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Teaching individuals with intellectual disability to email across multiple device platforms☆

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ABSTRACT

The purpose of this study was to examine the use of email by people with intellectual disability across multiple technological devices or platforms. Four individuals with intellectual disability participated in this study. Participants were taught how to access and send an email on a Windows desktop computer, laptop, and an iPad tablet device. Results indicated a functional relation. All participants acquired and generalized sending and receiving an email from multiple platforms. Conclusions are discussed about the importance of empowering people with intellectual disability by providing multiple means of expression, including the ability to communicate effectively using a variety of devices.

1. Teaching individuals with intellectual disability to email across multiple device platforms

Basic digital literacy skills are now critical for one to function in today's rapidly changing, yet increasingly technologically oriented, society. Transforming every aspect of daily life, technology is intertwined with everything from work and educational settings to domestic and recreational settings. Routine tasks, once involving lengthy and complicated processes, are now easiest completed electronically, with the idea of boosting the productivity and convenience for the users. As more daily interactions (communication, purchasing, and applications) are converted to digital tasks, digital skills are becoming increasingly critical for their completion. Therefore, technology has the power to separate and exclude both socially and economically those individuals who lack the skills (Clark, 2004). According to Carruthers (2009), technology allows people to think differently, to experience life in ways they never have before, and to do things better and more easily. For people with intellectual disability (ID), acquiring and maintaining essential digital literacy skills facilitates greater independence in school, at home, in the community, and at work. In the interest of improving employment, independence, and overall quality of life, functional digital literacy skills should be specifically addressed as part of the educational programming for students with ID. This study examined one aspect of digital literacy, the use of email across multiple technological platforms.

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1.1. Technology and people with intellectual disabilities

Technological advances have afforded many people opportunities to gain access to information they otherwise may not have obtained, including people with disabilities. The positive outcomes of using technology for people with ID are well documented in the literature, such as enhanced communication systems, extensions of social networks, and greater overall independence, in addition to gains in academic and literacy skills (Browder, Wakeman, Spooner, Ahligrm-Delzell, & Algozzine, 2006). Previous research also supports the use of handheld mobile devices for students with ID to acquire and generalize a variety of community and vocational skills (Cihak, Kessler, Alberto, 2007, Cihak, Kessler, & Alberto, 2008; Davies, Stock, & Wehmeyer, 2002a,b, Davies, Stock, & Wehmeyer, 2004; Ferguson, Myles-Smith, & Hagiwara, 2005). Mobile devices (e.g. tablets, smartphones) are shown to be effective tools for empowering students with ID to live and work with greater independence (e.g., Cihak, Fahrenkrog, Ayres, & Smith, 2010; Kagohara et al., 2010; Mechling, Gast, & Seid, 2010; Van Larrhoven, Van Larhowen-Myers, & Zurita, 2007; Wade & Troy, 2001). Computers and mobile devices, such as tablets and smartphones, offer educators a highly customizable new way of providing the multiple means of representation to support the independence and inclusion of students with ID (McMahon & Smith, 2012).

Although the research supports that individuals with ID benefit from technology, it is known that this population does not always fully take advantage of what technology has to offer them (Happestad, 2007; Kling & Wilcox, 2010; Tanis et al., 2012). Carey, Friedman, and Bryen's (2005) survey of people with disabilities indicated that people with disabilities were less likely to have a computer in their home as someone without a disability. Moreover, only 18% of people with ID were reported to have a working email address (Palmer, Wehmeyer, Davies, & Stock, 2012). Since knowledge is generated largely through social interaction and social networking (i.e., "who you know"), digital communication skills may be as important as skill competency (i.e., "what you know").

1.2. Email use

Email 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). Stanford and Siders (2001) developed an email pen friend correspondence project. They found a significant effect in favor of email pen friends compared with conventional pen friends. Stanford and Siders suggested that while any kind of pen friend offers students a genuine and authentic experience, email pen friends receive more immediate feedback. Networked communication (i.e., initiating relationships and communicative interactions) is also useful as a means of facilitating participation in the mainstream digital world (Boyd & Ellison, 2008). For example, e-Buddies (www.ebuddies.org) is an email "pen friend" project designed to support people with ID to find and make friends on the Internet. If persons with ID are at a disadvantage with job networks, and if networks affect employment for persons with disabilities as they do the general population, then it is possible that a portion of the unemployment experienced by persons with ID is due to this lack of social networking (Potts, 2005). In addition to providing a means for more immediate electronic communication exchanges, an email address also increasingly functions like a digital passport for many different login systems and social networking sites like Facebook, Twitter and other web applications. "If disability narrows the set of jobs one is qualified to fill, then having the right channels of job contacts to get access to that smaller set of job opportunities may be even more crucial to employment success" (Potts, p. 22).

The ability to successfully use email across multiple platforms is an important life skill for people with ID. It increases access to communication tools regardless of the brand(s) of devices available and may reduce problems when new versions or operating systems occur (i.e., Windows 7 to Windows 8). In addition, the type of computer or mobile device available for individuals will vary between home, different computer labs, and the individual's personal mobile device. Therefore, the purpose of this study was to examine the effects of teaching college students with ID to access, send, and receive emails across behaviors or different platform devices. A secondary goal was to teach students that their university-based email account could be accessed from any computer or device with an Internet connection. Specifically, we wondered will college students with ID acquire, maintain, and generalize emailing skills independently across multiple platforms?

2. Methods

2.1. Participants and settings

The participants in this study were four college students with ID, who attended a Post-Secondary Education (PSE) program. All were eligible for special education services under IDEA during grades K-12. All of the students were diagnosed with intellectual disability. The students' ages ranged from 21 to 23 years old. Participants were selected based on the following: (a) diagnosis of an intellectual disability, (b) participation in a post-secondary education program, (c) no email address, (d) no physical disability which impeded the performance of the skill, and (e) agreeing to participate in the study. Also, students reported they could only check their university email with computers on the campus. Three males (Ben, Carl, and Dylan) and one female (Ann) participated in this study. Participants' IQ ranged from 51 to 70 and adaptive behavior standard scores ranged from 65 to 71. Table 1 lists characteristics for each participant. In addition, all participants had at least a fourth grade reading level according to the Brigance Transition Skills Inventory (Brigance, 2010).

Table 1
Participants' characteristics.

Participants	Age	Intelligence (standard scores)	Adaptive (standard scores)
Ann	21	53[a]	65[d]
Ben	22	65[b]	70[d]
Carl	23	51[a]	69[e]
Dylan	22	70[c]	68[f]

[a] Wechsler Intelligence Scale for Children-III (WISC-III).
[b] Stanford-Binet Intelligence Scales, 5th ed.
[c] Woodcock-Johnson III (WJ III) Tests of Cognitive Abilities (WJ III COG).
[d] Vineland Adaptive Behavior Scales-II, Second Edition.
[e] Adaptive Behavior Assessment System.
[f] Behavior Assessment System for Children II.

Each of the four students had minimal experience with the technologies used in the intervention. All four students were familiar with the basic functions of a Windows desktop computer (i.e., powering on and off, using a mouse to click desired icon, and using the keyboard) through exposure to computers in high school classes, and through use of their personal Windows desktops at home. None of the students owned a laptop computer or iPad®, or had previous experience with the Apple® MacBook Pro at the onset of this study. Additionally, all students had limited experience with email. Although the students had email accounts during high school, none of the students were able to independently access their email accounts prior to the intervention. One student (Dylan) owned a smartphone but did not use it to access or compose emails. The other three students (Ann, Ben, and Carl) used traditional cell phones without Internet access or other smartphone features. All four students were familiar enough with the keyboard layout to independently type responses, though none of the students had ever taken a formal typing course.

Each student was assigned a peer tutor as part of the PSE program. The peer tutors worked with the students on course assignments, projects, and overall organizational skills. The peer tutors were undergraduate students enrolled in various programs and areas of study, including education, business, science, and communication. Peer tutors were required to participate in a three-hour training regarding the expectations of students and the PSE program, and working with college students with ID.

The setting was a university-based PSE program for college students with ID and autism spectrum disorders (ASDs). Each student attended traditional university courses for audit credit as well as participated in a work-based internship for approximately four to eight hours weekly. Students also attended special topic courses designed specifically for college students with ID, which included life skills, career development, and digital literacy skills. All phases of this study occurred in a university computer lab on campus where students met for their digital literacy course. The digital literacy course met three times per week for 50-min sessions. The course instructor was a doctoral student in special education who implemented all phases of this study. A total of eight students were enrolled in this class. All eight students had ID and all were full-time students in the PSE program.

2.2. Materials

The students had access to the same technology resources available to all university students. The university provided every student with a university system login called a NetID. The NetID allowed access to a university managed email system reached through links on the university webpage or through typing the address directly in the address bar of the Internet browser.

Access to this system was made available on any computer with an Internet connection. From the university homepage, the university email system was selected from a drop down menu. The student's university email address served as their traditional email address for communication and as a universal login for many university resources like computer labs, printing, registration and the course management system (i.e., blackboard).

The three platforms used in this study were selected because of their shared commonality in both educational and professional environments. A Windows desktop computer was the first platform selected for introducing the students to email because it was the computer model used during their digital literacy course. It was also the most common computer available in the university labs. The version of the Windows operating system (OS) was Windows 7, and the default browser used by the students was Internet Explorer. All of the Windows desktop computers featured 22-inch monitors and a standard keyboard and mouse.

The second platform was an Apple® MacBook Pro Laptop selected to examine each student's ability to generalize accessing and using email. Students who used the laptop to access and send emails from a variety of settings including the cafeteria, library, coffee shop and other common areas on campus. The laptops used ran the Lion version of OSX, and the students used the Apple® Safari browser to access the university email service web portal. In addition to the portability provided, the MacBook laptop offered several significant differences in hardware and user interface. The laptop featured a clickable touchpad located below the keyboard instead of an external mouse. Similar to the desktop, the icons for programs

and files were located along the bottom of the screen, but were scrollable and dynamic compared to the static dock of a windows computer. Differences in the two Internet browsers were minimal, and there were no visual differences once inside the university email system.

The third platform was an Apple® iPad 2 tablet running the iOS 5.1 version of the software, and Safari was the default browser. Similar to the laptop, students used the iPad to access and send emails from a variety of settings including the cafeteria, library, and other common areas on campus. The iPad platform offered the greatest differences in device and user interface compared to the two previous platforms, including the addition of a touch-responsive screen to replace any external hardware, such as a keyboard, touchpad, or mouse, adding to the portability and handheld nature of a tablet device. Similar to the previous platforms, the icon for the Safari browser was located at the bottom of the screen, but was tapped with the user's finger directly on the screen. Differences in the layout of the Internet browser were minimal, but there were several major differences in the text input process including touch typing using the onscreen keyboard, and the addition of predictive text features. We decided to have students access their email through the Internet browser rather than using the native email app to ensure a consistent login process across platforms, as well as to alleviate set-up procedures on a borrowed device.

Due to the login requirements to successfully sign into an email account, it was decided to provide non-contingent access to the student's username/email address and password to increase the likelihood of students performing later skill steps independently during baseline. Students were provided with an index card with their username/email address and password printed in a 14 point font for reference. As students consistently entered their username/email address and password independently (i.e., 3 consecutive sessions), the index card was stored in a locked cabinet for security purposes although students could still request the card at any time. In addition, screenshots of each task-analyzed step were created, printed and used to illustrate how to access, reply, compose, and send an email using each device. Screenshots of each motor demonstration step were used as visual prompts and incorporated during the digital literacy instruction phase.

2.3. Variables and data collection

Event recording procedures were used to record the number of task-analyzed steps completed independently to access, respond, compose, and send an emial. The number of task-analyzed steps completed independently was divided by the total number of steps to calculate a percentage of task analyzed steps completed independently. Table 2 lists the task-analyzed steps including (a) accessing the email account, (b) responding to an email, and (c) composing a new email to a peer tutor. A total of 21 task-analyzed steps were required to email independently. 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. If a student did not independently initiate the first step within 10 s or complete a subsequent step within 30 s, teacher assistances were implemented using a system of least prompts (Ault & Griffen, 2013).

To assess if each student replied to an email, the instructor emailed each student one question which required a reply. The instructor sent three separate emails, each asking a different question, targeting each of the three different devices by specifying in the email subject line either "reply using a desktop", "reply using the laptop", or "reply using the iPad". The instructor asked one factually based question per email message sent (e.g., what classes do you have today, where did you have lunch, what time are you leaving campus, who won the football game Saturday?). By asking factually based questions that required a response, it was determined if students read and comprehended the email based on their reply.

To assess if each student composed and sent an email to a peer tutor, the peer tutor forwarded the student's email to the instructor and a graduate assistant. If an email was not sent, then the peer tutor emailed the instructor and graduate assistant indicating that no email from the student was received on that day.

The instructor recorded the data and implemented all instructional procedures for all sessions. One session occurred three times per week at the beginning of the digital literacy course, except during baseline and maintenance phases. During baseline and maintenance phases, students were probed emailing using the different devices on the same day. Devices were randomly assigned to each student to reduce potential order effects.

Maintenance data were collected nine weeks after the student reached acquisition criteria. Similarly, event recording procedures were used to record the number of task-analyzed steps completed independently or with teacher assistance and

Table 2
Task analysis of accessing, replying and sending an email.

Skills	Task analysis
Accessing email	(1) Turn-on device; (2) Type netid to login into computer; (3) Type password to login into computer; (4) Click Internet Browser; (5) Click email icon on homepage; (6) Type netid; (7) Type password;
Responding to email	(8) Click email to open from instructor; (9) Read email; (10) Click reply; (11) Compose email; (12) Reread email; (13) Click send; (14) Accurately responded to instructor's question;
Sending an email	(15) Click new message, or compose; (16) Enter recipient's email address; (17) Enter subject of email; (18) Compose email; (19) Reread email; (20) Click send button; (21) Click sign out

then calculated as the percentage of task analysis steps completed independently for each student. During the nine weeks, students continued to use email.

2.4. Research design

A multiple probe design across different devices or platforms was used to examine the effects of digital literacy instruction to access, respond to, and send an email independently. This modified variation of the multiple probe design allowed the introduction of the intervention to be staggered across time. By introducing the intervention sequentially across time for a minimum of three phases repetition a more valid causal inferences are possible (Horner et al., 2005; Kratochwill et al., 2010). After students reached criteria of accessing, responding, composing, and sending an email on the first platform (desktop), the second platform (laptop) was introduced. Likewise, the third platform (iPad) was introduced contingent on reaching criteria on the second platform. Criteria were defined as accessing and sending an email with 100% independence for three consecutive sessions.

2.5. Procedures

2.5.1. Baseline

During baseline, all students were registered for an email account including a username and password. Students were instructed to select a password they could easily remember and change their default passwords. Username and password information was printed on an index card and provided to each student to increase the likelihood of each student demonstrating the most skills possible during the baseline phase. Baseline sessions occurred in a computer lab, where students sat in front of individual Windows desktop computers. The digital literacy skills course instructor asked the students to check their email at the beginning of class with the statement "It's time to start class. Please check your email". Students were cued to access their email account, reply to the email sent by the instructor, and compose an email to a peer tutor. Students were given 10 s to initiate the first step of the task analysis after being cued to "check your email" and 30 s to complete each subsequent step. Baseline probes were discontinued after 5 min of no response. Although students were prompted to check their email, no additional assistance was provided. Also, no external or tangible reinforcement was given. The baseline phase continued for a minimum of three days or until stability was achieved.

2.5.2. Digital literacy instruction phase

After the baseline data stabilized, digital literacy instructional procedures were systematically implemented. First, digital literacy instructional procedures targeted emailing from a desktop, then a laptop, and finally an iPad. Prior to the class, the instructor emailed each student a factually based question and typed in the subject line either "reply using a desktop", "reply using the laptop", or "reply using the iPad".

The instructor reviewed each screenshot and verbally described each task-analyzed step three times using total-task chaining procedures regarding how to access, reply, compose, and send an email using the targeted platform (i.e., desktop, laptop, or iPad). This review and demonstration occurred during one class session. Afterwards, each student practiced accessing, replying, composing, and sending an email using the targeted platform. Similar to baseline, students were given 10 s to initiate the first step of the task analysis after being cued and 30 s to complete each subsequent step. However, if the student did not initiate the first step independently within 10 s or complete a step within 30 s, then a least-to-most prompt hierarchy was implemented contingently until the student independently performed the step. A 4 s interval between each prompt level was implemented. The least-to-most prompt hierarchy consisted of the following levels across instructional trials: (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.

The instructor continued to cue students at the start of each digital literacy class to check their email with the prompt, "It's time to start class. Please check your email". Additionally, students were cued to compose and send a new email message to a peer tutor. Acquisition criterion was defined as 100% independent performance for three consecutive sessions. After the student reached criteria for accessing, replying, composing, and sending an email using a desktop, the instructor implemented digital literacy procedures to email using the laptop, and finally an iPad.

2.6. Maintenance

Nine weeks after initial acquisition, all students were sent three different emails from their instructor that required a response using each of the three platforms. Students used each platform to access and send the reply. Students also were prompted to send a peer an email. The purpose of the maintenance phase was to assess the long-term effects of accessing,

responding and sending emails using different devices. During the nine weeks between probing acquisition and generalization, students continued to send and receive emails.

2.7. Interobserver agreement (IOA) and treatment fidelity

Two graduate assistants 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 instructor 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 instructor was required to provide access to the computer and instruct students to access, reply and send an email. The instructor was observed providing instruction including reviewing screen captions and demonstrating each skill while providing verbal explanations. In addition, the instructor implemented the system of least prompts with a 4 s 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 95%, 88%, 95%, 98%, and 90% for Anne, Ben, Carl, and Dylan, respectively. The majority of disagreements occurred as a result of not waiting a full 4 s before introducing the next level of prompt.

3. Results

Overall, the students completed a mean of 25% of the task analyzed steps independently using the desktop, 24% using a laptop, and 16% using an iPad during baseline. Students required a mean of seven sessions to email independently with a mean of 86% of the task analyzed steps completed independently using the desktop, a mean of five sessions to independently email with a mean of 94% of the task analyzed steps completed independently using a laptop, and a mean of five sessions to independently email with a mean of 89% of the task analyzed steps completed independently using an iPad. Across all platforms, Ann, Ben, Carl, and Dylan immediately acquired accessing and sending an email with 100% nonoverlapping data. In addition, all students responded accurately to the instructor's questions indicating they comprehended the email message and maintained emailing nine weeks later.

3.1. Ann

Fig. 1 displays the percentage of task analyzed steps Ann completed independently for accessing and sending an email across the desktop, laptop and iPad platforms or devices. During baseline, Ann completed a mean of 18% of the task analyzed steps independently using the desktop. She required nine sessions to email independently with a mean of 91% (range = 77–100%). Using the laptop, Ann completed a mean of 17% of the steps during baseline. She required five sessions to email independently using a laptop with a mean of 95% (range = 81–100%). Using the iPad, Ann completed a mean of 6% of the steps during baseline. She required six sessions to email independently using an iPad with a mean of 91% (range = 72–100%). Across all platforms, Ann immediately acquired accessing and sending an email with 100% nonoverlapping data. In addition, Ann responded accurately to the instructor's questions and maintained emailing nine weeks following initial acquisition.

3.2. Ben

Fig. 2 displays the percentage of task analyzed steps Ben completed independently for accessing and sending an email across the desktop, laptop and iPad platforms. During baseline, Ben completed a mean of 29% of the task analyzed steps independently using the desktop. He required eight sessions to email independently with a mean of 75% (range = 36–100%) of the task analyzed steps completed independently. Using the laptop, Ben completed a mean of 26% of the steps during baseline. He required five sessions to email independently using a laptop with a mean of 93% (range = 72–100%). Using the iPad, Ben completed a mean of 15% of the steps during baseline. He required five sessions to email independently using an iPad with a mean of 88% (range = 58–100%). Across all platforms, Ben immediately acquired accessing and sending an email with 100% nonoverlapping data. In addition, Ben responded accurately to the instructor's questions and maintained emailing nine weeks later.

3.3. Carl

The percentage of task analyzed steps Carl completed independently for accessing and sending an email across the desktop, laptop and iPad platforms is displayed in Fig. 3. During baseline, Carl completed a mean of 27% (range = 19–34%) of

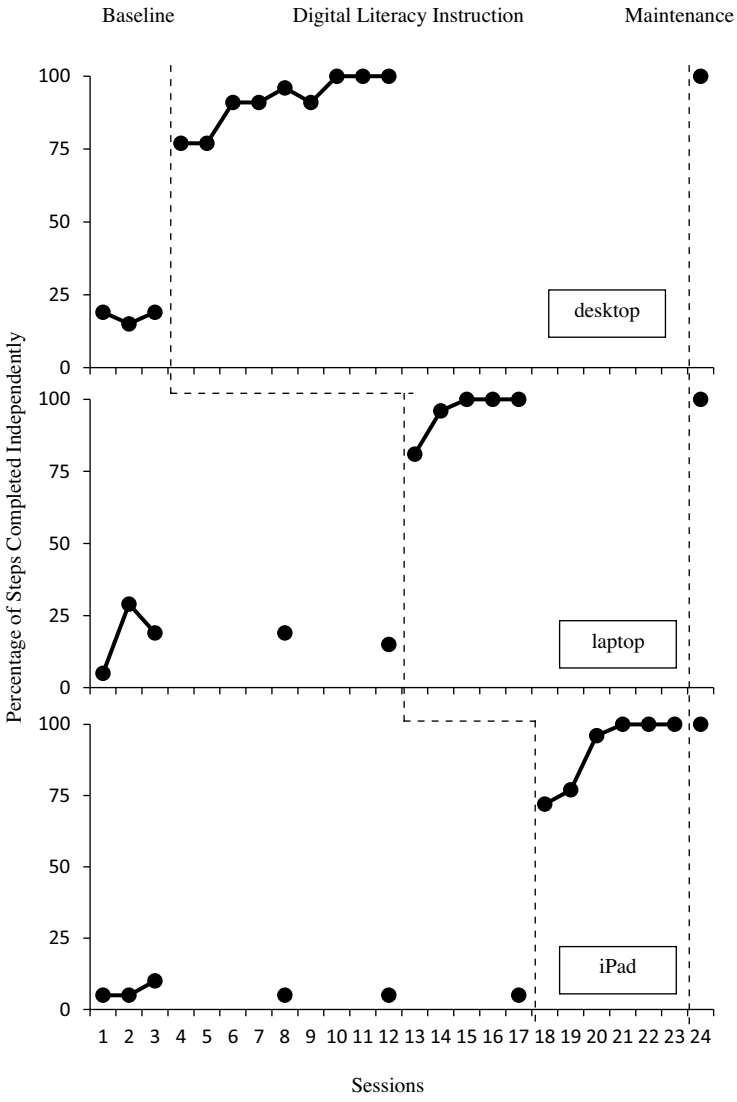

Fig. 1. Ann's percentage of task analyzed steps completed independently.

the task analyzed steps independently using the desktop, 26% (range = 10–38%) using a laptop, and .8% (range = 0–5%) using an iPad. He required seven sessions to email independently with a mean of 84% (range = 48–100%) using the desktop, seven sessions to independently email with a mean of 89% (range = 72–100%) using a laptop, and seven sessions to independently email with a mean of 79% (range = 29–100%) using an iPad. Across all platforms, Carl immediately acquired accessing and sending an email with 100% nonoverlapping data. In addition, Carl responded accurately to the instructor's questions and maintained emailing nine weeks later.

3.4. Dylan

The percentage of task analyzed steps Dylan completely independently for accessing and sending an email across the desktop, laptop and iPad platforms is displayed in Fig. 4. During baseline, Dylan completed a mean of 26% (range = 10–38%) of the task analyzed steps independently using the desktop, 23% (range = 15–29%) using a laptop, and 10% (range = 10%) using an iPad. He required six sessions to email independently with a mean of 92% (range = 72–100%) using the desktop, five sessions to independently email with a mean of 96% (range = 86–100%) using a laptop, and four sessions to independently email with a mean of 95% (range = 81–100%) using an iPad. Across all platforms, Dylan immediately acquired accessing and sending an email with 100% nonoverlapping data. In addition, Dylan responded accurately to the instructor's questions and maintained emailing nine weeks later.

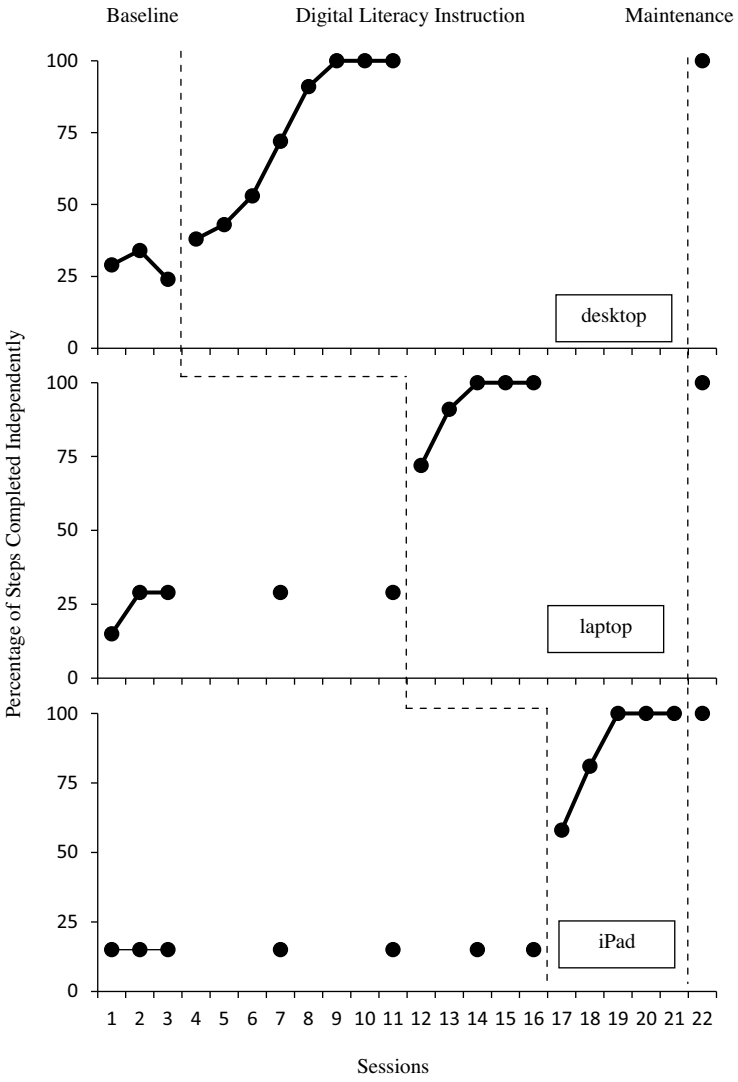

Fig. 2. Ben's percentage of task analyzed steps completed independently.

4. Discussion

This study sought to examine the acquisition, generalization and maintenance effects of teaching digital literacy skills to college students with ID to access, send and receive emails across different platform devices. The results were straightforward. All participants acquired and maintained the skills necessary to email using different platforms and devices. All participants demonstrated substantial increases in their performance of digital literacy skills. In addition, participants demonstrated that they could access their email account from any computer or device, as well as responded accurately to their instructor's email indicating they comprehended the email message. A functional relation was established since experimental control occurred by demonstration of data variation patterns in at least three different series in time between improved email skills and the introduction of digital literacy instructional procedures (Horner et al., 2005).

In a sense, an email address is mandatory for a person to exist in the digital society of today. Learning to use email is a first step in the digital literacy process. All participants readily acquired and generalized accessing and sending emails. Although the primary purpose of an email is to communicate electronically with others, an email also functions like a passport to various login systems. A working email is often required to download software or join an online community. Most participants were familiar with some of the steps of emailing but were unable to complete all steps independently. With the implementation of digital literacy instruction, which included, systematic prompting and task analysis procedures, all participants acquired and maintained sending emails using a desktop Windows computer, an Apple® MacBook Pro Laptop, and an iPad 2 tablet.

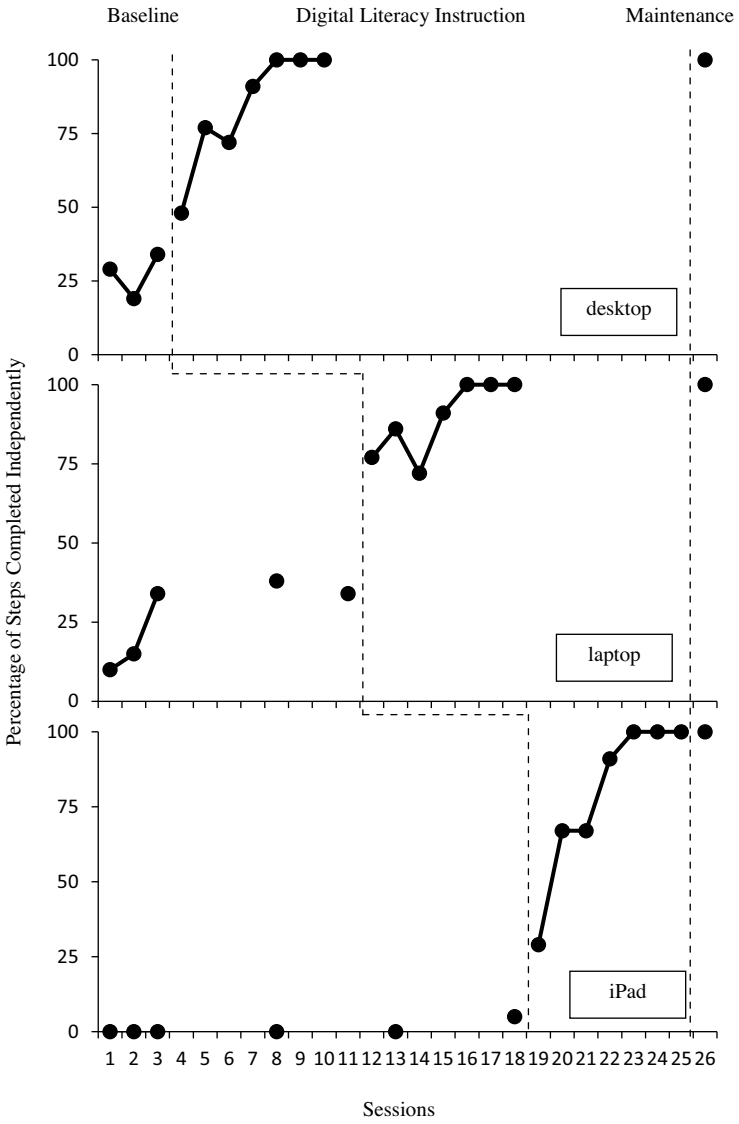

Fig. 3. Carl's percentage of task analyzed steps completed independently.

All participants required more instructional sessions to learn how to email using the Windows desktop computer independently. This was expected since this was a new skill for all students. Typical errors observed included clicking the incorrect button for creating a new email message, mistyping the email address, and errors typing login and password information. During instruction, students usually required verbal or gestural prompt when errors occurred. However, most students required verbal, gestures, and modeling when using the iPad. The additional supports were likely a result of the differences between the touch screen mobile device and keyboard. The onscreen keyboard required students to navigate additional menus to find certain keys including number keys and the "@" symbol. Once the participants completed the initial steps of the task analysis, however, they were able to accurately complete most of the steps of the process independently. Our research demonstrates that students with ID can learn and maintain knowledge about how to navigate email communication across a variety of computer systems.

Unfortunately, very little research exists on how networked communication might help students with ID. Bauer and Ulrich (2002) reported the use of handheld computers to engender social support for students with disabilities, though they cautioned that the teacher must manage their use. Abbott (2002) also considered the management difficulties in using technology for communication. The unmoderated and uncensored nature of on-line chat, for example, may render it inappropriate for educational purposes. Yet the equalizing effect it offers some students with ID clearly makes it a valuable educational resource. Abbott (2002) recommended careful planning before embarking on

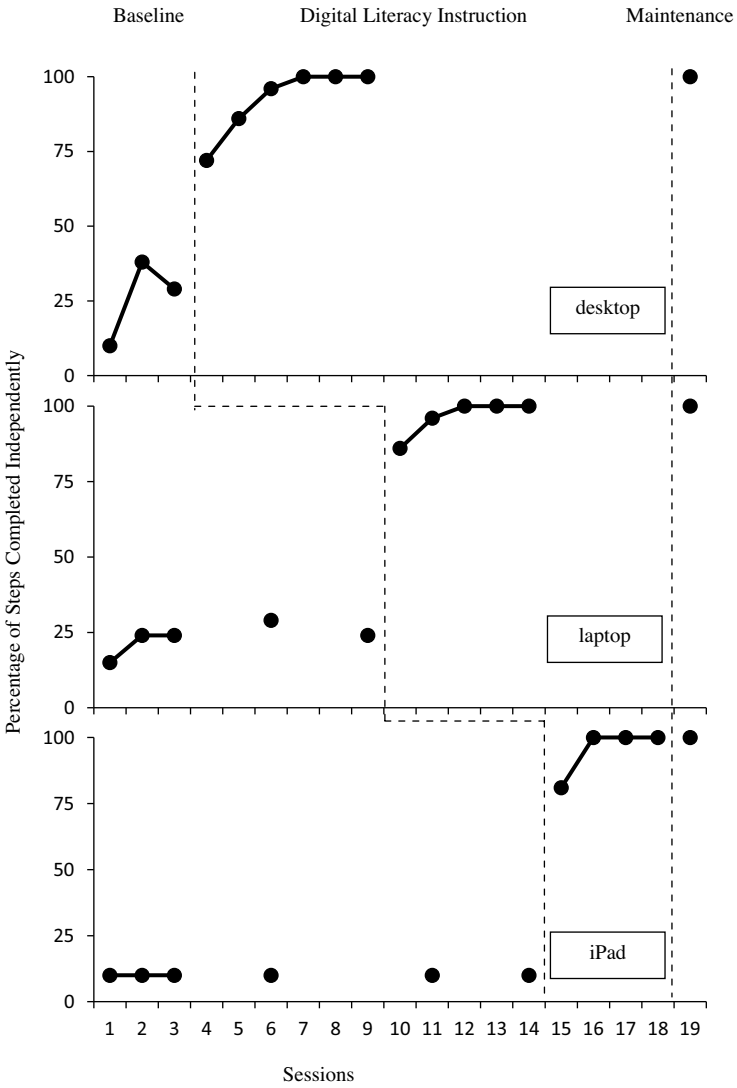

Fig. 4. Dylan's percentage of task analyzed steps completed independently.

communication projects. Educational projects should involve people who know each other (for example, teachers from other schools) and the use of filtering software on the school network. Means (1994) suggested that the tools and communication devices of technology do not have value in and of themselves. Rather, their instructional value lies in the educational activity that uses the tools and communication devices, an activity that must be planned by the teacher.

Although this study indicated positive outcomes, conclusions must be interpreted within the context of this study and several limitations need to be considered. For example, the location of this study occurred on a college campus with Wi-Fi access. In addition, only a small number of students participated, similar to other single-subject design studies. The small size makes it difficult to generalize the results to a broader population. This study requires replication across a larger number of participants. Participating students also were diagnosed with ID. People with ID are a heterogeneous population and other individuals that present a range of characteristics require examination.

Future research is needed related to those with varying literacy skills. Each participant in the current study had a minimum of a fourth grade reading level and had some previous experience using computers and the iPad for leisure purposes. Although literacy skills are important for student success in communicating through email, not all students with ID demonstrate this level of literacy. However, there are many assistive technology devices and software available to help people with disabilities communicate (e.g., speech-to-text and text-to-speech software, word prediction, electronic language boards, voice synthesizers and voice recognition software), so future research might examine this teaching technique with those requiring additional accommodations.

In addition, teachers can use email and other digital skills (e.g., social media, cloud computing) as a context to teach academic and life skills. Future research should investigate the use of digital media on specific skills such as language and communication, literacy, problem solving, and social interactions. Communication networks that allow groups of learners to communicate may also provide a context for developing other critical skills. For example, bulletin boards, e-mail and chat rooms are common examples of how networks can be used. However, access can also pose hazards. Future research also should examine how people with ID can use the Internet safely regarding who they meet, and what they share about themselves online.

5. Implications and conclusions

Familiarity with a variety of communication devices for students with intellectual disability increases their educational, employment, and independent living skills. People who are adept at using available technology are less likely to be isolated because of an inability to communicate. The implications are particularly significant for employment because the effects of networking spread beyond the employer – employee nexus. Social network participation also is likely to heavily influence job satisfaction, job retention, and career advancement, as well as alternative routes for finding job availability. Because computer technologies are used for both leisure and work on a daily basis, digital literacy is a critical life skill to live independently. By teaching students with ID to use multiple devices and methods of assessing email web applications, we hope to prepare them to access information using multiple existing technology devices and to use emerging technologies. User interface systems change and evolve over time as new technologies are developed; therefore, students with ID need to understand that not all systems operate in the same way. Rapidly changing technology including new devices and software compels educators to prepare students to be fluent in essential digital literacy skills and to be adaptable in a variety of communication options. By preparing students with ID to be fluent in a variety of devices, interface systems, and platforms, teachers can increase the likelihood of students continued practice of digital literacy skills and maintaining current skills with the ever changing future technologies.

References

Abbott, C. (2002). Making communication special. In C. Abbott (Ed.), *Special Educational Needs and the Internet: Issues for the Inclusive Classroom* London: Routledge/Falmer.

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

Bauer, A., & Ulrich, M. (2002). I've got a palm in my pocket. *Teaching Exceptional Children, 35*(2), 18–22.

Boyd, D. M., & Ellison, N. B. (2008). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Instruction, 13*, 210–230. http://dx.doi.org/10.1111/j. 1083-6101.2007.00393.x

Brigance, A. H. (2010). *Brigance transition skills inventory*. North Billerica, MA: Curriculum Associates.

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

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*(2), 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.

Carruthers, G. (2009). Engaging music and media: Technology as a universal language. *Research and Issues in Music Education, 7*(1), 1–9.

Cihak, D. F., Fahrenkrog, C. D., Ayres, K. M., & 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 Interventions, 12*, 103–115. http://dx.doi.org/10.1177/1098300709332346

Cihak, D. F., Kessler, K., & Alberto, P. A. (2007). Generalized use of handheld prompting systems. *Research in Developmental Disabilities, 28*, 397–408. http://dx.doi.org/10.1016/j.ridd.2006.05.003

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.

Clark, A. (2004). The mosaic approach and research with young children. In V. Lewis, M. Kellett, C. Robinson, S. Fraser, & S. Ding (Eds.), *The reality of research with children and young people*. London: Sage.

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. http://dx.doi.org/10.1352/0047-6765 (2002040<358:EITMSO>2.0.CO;2

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. http://dx.doi.org/10.2511/rpsd.28.4.182

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.

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. http://dx.doi.org/10.1080/17483100701249540

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). *The use of single-subject research to identify evidence-based practice in special education exceptional children, 71*, 165–179. http://dx.doi.org/10.1177/001440290507100203

Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., et al. (2010). *Single-case designs technical documentation*. Retrieved from: What Works Clearinghouse website: http://ies.ed.gov/ncee/wwc/pdf/wwc_scd.pdf

Kagohara, D. M., van der Meer, L., Acmadi, D., Green, V. A., O'Reilly, M. F., Mulloy, A., et al. (2010). Behavioral intervention promotes successful use of an iPod-based communication device by an adolescent with autism. *Clinical Case Studies, 9*, 328–338. http://dx.doi.org/10.1177/1534650110379633

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

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.

McMahon, D., & Smith, C. C. (2012). Universal design for learning: Implications and applications in UT Knoxville FUTURE Program. *Insight, A Think College Brief On Policy, Research, & Practice, 14*, 1–4.

Means, B. (1994). *Technology and education reform: The reality behind the promise*. San Francisco, CA: Josssey-Bass.

Pamler, S. B., Wehmeyer, M. L., Davis, D. K., & Stock, S. E. (2012). Family members' reports of the technology use of family members with intellectual and developmental disabilities. *Journal of Intellectual Disability Research, 56*, 402–414. http://dx.doi.org/10.1111/j. 1365-2788.2011.01489.x

Potts, B. (2005). Disability and employment: Considering the importance of social capital. *Journal of Rehabilitation, 71*(3), 20–25.

Stanford, P., & Siders, J. A. (2001). E-pal writing. *Teaching Exceptional Children, 34*(2), 21–24.

Tanis, E. S., Palmer, S., Wehmeyer, M., Davies, D. K., Stock, S. E., Lobb, K., et al. (2012). Self-report computer-based survey of technology use by people with intellectual and developmental disabilities. *Intellectual and Developmental Disabilities, 50*, 53–68. http://dx.doi.org/10.1352/1934-9556-50.1.53

Van Laarhoven, T., Van Laarhoven-Myers, T., & Zurita, L. M. (2007). The effectiveness of using a Pocket PC as a video modeling and feedback device for individuals with developmental disabilities in vocational settings. *Assistive Technology Outcomes and Benefits, 14*(1), 28–45.

Wade, T. K., & Troy, J. C. (2001). Mobile phones as a new memory aid: A preliminary investigation using case studies. *Brain Injury, 15*, 305–320. http://dx.doi.org/10.1080/026990501750111256