DO IPAD APPLICATIONS HELP STUDENTS WITH DEVELOPMENTAL DISABILITIES IMPROVE LIFE-READINESS SKILLS?

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ABSTRACT

Students with developmental disabilities often struggle with life-readiness skills (e.g., literacy skills such as reading and writing, task completion, and communication), which also help prepare students for the workplace. Assistive technology tools offer these students a means to do better in these areas. In this action-research study, we provided students with developmental disabilities (N=9) who were transitioning out of secondary school with iPad applications (apps) that could help them improve their life-readiness skills. The Common Core State Standards’ overall objective is students’ college and career readiness by the end of secondary school. While collecting qualitative and quantitative data across the 2012-2013 academic years, a group of educators worked with the students and their parents to help them learn and apply the iPad apps for life-readiness skills. The results indicated that all students improved in life-readiness skills. Ideas for future research as well as limitations of this study are also discussed.

KEYWORDS: Developmental disabilities, iPad applications, Life-readiness skills, Technology, Transition

Individuals with disabilities are increasing their use of technology as part of their education and daily life (Alper & Raharinirina, 2006; Palmer, Wehmeyer, Davies, & Stock, 2012). The Common Core State Standards (National Governors’ Association Center for Best Practices, 2010) include the use of technology for writing and other tasks beginning in the second grade (Graham & Harris, 2013). Technology has great potential for improving the
Capabilities and quality of life of people with disabilities (Alper & Raharinirina, 2006). Tablets and smartphones have eReader functions; for example, those offer students an option of listening to a text (e.g., website, eBook) in lieu of having to decode it. Mobile applications can also help with calendaring and step-by-step management of a task (e.g., YouTube videos illustrating task steps) such as making a cup of coffee. Social media applications promote students’ engagement with classmates, family, friends, and the general community. In the United States, federal legislation, such as the Individuals with Disabilities Education Improvement Act (IDEIA, 2004) and the Assistive Technology Act of 2004, requires that schools consider the use of assistive technology devices (e.g., a device or strategy) for students with disabilities as part of the planning process of their individual educational program (Alper & Raharinirina, 2006). The aim of this study was to provide transition-age (18-21) students who had developmental disabilities, with iPad tablets and applications (apps) that could help improve their management of life-readiness skills (e.g., reading, writing, task completion, and communication) that lead to work readiness.

For several decades, research has supported the use of technology to assist students enhance their learning experiences within and beyond the classroom. Most recently, research documents show how students with disabilities can have improved learning experiences and outcomes via technology (Bouck, Maeda, & Flanagan, 2012; Mechling, 2007). The use of a variety of technology (e.g., video, writing software, word processor, and other applications) demonstrates the effectiveness for academic, transitional skills, and employment outcomes for individuals with disabilities (Alper & Raharinirina, 2006; Sauer, Parks, & Heyn, 2010). The process of teaching students how to apply strategies with technology tools can be empowered through the use of Graham and Harris’ (1989) self-regulated strategy development (SRSD) model. Through teacher modeling, guided practice, and students' progressive independence in using a mobile app, students can apply it to one or more aspects of daily life.

Mobile technologies (e.g., tablet computers, like iPad, iPod, or smartphones, like iPhone, etc.) are smaller, newer, and advanced computing devices that students can use; educational researchers have been exploring how to help students improve in their effective use as technologies continue to advance (Edyburn, 2013; Kagohara et al., 2013; Rodriguez, Strnadová, & Cumming, 2014). Compared to some mobile technology devices, the iPad is relatively new given its introduction in April 2010 (Edyburn, 2013).

Kagohara et al. (2013) conducted a systematic review of literature from 2008 to 2012 on 15 studies using mobile devices/portable multimedia devices (e.g., iPad, iPod, and iPhones) to help students with developmental disabilities (e.g., autism spectrum disorders, intellectual disabilities) in five domains of skills: academic, communication, employment, leisure, and transition across school settings. Among these studies, only one was found to address academic in spelling words and two were found to address the employment domains. Palmer et al. (2012) indicated that research on the use of iPad technology and its effectiveness for communication and learning purposes is needed for all ages of individuals with developmental and intellectual disabilities. Therefore, in order to support the
widespread adoption of this device, more empirical evidence is needed (Cumming, Strnadosá, & Singh, 2014).

**Technology and Life-Readiness Skills**

Students with disabilities (e.g., developmental disabilities) often experience a low sense of self-regulation and self-efficacy for attaining and managing tasks in life such as work contexts due to having weak literacy skills (Dalgin & Bellini, 2008). In Phelps and Hanley-Maxwell’s (1997) review of the academic literature about school-to-work transition needs for students with disabilities, key themes were work readiness, literacy, and basic academic skills. Jones and Buchholz (2014), in a single subject design study with a student who had a developmental disability, found that iPad apps can help these students better manage their break time, face recognition of colleagues, and completion of work tasks.

As for our study, a means to assess progress over time with mobile app skills is curriculum based measurement (CBM; Deno, 2003) where skills are assessed based on each student’s zone of proximal development (Vygotsky, 1986). Students’ percentage of correct responses, for example, can be noted and then compared to a later point in time to assess the amount of change in ability. Literacy and other life-readiness skills (e.g., task completion) are types of skills that map well into this type of assessment process as the number of words written or work criteria met can be counted and compared/scored by a metric such as within one minute or total score possible.

Van Laarhoven, Johnson, Van Laarhoven-Myers, Grider, & Grider (2009) conducted a study to teach one individual who was 17 years old with developmental disabilities to complete three tasks (e.g., cleaning restroom, mopping floor and emptying trash, and cleaning kennels) using video segments on an iPod in a community-based employment setting (i.e., animal shelter). The purpose of Van Larrhoven et al.’s study was to evaluate the effectiveness of the video segments on the iPod as a prompting device to complete those tasks (2009). The participant used the video iPod independently. The study employed a multiple-probe design across three tasks. The results showed that after introducing the video segments on the iPod, the participant responded independently, and prompts given by a job coach were decreased.

Similarly, Burke, Andersen, Bowen, Howard, and Allen (2010) evaluated in two studies the efficacy of a vocational training program, which included an iPhone app as a “performance cue system” (PCS). In their first study, three young adults (two aged 20, and one aged 27) with autism spectrum disorder were trained for performing targeted employment skills (i.e., using scripted responses for fire safety training). PCS was used to present cues for the participants to follow instructions on the iPod screen. In their second study, three other young males (two aged 20, and one age 18) with autism spectrum disorder were introduced to the PCS first and then given the behavioral skills training if needed. We employed a multiple-baseline across subjects design. The results of the studies showed that except for one participant, the rest reached a pre-set criterion (i.e., performing 80% of the fire safety assembly tasks/skills in sequence) after the introduction of the PCS.
Positive evidence of the use of technology. As shown in previous studies (Burke et al., 2010; Jones & Bucholz, 2014; Van Laarhoven et al., 2009), students’ use of an iPad has demonstrated positive evidence in work and life readiness concerning task completion skills. However, these studies did not address academic skills related to seeking and attaining employment. Although iPads have demonstrated some positive effects on literacy and related academic skills (Crowley, McLaughlin, & Kahn, 2013; Flewitt, Kucirkova, & Messer, 2014; Flores, Hill, Faciance, Edwards, Tapley, Dowling, 2014; Hart & Whalon, 2012), there is a lack of research about iPad apps and academic skills related to life-readiness skills (e.g., reading, writing, math, social-interaction, and task-completion activities). Due to the lack of literature focused on transition-age (i.e. aged 18-21 years old) students’ use of iPad apps for managing literacy, task completion, and other tasks, the current study was designed to understand the effectiveness of the use of iPads on assisting students with developmental disabilities in gaining or improving their management of life-readiness skills.

Moreover, this study sought to provide perspectives about these skills through feedback from students, parents, and teachers, as it is important to take all points of view into consideration when using technology devices in vocational related training. Without support and involvement of family, equipment may be abandoned even it was introduced to use. As evident in the literature, there is a lack of family involvement during the decision-making process for the use of assistive technologies for students with disabilities. A comprehensive and systematic review of literature in English-language refereed journals about assistive technology for individuals with disabilities from 1988 to 2003 (Alper & Raharinirina, 2006) supports this finding as only a few of the studies reported family involvement.

The study was designed to extend the existing research literature on transition-age students with developmental disabilities with an action research approach to address the following question:

1. How do students with developmental disabilities improve their life-readiness skills in areas of literacy (e.g., reading, writing) after using iPad apps?
2. How do students with developmental disabilities improve their life-readiness skills such as task completion (e.g., task completion, cueing systems) after using iPad apps?
3. How do students with developmental disabilities improve their life-readiness skills such as communication (e.g., social media) after using iPad apps?

METHOD
The research team employed an action research approach in this study (Hendricks, 2006). The processes of the project incorporated planning a change (i.e., improving life-readiness skills), observing and participating in the process as well as the results of the change, reviewing the processes and results, and then reinitiating the planning, acting, and reflection cycle (Erickson, 1986; Kemmis &McTaggart, 2000). We included quantitative descriptive statistics (e.g., CBM scores, teachers’ beginning and end-of-project rating-scale
scores; Vogt, 2007) as well as qualitative methods in the form of collective case studies (Stake, 1995; Yin, 2003). Through analyzing a number of cases (N=9), common themes across the participants can emerge and provide insight as to what practices can best serve the students’ needs. Purposive sampling provided a means to compare similar cases (Oliver, 2006).

Participants
The purpose of the current study was to explore if iPad apps would help transition-age students (i.e., ages 18-21 years old) who have developmental disabilities (e.g., autism, cerebral palsy, intellectual disabilities, etc.) improve their work and life-readiness skills (e.g., reading, writing, task-completion, and communication). For the purpose of this study, we defined developmental disabilities as, “characterized by significant limitations both in intellectual functioning (reasoning, learning, problem solving) and in adaptive behavior, which covers a range of everyday social and practical skills. This disability originates before the age of 18” (American Association on Intellectual and Developmental Disabilities, 2014). School psychologists and medical doctors had provided each student’s diagnosis, as stated on their Individualized Education Plans (IEPs) and reported by the students’ teachers and parents.

This study involved nine transition-age (i.e., 18-21) students with moderate to severe developmental disabilities, their parents/guardians, and teachers in two urban school districts located in the US Pacific Northwest. Participating students and teachers were housed in congregated classrooms for 100% of the school day. Their academic programming focused on life-readiness skills (e.g., cooking, reading, and writing job applications). The research team invited parent participation throughout the timeline of the study including: a pre- and post-project interview with the student, teacher, and applicable support personnel (e.g., speech and language pathologist, paraprofessional); an online feedback website (password-protected to the research team only to respect confidentiality) where parents/guardians could post comments (a bi-weekly frequency); and a mid-project information session where the research team described activities to date and promote parent/guardian encouragement of students’ use of iPad apps at home.

The student participants are listed in Table 1. They ranged in communication abilities from moderate (e.g., elementary-level abilities yet able to converse with simple or complex sentences) to severe (e.g., multiple disabilities such as autism comorbid with severe hearing loss). Through the provision of strategy instruction and practice, the project’s aim was to develop students’ understanding of life-readiness skills and, hopefully, increase their level of independence even if by, theoretically, a few percentage points on curriculum based (Deno, 2003) or other measures.
Table 1: Student Participants’ Descriptive and Ability Levels at the Beginning Point of the Project

<table>
<thead>
<tr>
<th>Student</th>
<th>Age as of June 2013</th>
<th>Race/Ethnicity</th>
<th>Teacher</th>
<th>Disability type(s)</th>
<th>Reading Ability</th>
<th>Writing Ability</th>
<th>Math Ability</th>
<th>Communication Abilities</th>
<th>Physical/Motor Abilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Betty</td>
<td>21.9</td>
<td>White</td>
<td>Nancy</td>
<td>Intellectual Disability</td>
<td>Grade 7</td>
<td>Grade 6.6</td>
<td>Grade 4</td>
<td>3</td>
<td>Physical impairment which may prompt fatigue</td>
</tr>
<tr>
<td>David</td>
<td>19.7</td>
<td>White</td>
<td>Nancy</td>
<td>Other Health Impairment</td>
<td>Grade 2</td>
<td>Grade 3</td>
<td>Grade 25</td>
<td>3</td>
<td>Socially withdrawn, can be easily frustrated</td>
</tr>
<tr>
<td>Kevin</td>
<td>21.4</td>
<td>White</td>
<td>Nancy</td>
<td>Other Health Impaired</td>
<td>Grade 1</td>
<td>Grade 1</td>
<td>Grade 1</td>
<td>4</td>
<td>Can travel independently</td>
</tr>
<tr>
<td>Rebecca</td>
<td>21.6</td>
<td>White</td>
<td>Nancy</td>
<td>Intellectual Disability</td>
<td>Grade 1</td>
<td>Grade 1</td>
<td>Grade 1</td>
<td>3</td>
<td>Can travel independently</td>
</tr>
<tr>
<td>Bobby</td>
<td>21.1</td>
<td>White</td>
<td>Nancy</td>
<td>Autism</td>
<td>Grade 1</td>
<td>Grade 1</td>
<td>Grade 1</td>
<td>1</td>
<td>Can travel independently; could demonstrate anger by grunting loudly</td>
</tr>
<tr>
<td>Tyler</td>
<td>19.3</td>
<td>White</td>
<td>Tabitha</td>
<td>Autism</td>
<td>Grade 5</td>
<td>Grade 1</td>
<td>Grade 2</td>
<td>3</td>
<td>Needs some help with accessing public transportation</td>
</tr>
<tr>
<td>Tamara</td>
<td>20.1</td>
<td>East Asian</td>
<td>Tabitha</td>
<td>Intellectual Disability</td>
<td>Grade 1</td>
<td>Grade 1</td>
<td>Grade 1</td>
<td>3</td>
<td>Can travel independently</td>
</tr>
<tr>
<td>Barbara</td>
<td>19.6</td>
<td>White</td>
<td>Tabitha</td>
<td>Hearing Impairment, Cerebral Palsy, Moderate Intellectual Disability</td>
<td>Grade 1</td>
<td>Grade 1</td>
<td>Grade 3</td>
<td>2</td>
<td>Needs some help with accessing public transportation</td>
</tr>
<tr>
<td>Francine</td>
<td>20.2</td>
<td>White</td>
<td>Tabitha</td>
<td>Traumatic Brain Injury</td>
<td>Grade 3</td>
<td>Grade 1</td>
<td>Grade 1</td>
<td>3</td>
<td>Physical impairment which may prompt fatigue</td>
</tr>
</tbody>
</table>

1With comprehension
2Communication ability levels: 1) did not use words, only guttural sounds, students’ comprehension of oral language was often unclear; 2) could communicate with sign language; 3) could comprehend some simple ideas, used one or two word phrases/responses; 4) could comprehend typical conversation and respond in multiple full sentences.

The local educational service district’s (ESD) special education director facilitated the project by inviting other research-team participants (county disability services manager, ESD speech and language pathologist, first author) to organizational meetings and providing supports (e.g., loaner iPads, meeting rooms, asking teachers who would be interested in the project as a means to help their students, etc.). Nancy and Tabitha, the special education teachers, purposefully chose the student participants based on their having a developmental disability and a potential to improve their work and life-readiness skills with iPad apps. In addition, to being eligible for participation in the project, the students, and their parents/guardians, had to agree to the project’s components: interviews, writing a weekly post about their experiences, and the project team’s observing students’ use of iPad apps.
Students and Parent Research Activities
Each student and parent(s)/guardian(s) participated in an initial as well as end-of-project group interview with the special education teacher, support personnel when applicable (e.g., speech and language pathologist, teacher assistant), and the first author. The purpose of the interviews was to attain qualitative descriptions of students’ change in progress by the end of the study. Students and parents also participated in a beginning-of-project meeting, led by the teachers and the first author, to learn the purpose and use of the apps, which the teachers suggested as being uniquely effective for each student’s needs. The research team and parents/guardians met mid-project (January 2014) to review the goals of the project and how students could apply the iPad apps at home and other contexts outside of school. Students and parents also provided feedback in a bi-weekly online survey about the students’ use of apps, what they viewed as being helpful, and what challenges students may have experienced. After the project had ended, the students and parents participated in an end-of-project informational session lead by the teachers and first author, which was open to the general community.

General Procedures for Students’ Learning iPad Apps
The state vocational rehabilitation and county disability services departments provided the iPads for students’ use. In April 2012, the two special education teachers, Nancy and Tabitha, met with the project’s research team to discuss the aims of the project, learn about the iPads, and discuss app choices that could be of benefit to the intended student participants. The teachers had prior experience with tablets as they had previously used iPad apps. The teachers then developed a list of app choices based on each student’s needs, used the apps to develop their own familiarity and dialogued via email with the research team about their perspectives and other app options.

To teach iPad apps to students, the teachers employed the self-regulated strategy development (SRSD) model (Graham & Harris, 2005). In SRSD’s step one (assessment of background knowledge), the teachers reviewed students’ academic strengths and weaknesses to define a proposed list of apps that could help students improve. At the start of the 2012-2013 school year, the teachers completed SRSD’s step two (develop background knowledge): teaching student participants about the iPad apps and how they could help self-regulate as well as improve life-readiness skills (e.g., reading, writing, task completion, and communication). For SRSD’s step three (memorize the app/app’s name), the teachers explained each app, modeled its use, and attained the students’ commitment to learning and applying the app. In step four (support use of the app) the teachers offered students guided practice in two to three classes (20-30 minutes each). In step five (independent performance), teachers faded their feedback so as to develop each student’s independent of the apps. Step six (generalization and maintenance) provided for the teacher and students to discuss the apps and how they could be generalized to a choice of purposes (e.g., calendaring can be for school assignment dates as well as personal and family events) which would encourage the students to maintain use of the app over time.

As an example of this six-step SRSD process in teaching the Pages (Apple, 2014) app, the special education teacher met with a student in the first class session to present the
purposes of Pages (e.g., writing text, adding pictures with text, making diagrams, and creating charts) and illustrated some examples. In the second class session, the teacher reviewed the information presented in the previous class and then offered guided practice as the student typed some text, added some pictures, etc. In a third session, if the student demonstrated a need, the teacher offered more guided practice. The aim for initial learning was that the student could open an app on the iPad, complete one type of task (e.g., typing some text), and save the product for later use (e.g., within the app, or in a file-sharing service such as Dropbox). In the weeks and months that followed, the student developed the use of the app through practice at school, home, and work. In the process, the student developed ideas for generalizing the app’s use for various purposes (e.g., writing a letter, resume). The iPad was the focus tool for school and work; students’ change in life-readiness skills (e.g., reading, writing, task completion, communication) could, therefore, be partly attributed to their use of these tablet applications.

**Collection of Data**
Quantitative and qualitative data were collected throughout the project in order to provide multiple perspectives of students’ skills. The data obtained throughout this investigation was obtained through various means (curriculum-based measurement data from June 2013 and 2014 IEPs, interviews, observations, questionnaires, journal entries, etc.) and from various stakeholders in this project (teachers, parents/guardians, support personnel, researcher) in order to provide validity and reliability through triangulation (Sagor, 2000).

**Quantitative data.** Quantitative data were collected through the use of a paper-based and electronic teacher rating scale questionnaire, which the research team had created, as well as curriculum based measurement data from June 2013 and 2014. The purpose of this data was to attain a quantitative (e.g., descriptive statistics) comparison of students’ ability levels of the use of technology at the beginning and end of the project. Additionally, data provided information regarding the students’ life-readiness skills at the time of the study. The teachers completed each rating scale questionnaire (see Table 2) using a 1-5 rating scale (1- No Proficiency, 5-Superior Proficiency). Questions within the questionnaire included the use of an electronic calendar, use of internet to search for employment, or accessing/using reading-assistance software, among others.

**Qualitative data.** The qualitative data consisted of semi-structured interviews, bi-weekly journal entries, and observations of students’ using the iPad apps. The first author conducted beginning-of-project semi-structured group interviews during April and May 2012; end-of-project interviews were completed in April and May 2013. After a search of article databases to find interview questions about the topic of this study, the first author formulated a draft list of questions and later reviewed them with the educational service cooperative group for feedback, edits, and final copy:
**Table 2: Competency Rating Scale Questionnaire**

Date: _____  
Student’s identifier #: _____  
Disability category: _____  

In 2-4 sentences, describe the student’s skill/grade-level ability in reading, writing, math, and oral language skills:  __________________________________________________________________________

<table>
<thead>
<tr>
<th>In using a computer tablet’s software application(s), to what extent can the student...</th>
<th>Proficiency Levels</th>
</tr>
</thead>
</table>
| 1 Turn power on/off | Level 1 - No Proficiency  
Student can accomplish the task 0 times out of 5 |
| 2 Manage doing input on the tablet's screen | Level 2 - Some Proficiency  
Student can accomplish the task 1-2 times out of 5 |
| 3 Access a typing program (e.g., for resume writing) | Level 3 - Average Proficiency  
Student can accomplish the task on average 3 times out of 5 |
| 4 Use the Internet to search for employment | Level 4 - High Proficiency  
Student can accomplish the task on average 4 times out of 5 |
| 5 Use an electronic calendar | Level 5 - Superior Proficiency  
Student can consistently accomplish the task 5 times out of 5 |
| 6 Access/use reading-assistance software |  |
| 7 Access/apply a software's cueing system/task list |  |
| 8 Independently change tasks while using software |  |
1. What helps the student be able to manage life-readiness skills (e.g., reading, writing, task completion, and communication)?
2. Has the student used a computer/laptop/smartphone with apps? If so, did it help; how?
3. Does the student have a personal scheduling or calendar system?
4. Do you think that iPad apps could/has help(ed) the student? If so, how?
5. How would/did apps help your student(s) in life-readiness skills?
6. Can the student independently move from one job task to another while at school?
7. Is the student involved in community based work experience as part of the school day?

Interviews offer a powerful method to understand others’ perspectives (Fontana & Frey, 2000). The first author’s consistent participation in the interview process provided for a sense of trust with the students, parents/guardians, teachers, and support personnel as well as insights and perspectives of their thoughts and changes in opinion across the timeline of the study. Each group interview lasted 30-60 minutes (mean = 40 minutes). The discussions were audio recorded for later transcription. The first author then reviewed and edited each file before offering via email participant validation of the transcripts.

The two teachers, students, and parents had access to a bi-weekly web survey where they could note what apps they liked, why, and what issues were posing a challenge. The first author, members of the educational service district group, and some graduate students from a local university then conducted bi-weekly, 40-minute observations of the students at school (e.g., one week at school in the classroom, the next week at a job site if the student had one). Each observer met with the first author prior to beginning observations. They reviewed the goals of the project, example apps and related activities (e.g., using an iPad screen reader to help with decoding text). The first author then described and showed some example online video examples of students’ completing activities and how the observer could make notations. The observation protocol’s content included prompts such as: describe the location (e.g., classroom, jobsite, how many people at the site, what are the apparent tasks?). How did the student’s use of the iPad/apps help facilitate completion of the task? After completing some example observations, the first author and observers reviewed their data until they attained 100% inter observer agreement. Part of each observation at sites was the aim of taking some video content, which was later used for at least 50% of the data as a means for two research team members to review both the notes and video and make any suggested corrections or offer feedback to the observer. Data collection continued until May 15, 2013, when the timeline of the study ended, as defined by the research team.

Data Analysis
Data consisted of two types—quantitative and qualitative as previously described. We chose standard methods to analyze each data set. The quantitative data for this study consisted of descriptive statistics (Vogt, 2007) resulting from the teachers’ rating scale questionnaires and curriculum based measurement (CBM) data. We noted each student’s set of beginning/end-of-project scores and then calculated the means for each one using Microsoft Excel (2013). The means of student’s pre- and post- intervention scores were
compared in order to observe the change across time. It was important to observe this change across time in order to answer the research question focused on the effectiveness of the use of iPad apps to improve work and life readiness skills.

For qualitative data, we applied an in-depth, five-step framework analysis approach (Ritchie & Spencer, 1994; Rubin & Rubin, 1995; Silverman, 2000). First (familiarization with the data), we read all 12 transcripts many times to develop familiarity with the content, make notes, and create initial categories. Second (coding to identifying a thematic framework), from each page we coded key themes, concepts, and ideas into categories as well as overarching subthemes (see Table 3).

<table>
<thead>
<tr>
<th>Coding labels</th>
<th>Sample Quotes</th>
<th>Notes and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology, literacy</td>
<td>Nancy (teacher): David did use the iPad for reading and writing in the sense of career development. He played Jeopardy for practicing career interview questions. David also used the iPad to update his resume/job portfolio and make a 60 second commercial selling himself. He used In Class to take notes and what we took Skills and Abilities together, Interviewing.”</td>
<td>Apps provided engaging (e.g., games, videos) to practice skills and manage task completion</td>
</tr>
<tr>
<td>skills</td>
<td>“Tabitha (teacher): for Francine, I think it has made her more responsible. Now, she has the iPad charged every day. Parent: Francine is now more organized. She mentions reminders throughout the day about things that need to be done. Student: Every time, I am on top of tasks and meetings. Teacher: I think that is true. Parent: She has been more responsible.”</td>
<td>iPad apps can help students manage their day better. Calendaring apps reminder features help students have lead time to prepare for a task or event as well as help others.</td>
</tr>
<tr>
<td>Task completion,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>communication</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Third (indexing), after we created the codes from the transcribed data, we analyzed our notes and cross-referenced back to the research questions to confirm that the codes captured the participants’ ideas. Fourth (charting), we summarized the data into a matrix for each theme and noted key ideas and/or illustrative example quotes with participants’ verbatim keywords. Fifth (mapping and interpretation), we reviewed the matrix within and across participants to begin our interpretation of the data to develop coherent themes and possible explanations of interviewees’ comments and ideas. From the professional
literature, we associated concepts and practices to establish triangulation with the interview data and observations. As an outcome of these methods, we generated a hierarchical diagram of key themes to guide the presentation of our data, as presented later in the results section.

**Confirmability.** We employed several approaches to confirm the findings: triangulation, member checking, and review of documents. Triangulation provided a means to corroborate evidence from different individuals and documents (i.e., observation notes, student record information such as IEP meeting summary statements; Creswell, 2002; Sagor, 2000). Corroboration was achieved when participants stated ideas and practices that were reflected in the content of other transcripts. The first author offered participants the opportunity to review transcripts from the pre- and post-intervention group interviews to as a means for them to give feedback or clarify the content and intended meaning of their comments. The teachers provided copies of individual education plans and summary documents of meetings about the students as additional sources of data.

**RESULTS**
The current study sought to enhance the literature by exploring if iPad apps would help transition-age students (i.e., ages 18-21 years old) who have developmental disabilities (e.g., autism, cerebral palsy, intellectual disabilities, etc.) improve their work and life readiness skills (e.g., reading, writing, task-completion, and communication). Quantitative and qualitative data and analyses provided a well-rounded understanding of the students’ successful improvement of their life-readiness skills when using iPad apps. Student participants’ beginning and end-of-project IEP curriculum based measurement scores are listed in Table 4 and teachers’ rating scale scores are listed in Table 5.
**Table 4: Student Participants’ Curriculum Based Measurement Data**

<table>
<thead>
<tr>
<th>Student</th>
<th>Teacher</th>
<th>Disability type(s)</th>
<th>Reading (with comprehension) Ability</th>
<th>Writing Ability</th>
<th>Math Ability</th>
<th>Employability Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Betty</td>
<td>Nancy</td>
<td>Intellectual Disability</td>
<td>50%</td>
<td>83%</td>
<td>80%</td>
<td>81%</td>
</tr>
<tr>
<td>David</td>
<td>Nancy</td>
<td>Other Health Impairment</td>
<td>75%</td>
<td>96%</td>
<td>77%</td>
<td>82%</td>
</tr>
<tr>
<td>Kevin</td>
<td>Nancy</td>
<td>Other Health Impaired</td>
<td>48%</td>
<td>71%</td>
<td>75%</td>
<td>83%</td>
</tr>
<tr>
<td>Rebecca</td>
<td>Nancy</td>
<td>Intellectual Disability</td>
<td>30%</td>
<td>33%</td>
<td>33%</td>
<td>40%</td>
</tr>
<tr>
<td>Bobby</td>
<td>Nancy</td>
<td>Autism</td>
<td>0%</td>
<td>25%</td>
<td>50%</td>
<td>70%</td>
</tr>
<tr>
<td>Tyler</td>
<td>Tabitha</td>
<td>Autism</td>
<td>0%</td>
<td>76%</td>
<td>0%</td>
<td>25%</td>
</tr>
<tr>
<td>Tamara</td>
<td>Tabitha</td>
<td>Intellectual Disability</td>
<td>57%</td>
<td>100%</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td>Barbara</td>
<td>Tabitha</td>
<td>Hearing Impairment, Cerebral Palsy, Moderate Intellectual Disability</td>
<td>50%</td>
<td>80%</td>
<td>60%</td>
<td>80%</td>
</tr>
<tr>
<td>Francine</td>
<td>Tabitha</td>
<td>Traumatic Brain Injury</td>
<td>40%</td>
<td>60%</td>
<td>40%</td>
<td>80%</td>
</tr>
</tbody>
</table>
### Table 5: Students’ Pre- and Post-Intervention Rating Scale Scores

<table>
<thead>
<tr>
<th>Student’s Name</th>
<th>1) Turn power on/off</th>
<th>2) Managing screen input</th>
<th>3) Accessing a typing program</th>
<th>4) Using the internet to search for employment</th>
<th>5) Using an electronic calendar</th>
<th>6) Accessing / using reading assistance software</th>
<th>7) Access / apply a software’s cueing system / task list</th>
<th>8) Independently change tasks while using software</th>
<th>Overall Mean Score for each Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Betty</td>
<td>Pre: 1  Post: 5</td>
<td>Pre: 1  Post: 5</td>
<td>Pre: 3  Post: 4</td>
<td>Pre: 2  Post: 3</td>
<td>Pre: 1  Post: 5</td>
<td>Pre: 3  Post: 1</td>
<td>Pre: 1  Post: 3</td>
<td>Pre: 1  Post: 3</td>
<td>Overall Mean Score for each Participant: 1.38 3.88</td>
</tr>
<tr>
<td>David</td>
<td>5 5</td>
<td>3 5</td>
<td>3 4</td>
<td>2 3</td>
<td>2 5</td>
<td>1 3</td>
<td>1 4</td>
<td>1 3</td>
<td>2.25 4.00</td>
</tr>
<tr>
<td>Kevin</td>
<td>3 5</td>
<td>3 5</td>
<td>2 3</td>
<td>3 3</td>
<td>2 5</td>
<td>1 3</td>
<td>1 3</td>
<td>1 3</td>
<td>2.00 3.80</td>
</tr>
<tr>
<td>Rebecca</td>
<td>2 5</td>
<td>1 5</td>
<td>2 2</td>
<td>1 2</td>
<td>1 3</td>
<td>1 5</td>
<td>1 2</td>
<td>1 3</td>
<td>1.25 3.38</td>
</tr>
<tr>
<td>Bobby</td>
<td>3 5</td>
<td>3 5</td>
<td>2 2</td>
<td>1 2</td>
<td>2 3</td>
<td>1 5</td>
<td>1 2</td>
<td>2 3</td>
<td>1.88 3.38</td>
</tr>
<tr>
<td>Tyler</td>
<td>5 5</td>
<td>2 3</td>
<td>2 3</td>
<td>2 2</td>
<td>1 3</td>
<td>1 3</td>
<td>1 3</td>
<td>3 3</td>
<td>2.13 3.13</td>
</tr>
<tr>
<td>Tamara</td>
<td>3 5</td>
<td>3 4</td>
<td>1 1</td>
<td>1 1</td>
<td>1 3</td>
<td>1 1</td>
<td>1 3</td>
<td>1 4</td>
<td>1.50 2.75</td>
</tr>
<tr>
<td>Barbara</td>
<td>2 5</td>
<td>2 4</td>
<td>1 1</td>
<td>1 1</td>
<td>1 3</td>
<td>1 1</td>
<td>1 3</td>
<td>1 4</td>
<td>1.25 2.75</td>
</tr>
<tr>
<td>Francine</td>
<td>2 5</td>
<td>1 3</td>
<td>1 2</td>
<td>1 1</td>
<td>1 3</td>
<td>1 3</td>
<td>1 3</td>
<td>1 3</td>
<td>1.13 2.88</td>
</tr>
</tbody>
</table>
The findings of the study are organized by themes, which emerged from the data as a collective case study, providing support for this study's research questions. A visual representation of the thematic breakdown is presented in Figure 1.

**Figure 1. Themes and Subcategories related to iPad and application usage for job-related tasks**

Research question 1: Do students with developmental disabilities improve their life-readiness skills in areas of literacy (e.g., reading, writing) after learning and applying iPad apps? Quantitative results demonstrated a positive trend in students' change in literacy skills (e.g., reading, writing) as the project progressed. All students demonstrated improvement with CBM scores. Tamara made the largest CBM gain (+43%) for reading. Bobby scored the lowest yet still made gains as much as 25%. For the teachers' ratings, five students attained a level 5 for at least two rating-scale questionnaire items. David, Kevin, Rebecca, and Bobby each attained three end-of-project 5 scores. Betty made the largest overall gain (+2.62). Tyler had the smallest gain (+1.00).

As many students with disabilities, their families and teachers focus on literacy skills as an area of improvement; this study focused on specific literacy skills related to job or
employment skills. Due to the importance of learning life-readiness tasks to transition from high school to post-secondary life, students with developmental disabilities would benefit more from literacy skills related to writing resumes, cover letters, as well as reading job announcements (Ayres, Lowrey, Douglas, & Sievers, 2011). In addition, literacy skills were often a focus of teachers and parents as they could also be generalized to other settings and tasks. For example, a student utilized different apps to improve his life-readiness skills as the teacher explained: “We had an app that he played that was like Jeopardy about career interview questions; he used it to update his resume, job portfolio, and create a 60 second commercial selling himself. We also took some classes together at Work Source and he used In Class to take notes, he could later play back.”

Similarly, other students relied on apps to improve or develop their resume through written or video formats: “he did use it for reading and writing in the sense of the career development” or “He’s working on now a video resume in Movie Me.” As stated by a student, “I used Edmodo practicing for my resume applications my job stuff.” Other examples include: “the calendar would be also using the iPad to do her resume or that type of thing that she can email it somehow maybe with assistance she could do those things which and she could continue to develop searching for jobs” and “Yes, I’ve used job search apps to look for jobs at home....I’ll click on one of the apps and see how many job sites there are that are open and I’ll apply for one.” Finally, participants express their observations about overall writing improvement such as, “Now with Edmodo ... she gets feedback quicker and I’ve also noticed Betty that the writing (spelling and grammar) in your texting has improved.”

The students’ demonstrated appreciation for the apps as listed in Table 5. Bobby, for example, was fascinated by the Apple eReader app. On his own initiate, he would find websites and listen to text being read for much of every available minute of the school day and at home. More often, students would need a teacher or paraprofessional to prompt them to use the iPad and apps, but the observations indicated that students appreciated having to use these digital tools to help them complete tasks.

Research question 2: Do students with developmental disabilities improve their life-readiness skills such as task completion after learning and applying iPad apps? CBM scores indicated that all students improved with skills pertaining to task completion such as at the workplace. Francine made the most gains (+25%). Rebecca had the smallest gain (+4%). Teachers’ rating scale scores indicated that all students made gains with task-completion skills (e.g., using an electronic calendar, cueing system).

Students with developmental disabilities are often faced with tasks that can be difficult to complete due to the many steps it requires or the organization skills needed prior to attempting the task. The current study was seeking answers related to whether students with developmental disabilities (e.g., autism, cerebral palsy) would improve their completion of job tasks after learning and applying iPad apps to these purposes. The data analysis provides a positive outlook to this question through its theme, Task Completion, and its sub-themes, Step Completion and Organization (see Figure 1). Through strategy
instruction with iPad apps, students developed and improved their ability to complete tasks related to a specific job (See Table 6 for apps that the students used).

**Table 6: iPad Apps and Descriptions**

<table>
<thead>
<tr>
<th>iPad app(s)</th>
<th>Purpose and description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proloquo2Go, Notify Me, Choice Works</td>
<td>Help with scheduling and communicating what a student wants and needs</td>
</tr>
<tr>
<td>Skype</td>
<td>A voice-over-internet-protocol (VOIP) app that provides the user with a means to voice and video call others</td>
</tr>
<tr>
<td>Toodle Do, Notes</td>
<td>Help students in making lists</td>
</tr>
<tr>
<td>First/Then app</td>
<td>Helps the user to manage the steps in doing a task</td>
</tr>
<tr>
<td>Apple eReader</td>
<td>Decodes text on the screen</td>
</tr>
<tr>
<td>Edmodo, Pages, Keynote, DropBox, WebDAV, Resum8</td>
<td>Encodes text and provides a means for storage and later access to saved files</td>
</tr>
<tr>
<td>Animoto, Ablenote</td>
<td>Offers tools in making a video resume</td>
</tr>
<tr>
<td>Word for Friends, Hanging, Yahtzee, Bowling</td>
<td>Help with spelling and word meanings</td>
</tr>
<tr>
<td>YouTube, Dictionary 5200 Signs, Coda Brothers</td>
<td>Apps that can help students learn ASL signs to communicate with others (e.g., employer)</td>
</tr>
<tr>
<td>Choiceworks</td>
<td>App to assist with scheduling, feelings, and waiting.</td>
</tr>
<tr>
<td>Yes/No</td>
<td>App to provide voice output</td>
</tr>
</tbody>
</table>

Beginning-of-project interviews provided an outlook of the difficulty students would have at completing tasks based on their challenges to complete specific steps without prompting from an adult. For example, teachers and/or parents would express these observations with statements such as: “Bobby needs nonverbal prompts to move from tasks to task” or “Essentially [it] would make him more independent not having to have that teacher to hold his hand through out every single task.” End-of-project data suggests positive outcomes from the use of iPad apps to assist them in task completion. Teachers, parents, and even students discussed these observations: “we are using the First/Then app to bring out his task lists and Bobby is able to almost independently without prompts get that out and say ‘okay, I store my belongings, I get the stuff that I need to clean. I dust first then I do the windows then I dust some more, then I take out the trash.’ ” or “Oh she can definitely move
from task to task. And she’s not needed the task queuing system at the work site. She has been able to use the iPad to take notes if a job description changes so she can go back and look and say ‘oh ok, this is what’s new.’ These tasks were also often observed by the students’ supervisor or boss during task completion at their jobs: “So when she didn’t have that iPad before to do that training the adult would go teach her the five tasks and that’s all they would do. Whereas now the boss saw that she could independently, ‘oh, look at my iPad I can do these five tasks’ and then they said ‘oh well let’s give her some more’. So [it] broadened their view of what she’s capable of doing” or “She did access her food handler’s card using the iPad, doing practice tests in Edmodo, watching the video on the county website and that is required for the job placement she was at.” The information expressed by these stakeholders support the themes within the findings regarding improvements of all students’ task-completion skills when using specific iPad apps in comparison to beginning-of-project data.

Information about the first sub-theme, Step Completion, teachers and parents found the use of the iPad apps useful for specific workplace tasks, such as traveling: “I think her using the alarms made her more independent because she was always dependent on everybody around her to tell her when to go catch her bus.” As stated by students, “Yes I can work unsupervised. I can travel to a different bus and connect to another bus to get to my worksite or I can travel to go home on the one bus” and “I like to go help with other students from the school like the new one I went yesterday to go to High School...and come back here to show her which way to go and how to do it, what bus and show other girls how things for new students each year.” Additional data from various interviewees provide similar information regarding improvement on workplace task completion with the use of specific apps tailored to the individual student’s needs and IEP goals.

Additionally, Organization was found to be another sub-theme as it was essential for many of the students to complete these workplace tasks. Prior to the use of the iPad, students’ organizational skills were limited. After the students learned and applied the iPad apps for workplace skills (e.g., reading, writing, task-completion, and communication), teachers, parents, and students expressed their utilizing these technology tools to improve these skills: “I think that the scheduling app really helped with Miss Betty, stabilize her health condition for a bit which helped with employment” and about another student, “yes he has uses Choiceworks and he sets the schedule up with that and he also has Proloquo to Go that helps a little bit with scheduling and communicating what he wants.” The interviewees provided insight information on how the iPad and its apps provided students assistance with organization skills as well as literacy skills that went beyond life-readiness tasks, often generalizing their learned skills to home and school-related tasks (e.g., listening to a social-media text sent by a friend or family member then responding, following a recipe to make a meal). In conclusion, observations from parents and teachers especially provide an insight on how iPad apps assist students with developmental disabilities become more independent and are able to improve their life-readiness tasks, communication, and literacy skills. An example is this statement provided by a parent: “Bobby he just goes everywhere with his iPad it’s really has made him blossom” and “I think its kept Betty connected to the community.” Students were even aware of the potential impact these
learned skills and the use of an iPad as an assistive technology could be for other students, as expressed in this statement: “I would give them [other students] advice to use the iPad accordingly to schedule and to foster ideas or to schedule the day so they do not get confused what they need to do at a certain time. Like wait I have to go to math class or I got to go home in time.” As part of an overall goal for students with developmental disabilities, the use of the iPad and its apps allows for students to increase their workplace skills as well as generalize those learned skills to other tasks related to home and school. The use of this type of assistive technology adds to the literature that supports positive outcomes from such technology usage to assist students with developmental disabilities become more independent within their overall community. This includes sharing these knowledge and skills with other students, providing a greater impact to their surrounding community.

Research question 3: Do students with developmental disabilities improve their life-readiness skills such as communication (e.g., social media) after learning and applying iPad apps? As the literature explains, communication in workplace skills for students with disabilities is vital for their success with employment (Carter et al., 2010). Due to the many challenges students with developmental disabilities face, assistive technology has become an outlet for improving these skills (Sauer et al., 2010). Specifically, communication skills using iPad apps have supported this claim in recent years (Flores et al., 2012; Kagohara et al., 2013). To add to the literature, this study provides evidence of the improvement of workplace communication skills. Some excerpts of the data that support this statement include: “She did use the iPad though to communicate with me and using Edmodo and doing messages. She also used the iPad, she used Skype to communicate with staff and friends and potential job employers” and “there’s a sign language app and so we’ve use that to communicate with the staff... Like they told her ‘okay we want you to clean the mirrors and do the dusting,’ so they’ve used the app to be able to communicate independently with her.” In addition, an increase in overall communication was observed across settings, assisting the students to generalize the skills learned with the iPad apps for work-related communication to school and home communication. An increase in social interaction with peers was also observed throughout this study, according to the participants.

**DISCUSSION**

In our review of the literature, a gap within research is evident regarding the use of hand held devices to support students with developmental disabilities in their effort to learn life-readiness skills (e.g., reading, writing, communication, task completion, etc.). The purpose of this study was to add to this literature by providing quantitative and qualitative information for a more well-rounded description of the use of technologies for students with moderate to severe developmental disabilities. The study provides a positive outlook to the opportunities hand-held devices, such as the iPad, can provide for students with disabilities and their effort to improve their workplace skills for their future jobs.

**Use of Technology to Enhance Work and Life Readiness Skills**

The current study provides evidence of the need to research the use of hand-held technologies, such as the iPad, to improve the lifestyle and work opportunities for students with moderate to severe disabilities. Task-completion, communication, and literacy
assistance were only a few of the many improvements observed during this study. It is key to continue the exploration of the use of these technologies in order to increase the quality of education for students with moderate to severe disabilities in their vocational training (Cumming et al., 2014). As mentioned in the results, communication and social interaction were also observed by teachers, family members, and peers throughout the study, showing the various other ways these technologies could impact a student’s life.

**Recommendations for Educators and Future Implications**

Due to the enormous amount of apps found today, we recommend further research focuses on the use of specific apps to assist students with disabilities in the improvement of life-readiness skills. We also encourage teachers, administrators, and parents, to do in-depth research on specific apps and technologies that are focused on the individual’s needs. Additionally, these apps as well as the time to train the professionals or families on how to use them can be a challenge (Van Laarhoven et al., 2009). It is important for professionals and families to take time and training into consideration prior to the utilization for each app. We suggest for administrators to provide time during professional development dedicated for these tasks in order to be proactive about the use of this technologies for the students and their needs. Finally, previous studies recommend that future research should also focus on the professional development and training of all stakeholders in the use of these technologies by students with developmental disabilities (Cumming et al., 2014; Hammond, Whatley, Ayres, & Gast, 2010; Van Laarhoven et al., 2009).

**Limitations**

Students with moderate to severe developmental disabilities exemplify students with high levels of need. Their challenges with expressive language and memory skills can render the timeline for learning and application to be long. These aspects can also make determining progress a challenge. Teachers’ offering these students multiple examples and practice with feedback of a given strategy such as an iPad app can be very helpful to promoting their improvement with life-readiness tasks (Graham & Harris, 2005). Curriculum based measurement, observations, and interviews offered insight in students’ perspectives and change/improvement over time, but for at least some students (e.g., Bobby), improving in these areas will be a life-long endeavor and likely with the assistance of a job coach. This study illustrated teaching practices that the research suggests should help; we believe this is a positive addition to the professional literature.

The research team’s aim was to invite parent and student input throughout the timeline of the project. Ongoing anecdotal student input was manageable given the daily contact with the special education teacher and support personnel. Parents demonstrated their liking the project based on their initiative to be part of the interviews and attendance of the June 2013, January and June 2014 meetings. The online parent questionnaire had an initial glitch of only being accessible once from a given internet protocol address; parents attempts to submit two or more times during the first month became impossible. Once the first author learned of this and corrected the glitch, the questionnaire worked but a new challenge appeared: parents just did not take time to make posts even with reminders from
the research team. A solution would be to employ a low-tech means for attaining feedback: a paper questionnaire, which parents/guardians could complete at each of the meetings.

The use of purposeful sampling for this type of research may limit the generalization of the results. All of the participants, as well as their teachers and parents, were willing participants that looked to explored technologies to further the students’ knowledge and skills. Therefore, it is difficult to assume that their willingness to participate in this study did not directly affect the results. Additionally, the N of students participanting in the study is not large. Although both quantitative and qualitative data were provided for analysis and answering the research questions, we have to be cautious on the generalization of the overall results. In order to improve or overcome these limitations, quasi- or experimental studies should be conducted focusing on the effects of the use of iPad apps on students with developmental disabilities and their workplace skills.

**Summary**

Students with developmental disabilities benefited from their use of iPad apps. To have these tools for workplace skills also promoted their communication with peers, friends and family, and employers in the community. Having a tablet is very common amongst the general public. Students’ being part of today’s technology culture offered a sense of belonging as well as a means to manage school and life activities.

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