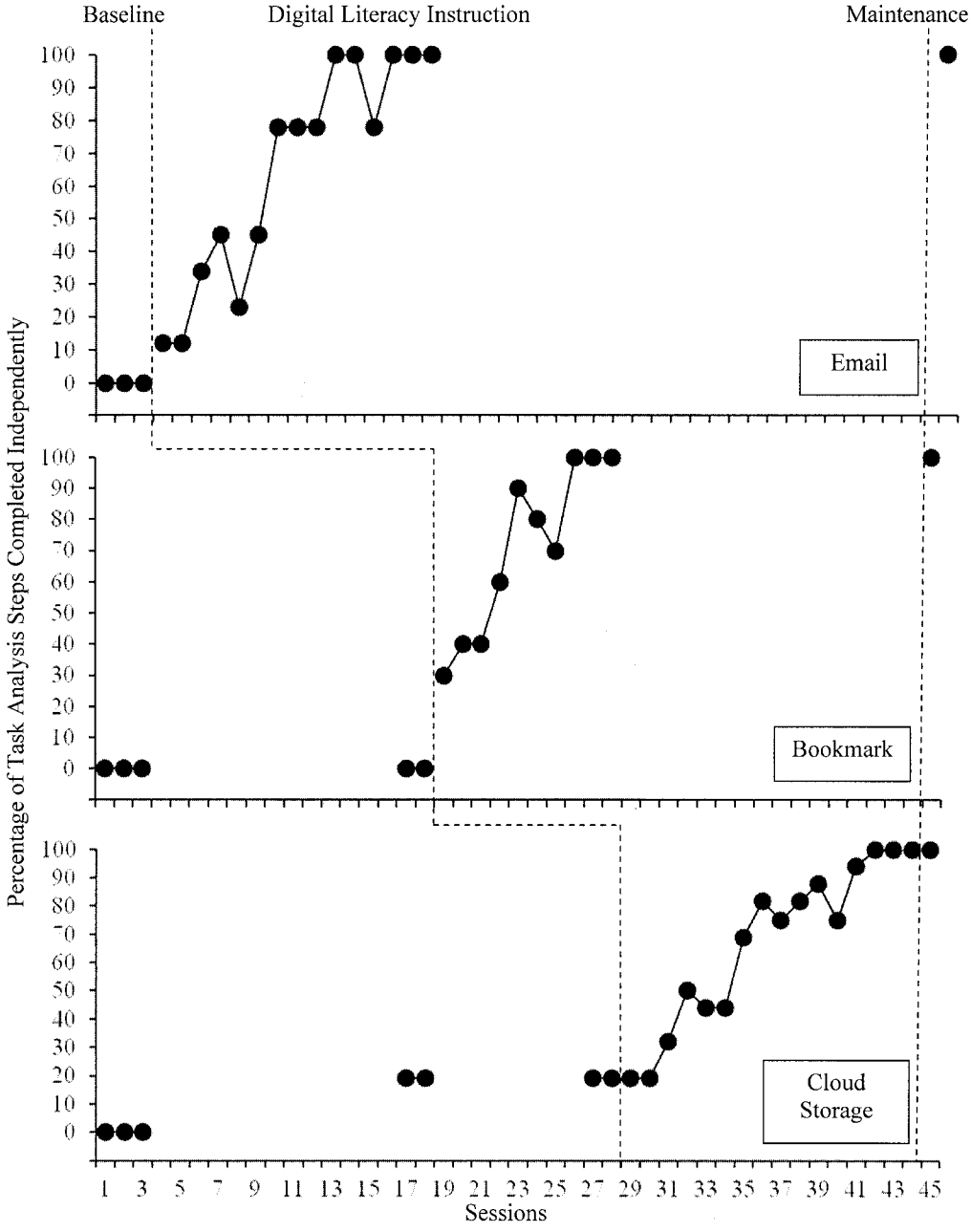

Figure 2. Faith's percentage of steps completed indepdently across digital literacy skills.

tion and emailing, social bookmarking, and using cloud storage independently.

These findings support previous findings that suggest that systematic instruction is an effective strategy to teach new skills (Spooner et al., 2012), computing skills (Pennington, Stenhoff, Gibson, & Ballou, 2012) and digital media skills (Cihak, Fahrenkrog et al., 2010) to learners with intellectual and developmental disabilities. This study extends the

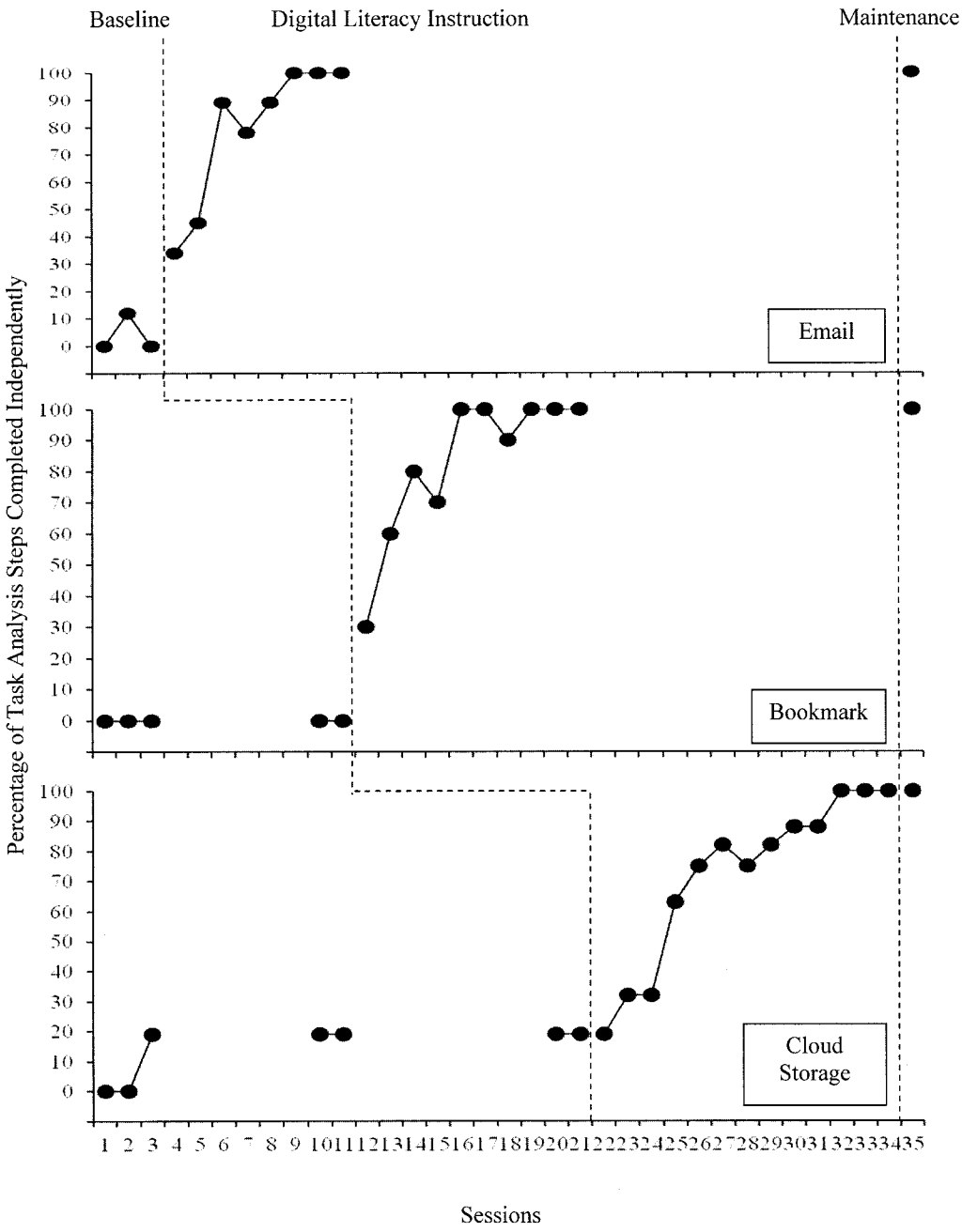

Figure 3. Charles' percentage of steps completed independently across digital literacy skills.

existing body of research by demonstrating the use of systematic instruction for teaching digital literacy skills to students with mild to moderate ID.

This study extended the current literature in several ways. First, by demonstrating the effectiveness of teaching functional digital literacy skills, it also demonstrates the ability of such instruction to provide students greater access to the digital society. Burgs-

TABLE 3

Student Rating of Social Validity Questionnaire

Items	*Kate*	*Faith*	*Charles*
Learning to email is a useful skill	5	5	5
Learning how to email will help me communicate with friends and family	5	5	5
Learning how to email will help me communicate with supervisors and co-workers	5	5	5
I will continue to use email	5	5	5
I liked learning how to use email	5	5	5
Learning to use social bookmarking is a useful skill	5	5	4
Social bookmarking will help retrieve my important websites	5	5	5
I will continue to use social bookmarking	5	5	5
I will tell other students about social bookmarking	5	5	5
I liked bookmarking sites I visit often	5	5	4
Learning to use cloud storage is a useful skill	4	3	3
I will continue to use cloud storage	3	3	2
I liked learning how to use cloud storage	5	4	4
I will tell other students about cloud storage	4	3	3
Total	66	63	60

Note. Likert scale was strongly disagree (1), disagree (2), neither agree or disagree (3), agree (4) and strongly agree (5).

tahler (2002) noted a digital divide exists between people with disabilities and people without disabilities. Digital literacy is a critical life skill in today's digital society. Instead of utilizing such technology to only target specific skill deficits and/or as intervention delivery systems (i.e., Kagohara et al., 2013), it is important to employ such technology in order to teach students with ID how to access digital communities. When considering the rise in availability of new software and applications, teaching students with ID the fundamentals of such technology will provide them greater access to and use of the new technology. Rather than using technology as a cul-de-sac, acquiring and using digital literacy skills allows users to access an on-ramp of information and social contacts for employment, interactions, and independent living. Digital technology can be a resource for learners with ID in personal, academic, and employment pursuits.

An additional benefit of the intervention was the expansion of language through email. Early in the intervention, students simply responded to the teacher's email with one word or short phrases, but as the intervention progressed, they sent more elaborate statements and details. Additionally, after Kate acquired the first skill, she emailed the researcher from her home computer without instruction from the researcher. This indicates that Kate generalized the skill to another setting and proves email to be a socially valid skill for Kate.

Second, this study incorporated the use of essential digital tools (i.e., email, social bookmarking, and cloud computing). Because digital literacy skills are necessary for participation in education, the gap is widened for those without the skills. Researchers indicated that 85% of people without disabilities use a computer or other device to access the Internet in comparison to only 54% of those with disabilities (NCD, 2011). The National Center on Educational Statistics (NCES) reported that children aged 5 to 17 years without a disability were significantly more likely to use computers and the Internet than their peers with disabilities (2001). Children and adolescences with ID were even less likely to use a computer or the Internet. Technology can either stand as an obstacle or a facilitator in education for individuals with disabilities (Fichten et al., 2001). Teaching students to use digital tools such as email, social bookmarking, and cloud storage enables them to be more fully included as digital citizens.

From elementary schools to college campuses, the use of technology is widespread. Mobile devices and electronically formatted textbooks are now commonly found in the classroom. The portability of such technology enables users with disabilities to access supports from anywhere in the world. Equipped with digital skills, people with intellectual disabilities can communicate with friends and family members via email, bookmark employment websites, and retrieve saved documents via cloud computing.

Third, the current study provided supports to facilitate work readiness skills. Digital communication is vital to establish connections with friends, communicate with coworkers, and network with other professionals. In this study, students were instructed to respond to emails, bookmark websites of interest, and store documents in the cloud for later use. The overarching goal of secondary education for students with ID is to prepare them to be productive, wage-earning citizens. To prepare for the competitive workforce, learners with ID must be equipped with digital skills such as using username and passwords, email usage, and internet access. As a component of Information and Communication Technology (ICT), digital communication is an important skill offering individuals with ID a means of communicating with others for work and/or leisure purposes. It can ease social isolation and advance academic, career, and leisure goals by connecting people with ID to a community of peers and a network of supports (Burgstahler, 2002). People with ID can use email to communicate and socialize with friends, family members, teachers, and employers. Email is the primary means of communication outside of school between employers and workers. Email has become an environment for conducting work, and for maintaining social life.

Participants of this study ranged in levels of ability, and all students were successful in acquiring the digital literacy skills. Students also indicated that the skills were useful and enjoyable, particularly emailing. These skills allow high school students the opportunity to communicate through email, to save important websites, and to obtain information and supports to complete academic and non-academic tasks. These are all necessary skills for students preparing to transition into life after school. They facilitate the job application process and can be used to increase numerous other educational skills.

Although this study indicated positive outcomes, conclusions must be interpreted within the context of this study and several limitations should be considered. The participating students in this study were all diagnosed with an intellectual disability, which limits generalizability to other populations. Further investigations that include participants with a wide range of characteristics are warranted.

A second limiting factor was response generalization. As the students were learning to email, they generalized entering their username and password to access and use cloud storage. Due to the number of shared steps of the task analysis, future studies can address this limitation by reducing the number of common steps among specific digital literacy skills. Third, the technology itself is a third limiting factor. Many students may be unfamiliar with digital tools such as social bookmarking and cloud computing. This would prevent the accessibility and use of these skills. Also, these applications require the use of internet access, preferably high speed internet access.

As the findings from the study suggest, incorporating functional digital literacy skills into curriculum for secondary students with intellectual disabilities may be effective at improving functional, academic, and independent living skills. Future research should include the establishment of a framework of recommended practices for educators to provide effective systematic instruction of these critical skills. Additional target skills should include instruction for using internet search engines, utilizing built-in accessibility features, and the use of mobile applications. Students also were provided an index card with their username and password until they could consistently enter their security information independently. A more advised security practice that assists students to create an easy to remember but challenging password is needed.

Although teaching digital literacy skills to students with mild to moderate ID is an ongoing endeavor for educators and requires sustained effort, this study demonstrates positive outcomes for the participating students. A stu-

dent's disability is not the defining characteristic of the participant, nor is it necessarily a barrier to digital literacy participation. The Internet can be a wonderful resource for students with ID. They can use it for school, communicating with others, searching for job opportunities, building a network of supports, and playing interactive games. Students who are old enough to type in a few letters on the keyboard can literally access the world. The first step in the digital literacy process is ensuring that students with ID can demonstrate various essential digital skills. This study demonstrated the feasibility of increasing digital literacy by teaching students how to use these skills effectively and over time. With the advancement of technology, accessibility features, and user-friendly design, people with ID can participate as active members of a digital society.

References

Alberto, P., Fredrick, L., Hughes, M., McIntosh, L., & Cihak, D. (2007). Components of visual literacy: Teaching logos. *Focus on Autism and Other Developmental Disabilities, 22,* 234–243.

Ault, M. J., & Griffen, A. K. (2013). Teaching with the system of least prompts: An easy method for monitoring progress. *Teaching Exceptional Children, 45*(3), 46–53.

Bawden, D. (2008). Origins and concepts of digital literacy. In: C. Lankshear & M. Knobel (Eds.), *Digital literacies: Concepts, policies and practices* (pp. 17–32). New York: Peter Lang.

Browder, D., Ahlgrim-Delzell, L., Spooner, F., & Baker, J. (2009). Using time delay to teach literacy to students with severe developmental disabilities. *Exceptional Children, 75,* 343–364.

Browder, D., Lee, A., & Mims, P. (2011). Literacy for students with multiple disabilities: Using systematic instruction, individualized responses, and assistive technology. *Education and Training in Autism and Developmental Disabilities, 46,* 339–351.

Browder, D. M., Wakeman, S., Spooner, E, Ahlgrim-Delzell, L., & Algozzine, B. (2006). Research on reading instruction for individuals with significant cognitive disabilities. *Exceptional Children, 72,* 392–408.

Bryen, D. N., Carey, A., Friedman, M., & Taylor, S. J. (2007). Cell phone use by adults with intellectual disabilities. *Intellectual and Developmental Disabilities, 45,* 1–9.

Burgstahler, S. (2002). Bridging the digital divide in postsecondary education: Technology access for youth with disabilities. *Addressing Trends and Development in Secondary Education and Transition, 1,* 1–4.

Carey A. C., Friedman M. G., & Bryen D. N. (2005). Use of electronic technologies by people with intellectual disabilities. *Mental Retardation, 43,* 322–333.

Cihak, D., Fahrenkrog, C., Ayres, K., & Smith, C. (2010). The use of video modeling via a video iPod and a system of least prompts to improve transitional behaviors for students with autism spectrum disorders in the general education classroom. *Journal of Positive Behavior Supports, 12,* 103–115.

Cihak, D. F., Kessler, K., & Alberto, P. A. (2007). Generalized use of handheld prompting systems. *Research in Developmental Disabilities, 28,* 397–408.

Cihak, D. F., Kessler, K., & Alberto, P. A. (2008). Use of a handheld prompting system to transition independently through vocational tasks for students with moderate and severe intellectual disabilities. *Education and Training in Developmental Disabilities, 43,* 102–110.

Cihak, D. F., Wright, R., & Ayres, K. M. (2010). The use of self-modeling static-picture prompts via a handheld computer to facilitate self-monitoring in the general education classroom. *Education and Training in Developmental Disabilities, 45,* 136–149.

Clendon, S. A., & Erickson, K. A. (2008). The vocabulary of beginning writers: Implications for children with complex communication needs. *Augmentative and Alternative Communication, 24,* 281–293.

Coleman, M. B., Hurley, K., & Cihak, D. F. (2012). Comparing teacher-directed and computer-assisted constant time delay for teaching functional sight words to students with moderate intellectual disabilities. *Education and Training in Autism and Developmental Disabilities, 47,* 280–292.

Collier, L. (2007). The shift to 21st-century literacies. *The Council Chronicle, 17,* 4–8.

Cooney, L. (2012). Essential apps for college students. *Think College E-News.* Retrieved on December 13, 2013, from http://www.thinkcollege.net/september-2012/essential-apps-for-college-students

Eshet, Y. (2004). Digital Literacy: A conceptual framework for survival skills in the digital era. *Journal of Educational Multimedia and Hypermedia, 13,* 93–106.

Davies, D. K., Stock, S., & Wehmeyer, M. L. (2002a). Enhancing independent task performance for individuals with mental retardation through use of a handheld self-directed visual and audio prompting system. *Education and Training in Mental Retardation and Developmental Disabilities, 37,* 209–218.

Davies, D. K., Stock, S., & Wehmeyer, M. L. (2002b). Enhancing independent time-management skills of individuals with mental retardation using a

palmtop personal computer. *Mental Retardation, 40,* 358–365.

Davies, D. K., Stock, S., & Wehmeyer, M. L. (2004). A palmtop computer-based intelligent aid for individuals with intellectual disabilities to increase independent decision making. *Research and Practice for Persons with Severe Disabilities, 28,* 182–193.

Ferguson, H., Myles-Smith, B., & Hagiwara, T. (2005). Using a personal digital assistant to enhance the independence of an adolescent with asperger syndrome. *Education and Training in Mental Retardation, 40,* 60–67.

Fichten, C. S., Asuncion, J., Barile, M., Fossey, M. E., Robillard, C., & Wolforth. J. (2001). Computer technologies for postsecondary students with disabilities II: Resources and recommendations for postsecondary service providers. *Journal of Postsecondary Education and Disability, 15,* 59–82.

Flores, M., Musgrove, K., Renner, S., Hinton, V., Strozier, S., Frankin, S., & Hil, D. (2012) A comparison of communication using the Apple iPad and a picture-based system. *Augmentative and Alternative Communication, 28,* 74–84.

Gast, D. L., & Ledford, J. (2010). Multiple baseline and multiple probe designs. In D. L. Gast, *Single subject research methodology in behavioral sciences* (pp. 276–328). New York, NY: Routledge.

Gilster, P. (1997). *Digital literacy.* New York: Wiley and Computer Publishing.

Happestad, B.S. (2007). Inadequacies in computer access using assistive technology devices in profoundly disabled individuals: An overview of the current literature. *Disability and Rehabilitation: Assistive Technology, 2,*189–199.

Individuals with Disabilities Education Act, 20 U.S.C. § 1400 (2004).

Jackson, R. M. (2005). *Curriculum access for students with low incidence disabilities: The promise of universal design for learning.* Wakefield, MA: Center for Applied Special Technology.

Johnson, G. M. (2007). Functional internet literacy: Required cognitive skills with implications for instruction. *E-Learning and Digital Media, 4,* 433–441.

Jones-Kavalier, R., & Flanigan, L. (2006). Connecting the digital dots: Literacy of the 21st century. *EDUCAUSE Quarterly, 29*(2), 8–10. Retrieved December 13, 2012, from: http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazineVolum/ConnectingtheDigitalDotsLitera/157395

Kagohara, D. M., Sigafoos, J., Achmadi, D., O'Reilly, M. F., & Lancioni, G. (2012). Teaching children with autism spectrum disorders to check the spelling of words. *Research in Autism Spectrum Disorders, 6,* 304–310.

Kagohara, D. M., Sigafoos, J., Achmadi, D., van der Meer, L., O'Reilly, M., & Lancioni, G. (2011). Teaching students with developmental disabilities to operate an iPod Touch to listen to music. *Research in Developmental Disabilities, 32,* 2987–2992.

Kagohara, D. M., van der Meer, L. Ramdoss, S., O'Reilly, M. F. Lancioni, G. E., Davis, T. N. . . . Sigafoos, J. (2013). Using iPods and iPads in teaching programs for individuals with developmental disabilities: A systematic review. *Research in Developmental Disabilities, 34,* 147–156.

Kliewer, C. (1998). Citizenship in the literate community: An ethnography of children with Down syndrome and the written word. *Exceptional Children, 64,* 167–180.

Kling, A., & Wilcox, J. (2010). Young children with physical disabilities: Caregiver perspectives about assistive technology. *Infants and Young Children, 23,* 169–183.

McMahon, D. D., Cihak, D. F., Gibbons, M. M., Fussell, L., & Mathison, S. (2013). Using a mobile app to teach individuals with intellectual disabilities to identify potential food allergies. *Journal of Special Education Technology, 28,* 21–32.

Mechling, L. C., Gast, D. L., & Seid, N. H. (2010). Evaluation of a personal digital assistant as a self-prompting device for increasing multi-step task completion by students with moderate intellectual disabilities. *Education and Training in Autism and Developmental Disabilities, 45,* 422–439.

National Center on Educational Statistics. (2001). *Computer and Internet use by children and adolescents in 2001.* Washington, DC: U.S. Department of Education.

National Council on Disability. (2011). *The power of digital inclusion: Technology's impact on employment and opportunities for people with disabilities.* Washington, DC.

No Child Left Behind (NCLB) Act of 2001, Pub. L. No. 107–110, § 115, Stat. 1425 (2002).

National Council on Disability. (2011). *The power of digital inclusion: Technology's impact on employment and opportunities for people with disabilities.* Washington, DC.

Palmer, S., Wehmeyer, M., Davies, D., & Stock, S. (2012). Family members' reports of the technology use of family members with intellectual and developmental disabilities. *Journal of Intellectual Disability Research, 56,* 402–414.

Pennington, R., Stenhoff, D., Gibson, J., & Ballou, K. (2012). Using simultaneous prompting to teach computer-based story writing to a student with autism. *Education and Treatment of Children, 35,* 389–406.

Ramdoss, S., Mulloy, A., Lang, R., O'Reilly, M., Sigafoos, J., Lancioni, G. E. . . . El Zein, F. (2011). Use of computer-based interventions to improve literacy skills in students with autism spectrum

disorders: A systematic review. *Research in Autism Spectrum Disorders, 5,* 1306–1318.

Redden, C. (2010). Social bookmarking in academic libraries: Trends and applications. *Journal of Academic Librarianship, 3*6, 219–227.

Spooner, F., Knight, V., Browder, D., & Smith, B. (2012). Evidence-based practice for teaching academics to students with severe developmental disabilities. *Remedial and Special Education, 33,* 374–387.

Szewczak, E. J., & Snodgrass, C. R. (2002). *Managing the human side of information technology: Challenges and solutions.* Hershey, PA: IGI.

Taber, T. A., Alberto, P. A., Seltzer, A., & Hughes, M. (2003). Obtaining assistance when lost in the community using cell phones. *Research and Practice for Persons with Severe Disabilities, 28,* 105–116.

Tanis, E. S., Palmer, S., Wehmeyer, M., Davies, D.K., Stock, S.E., Lobb, K., & Bishop, B. (*2012*). Self-report computer-based survey of technology use by people with intellectual and developmental disabilities. *Intellectual and Developmental Disabilities, 50,* 53–68.

U.S. Census Bureau. (2010). *Americans with disabilities: 2010.* Washington, DC: Government Printing Office.

Wehmeyer, M., Smith, S., Palmer, S., & Davies, D. (2004). Technology use by students with intellectual disabilities: An overview. *Journal of Special Education Technology, 19*(4), 7–21.

Received: 30 January 2014
Initial Acceptance: 1 April 2014
Final Acceptance: 26 July 2014