Using Wearable Assistive Technology to Improve Time Management of Students with Disabilities in a School-Based Employment Training Setting

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USING WEARABLE ASSISTIVE TECHNOLOGY TO IMPROVE TIME
MANAGEMENT OF STUDENTS WITH DISABILITIES IN A SCHOOL-
BASED EMPLOYMENT TRAINING SETTING

by

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A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in the School of Teacher Education
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Major Professor: Lisa Dieker
ABSTRACT

All areas of life require time management, but those skills are especially integral and require a different level of accountability for an individual to be successful in academia or when employed (DiPipi-Hoy et al., 2009; Macan et al., 1990). A study by Janeslätt et al. (2015) measured daily time management of adults and found individuals with cognitive disabilities possessed low daily time management skills compared to neurotypical peers. In a study by Button et al. (2019) the majority of college students with disabilities at one university who sought out support services spent most of their time working on the area of time management. A potential way to address these deficits is a new trending tool to assist students with disabilities to improve time management skills, wearable and mobile assistive technology. The purpose of this study was to determine the effectiveness of a vibrating smart watch (Apple Watch® Series 6) using preprogrammed calendar events to improve the time management skills of students with disabilities.
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LIST OF ABBREVIATIONS

ADA – Americans with Disabilities Act
AR – Augmented Reality
ASD – Autism Spectrum Disorder
AT – Assistive Technology
CTP – Career Training Program
ID – Intellectual Disability
IDEA – Individuals with Disabilities Education Act
IEP – Individualized Education Program
ROI – Return on Investment
SES – Socio-Economic Status
STEM – Science, Technology, Engineering, and Mathematics
TECH ACT - Technology Related Assistance to Individuals with Disabilities Act
TUE – Time Use Efficiency
UDL – Universal Design for Learning
VR – Virtual Reality
XR – Extended Reality
CHAPTER ONE: INTRODUCTION

Introduction

Humans typically operate in the framework of time (Skold & Janeslätt, 2017). The concept of time directly dictates how much sleep a person needs or how much daylight a person sees on any given day. Being able to manage time appropriately to accomplish daily living is a human necessity. Most areas of life require time management, but those skills require a different level of accountability for an individual to be successful in academia and employment (DiPipi-Hoy et al., 2009; Macan et al., 1990).

Some people may find time management to be an area of difficulty; it can be especially problematic for students with disabilities (Janeslätt et al., 2015). Janeslätt et al. (2015) used a self-rating scale to measure daily time management of adults and found individuals with cognitive disabilities possessed low daily time management skills compared to neurotypical peers. These issues are present for students in general but are especially critical for those attending college or preparing for employment. Morash-Macneil et al. (2018) concluded that time management for individuals with intellectual disability (ID) was a critical skill necessary for obtaining and maintaining employment. Button et al. (2019) found the majority of college students with disabilities who sought out university support services spent most of their time working on the area of time management.

A new area of interest for researchers to improve time management skills for students with disabilities is the use of wearable and mobile assistive technology (AT; Finn et al., 2015; Green et al., 2011; Legge et al., 2010). The Technology Related Assistance to Individuals with Disabilities Act (Tech Act) of 1988 and the Individuals with Disabilities Education Act (IDEA) of 2004 defined AT as “any item, piece of equipment, or product system, whether acquired
commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities” (Section 1401, 1A). The emergence of wearable and mobile AT could address deficits in time management. Grigal et al. (2018) suggested many specialized applications and wearable technologies could improve students’ daily lives on college campuses and support specific tasks such as time management. Several researchers have found promising results from wearable wrist technology such as the Fitbit®, Watchminder®, and MotivAider® for students with disabilities to improve their daily time management skills (Finn et al., 2015; Green et al., 2011; Legge et al., 2010). The researcher in this study aimed to add to the emerging literature in the field by examining the use of the Apple Watch® Series 6 as an AT device to improve time management skills for students with disabilities in an employment training setting.

**Purpose of the Study**

The purpose of this study was to improve the time management skills of students with disabilities. The researcher set out to test the hypothesis of a vibrating smart watch using preprogrammed calendar events that sync to the wearable smart watch for students with disabilities in an employment training setting. Specifically, students in a career training program (CTP) were given the opportunity to use the Apple Watch device, specifically the calendar application synchronization capabilities, to assist with managing timely arrival at their CTP employment skills training stations.
Research Questions

1. To what extent do calendar alerts on an Apple Watch affect the time of arrival to a career training program employment skills workstation for students with disabilities?

2. What are the perceptions of students and teachers regarding the goals, use, and outcomes of the implementation of a smart watch for time management as measured by a survey?

In this study the researcher hypothesized that wearing a smart watch would assist students with disabilities in arriving on time to the next CTP employment skills training station. The researcher determined the impact of the device on time management using a single subject ABAB withdrawal design. Six study participants from a CTP focusing on employment skills training entered the baseline sessions (A₁) by following their employment skills training station schedule as usual. In the second phase (B₁), the researcher provided participants with the Apple Watch Series 6 to assist with the time management of their CTP employment skills training station schedule through the use of an audible chime, vibrating haptic, and visual calendar reminders displayed on the screen of the watch. Following the implementation phase (B₁), the researcher rescinded the Apple Watch with participants reverting back to business as usual during the second baseline phase (A₂). The smart watches were then returned to participants for the return to treatment phase (B₂).

The researcher gathered anecdotal research notes during observation for the purpose of study discussion. A survey was conducted at the conclusion of the study to determine social validity. Participating students and the teachers overseeing the participants at each employment skills training station were asked to share their thoughts and feelings toward the impact and use of the device on participants’ time management skills.
Theoretical Framework

The successful use and adoption of the Apple Watch Series 6 by students with disabilities requires a better understanding of how best to introduce and integrate AT into their daily lives. The core of this study was ensuring the AT device addressed time management of the individuals involved in a way that allowed them to be more successful in following their station schedule. The researcher used two theoretical frameworks to guide the research: Kelly’s (2002) Time Use Efficiency (TUE) framework and Kintsch and DePaula’s (2002) Cycle for Adoption of Assistive Technology framework.

Kelly (2002) suggests that TUE is when an individual makes the best use of their time. This framework is based on the assumption an individual has awareness of time, awareness of the elements that fill time, and positive work habits. Kelly does not suggest awareness of time means the individual must be able to tell time but rather they understand that time is passing and “events take place in some degree of order” (p. 13). Awareness of the elements that fill time requires an individual (a) understands tasks or activities requiring time to complete, (b) can concentrate on that task or activity, and (c) knows how to approach completion of the task. Positive outcomes for individuals with high TUE can be demonstrated by improved work performance, increased productivity, higher personal motivation, improved self-discipline, and overall time-management behaviors. The introduction of the Apple Watch could increase TUE for individuals with disabilities by improving their use of time.

The Cycle for Adoption of Assistive Technology (Kintsch & DePaula, 2002) shows the interworking of each step in introducing AT and served as the framework for the procedures in this study (see Figure 1). The first phase of the cycle, the development phase, occurred through the systematic literature review of current practices in AT use, gathering feedback of previous
researchers’ findings while taking into consideration their suggestions for future research in the area (Finn et al., 2015; Green et al., 2011; Janeslätt et al., 2014; Legge et al., 2010; Van Laarhoven et al., 2009). The findings of the literature review shaped the selection process of the AT device used in this study. The need for time management skills for individuals with disabilities in the area of employment was echoed by many researchers in the field (e.g., DiPipi-Hoy et al., 2009; Green et al., 2011; Lindsay et al., 2012; Morash-Macneil et al., 2018; Van Laarhoven et al., 2009).

![Cycle of Adoption of Assistive Technology](image)

Figure 1: Cycle of Adoption of Assistive Technology

The learning phase occurs as participants are introduced to and adopt new AT. The researcher selected a wearable AT device based upon emerging research. The growing popularity of the Apple Watch®, since the publication of the aforementioned studies and the lack of
comparable studies using the Apple Watch for time management, made it the preferred AT tool for this study. The researcher did not consider the trial and re-assessment components of the selection phase of the framework due to the time constraints of this study. However, the researcher notes from previous professional experiences, individuals with disabilities are already using the Apple Watch in various settings of their personal lives. Conducting this study satisfied the next phase of integration as participants began to use the watch in one part of their day-to-day activities. Gathering feedback through data collection and the social validity survey completed a full cycle of this framework and leading to future research and developments in the use of AT to support individuals with disabilities in TUE.

The TUE (Kelly, 2002) and *Cycle for Adoption of Assistive Technology* (Kintsch & DePaula, 2002) frameworks assured the researcher provided individuals with disabilities unambiguous implementation of the Apple Watch AT for time management. The hypothesis of this study was that adoption of the AT would lead individuals with disabilities to a high TUE, providing higher positive personal and organizational outcomes. If an individual does not follow the prompts and alerts of an Apple Watch as an AT for time management skills, then they may lack desire to improve their TUE. This reaffirms the notion by Kelly (2002) that an individual must have positive work habits.

**Definitions**

**Apple Watch**

The Apple Watch is a wearable smart watch for your wrist that pairs and syncs with an Apple iPhone. The watch allows a student to see the time similar to a traditional analog watch and syncs with the student’s calendar in order to send them updates, prompts, and reminders.
about their upcoming classes. The student will receive the reminders through a vibration emitted by the watch and a pinging sound followed by a displayed schedule reminder.

Artificial Ceiling

Following the precedent by Green (2011), an artificial ceiling was adopted for this study. This artificial ceiling was intended to ensure students did not entirely miss any employment skills training stations. In coordination with the CTP lead teacher, an artificial ceiling was set at 5 minutes. Regardless, if a student was early or late to a station by more than 5 minutes, the recorded time was recorded as (-5) minutes if they were early or (+5) minutes if they were late. The teacher would only prompt a student to report to their station if they were late by 5 minutes which exceeds the artificial ceiling.

Assistive Technology (AT)

The Tech Act of 1988 and the IDEA (2004) define AT as, “any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities” (Section 1401, 1A).

Career Training Program (CTP)

The school’s CTP is a voluntary school-based program where students participate in a variety of workstations around the school campus that are designed to focus on helping students improve various employment skills. This CTP consisted of seven workstations: Culinary Assistant, Administrative Assistant (two stations), Educational Assistant, Computer Skills, Financial Literacy, and Physical Education Assistant. Students attend stations based on career interests and goals. Each station has an assigned supervising teacher or school personnel oversee the training of employment skill tasks.
Intellectual Disability (ID)

IDEA (2004) defines ID as a person having significantly subaverage general intellectual functioning, existing concurrently with deficits in adaptive behavior and manifested during the developmental period, that adversely affects a child’s educational performance.

Neurotypical

Any individual not diagnosed as having a disability. Attends and participates in all academic and non-academic school functions. Does not require and has never required an individualized education program (IEP).

Smart Watch

Darmwal (2015) states smart watches are “wearable devices that do much more than just tell time. Typically, they integrate with your smartphone and help users by logging lifestyle information, show alerts and interact with smartphones” (p. 1).

Time Management

Kelly (2002) defines this efficiency as the achievement of an outcome with a minimal waste of time.
CHAPTER TWO: REVIEW OF LITERATURE

Current Employment Status

According to a 2019 report from the U.S. Department of Labor Bureau of Labor Statistics, published immediately prior to the onset of COVID-19, only 19.3% of all persons with disabilities in the United States were employed. In the 2018 Disability Status Report by Cornell University, individuals between 21 and 64 years of age who had a disability made up 10.4% of the United States’ total working age population (Erickson et al., 2020). The Cornell University report also showed only 28.6% of those identified as non-institutionalized and of working age (21 to 64 years of age) with a cognitive disability were employed. This percentage translates to 5.8 million individuals with a cognitive disability, of working age and who were not institutionalized, were not employed in 2018. According to a survey by the National Core Indicators (NCI) for 2017-2018, administered to 25,671 individuals with an intellectual or developmental disability across 35 states and the District of Columbia, only 18% of respondents had a job, while 45% reported they did not have a job but wanted one.

Employment Addressed in Education

The 2018 Disability Status Report by Erickson et al. (2020) showed that 7.3% of people with disabilities (more than 12 million people) between the ages of 21 and 64 were looking for work. While the U.S. Department of Education (USDOE) reported in their Digest of Education Statistics for 2018 seven million students between the ages 3 and 21 were being served under the Individuals with Disabilities Education Act (IDEA; 2004) or 13.7% of all students in the United States (USDOE, 2019). According to IDEA, measurable goals in individualized education programs (IEP) related to employment are required for students beginning at the age of 16.
Implementation at this age gives the school as little as two years to assist students with disabilities in addressing and accomplishing their employment goals and beginning to look for work before they graduate if planning to do so by the age of 18.

If college is the next step for students with disabilities, two years of targeted support for this transition seems limited. At age 18 students with disabilities will no longer get support through an IEP nor are they protected or supported by IDEA. Instead, these students may attend college or seek employment support through various programs and partnerships. Whatever the pathway, the direct result of recent advances in advocacy allows many students with intellectual disability to attend college and university programs throughout the country. Yet current transition IEPs may not reflect these changes. One example of these advances are Transition and Postsecondary Programs for Students with Intellectual Disabilities (TPSIDs). According to Think College, a project of the Institute for Community Inclusion at the University of Massachusetts Boston approximately 4,000 students across 100 institutions of higher education (IHEs) in 31 states were attending TPSID-funded programs (Grigal et al., 2020). Grigal et al. (2020) stated that 93% of students who were participating in a TPSID program were involved “in at least one employment or career development activity” (p. 1). Of students who completed a TPSID program from the 2015-2016 academic year to the 2017-2018 academic year, 64% had a paid job one year post graduation. Grigal et al. (2020) noted students in TPSID programs were focusing on employment as an integral part of their learning process. Yet, Green et al. (2011), Lindsey et al. (2012), and Morash-Macneil et al. (2018), suggested any individuals seeking employment without time management skills could find that goal unachievable. Perhaps the answer to increased employment is earlier instruction and planning for critical job skills like time management.
Time Management Goals

A study by Brendle et al. (2019) looked at job quality indicators for individuals with learning disabilities and concluded schools should provide instruction in time management as well as opportunities to practice these skills in a workplace setting. Lindsay et al. (2012) conducted a study on an employment-training program for youth with varying abilities between 15 and 20 years of age and found, through interviews, one of the most important skills they learned was time management. Another study by Button et al. (2019) of students seeking academic consultation in college indicated 15% had the primary focus of wanting support with time management. Button further showed the majority of students who initially requested support in other areas ended up needing support in organization and time management to address their academic struggles.

Time Management using Assistive Technology in Employment and Educational Settings

A systematic review of literature was conducted on the use of AT for prompts and reminders specifically for students with disabilities. To date, a limited number of researchers have examined how smart devices impacted the time management of individuals with disabilities (e.g., Finn et al., 2015; Green et al., 2011; Legge et al., 2010). The Apple Watch did not appear in any current research, nor did the use of a smart device appear in any secondary education employment skills training setting. Despite time management being identified as a critical area for individuals with disabilities in employment settings (Morash-Macneil et al., 2018), minimal attention has been paid to using AT or other tools to address this issue aligned with employment outcomes.
Using the intervention of smart watches as an AT device for students with disabilities to increase their accuracy in arriving to assigned employment tasks in a controlled environment could transfer to future college and career pathways where time management is critical (Green et al., 2011). The purpose of this study was to determine the effectiveness of a vibrating smart watch (Apple Watch) using preprogrammed calendar events to improve time management skills of students with disabilities in an educational setting focused on developing employment skills.

**Summary of the Literature**

To better situate this study in the theoretical frameworks, the researcher conducted a systematic review of literature on the use of wearable smart watches as an intervention of AT for students with disabilities in educational or employment settings. The goal of the literature review was to identify key features in previous research to support the idea of using a wearable smart watch AT device for time management in an educational or employment setting for students with disabilities. Organization of the literature was conducted methodologically to highlight the best methods used for AT in time management. While countless resources exist on time management and AT for students with disabilities, many studies did not include specific parameters for the population of this study nor employment settings. As defined by Feak and Swales (2009), the researcher provided a narrative literature review to cover past research, methodologies, findings, and limitations to assist in the overall purpose, process, procedures, and outcomes of a study.

**Search Criteria**

Criteria for this literature review were based on the use of AT for time management for students with disabilities. This search was conducted through the University of Central Florida
online library databases including ERIC (EBSCOhost), Education Source, Professional Development Collection, and ProQuest. After an initial search was conducted, yielding very few articles, several synonyms and closely related search terms were added from the database thesauruses to expand the search. For example, “time management” was expanded to include “time on task”. Other search terms used along with AT included wearable technology, wearable device, smart phone, smart device, and smart watch. The search also included all suggestions for disabilities. An example of the Boolean search: ["disabilities" OR "intellectual disability" OR "Down syndrome" OR "mild intellectual disability" OR "moderate intellectual disability" OR "severe intellectual disability" OR "cerebral palsy" OR "developmental disabilities" OR "fetal alcohol syndrome" OR "genetic disorders" OR "intelligence" OR "learning problems" OR "neurological impairments" OR "pervasive developmental disorders" OR "special health problems"] AND ["time management" OR "time on task"] AND ["assistive technology" OR "smart watch" OR "smart phone" OR "smart device" OR "wearable technology" OR "wearable device"]. In all database searches, limitations were set to English only, peer-reviewed only, and published in 2007 or later.

Results were limited to English to avoid the need for translation. The decision to use research published as early as 2007 was based on the introduction of the Apple iPhone during that year. These parameters of dates were used to ensure the search was inclusive of any researchers who used Apple products such as the iPhone or Apple Watch. This search was not limited to smart devices made by Apple exclusively, rather it was based upon the introduction and instant popularity of smart technology at the time of Apple’s entrance to this field of technology creating a unique phenomenon as a starting point. The search using the parameters described across all mentioned databases returned a total of 118 articles. The articles were then
meticulously examined for duplicates, irrelevant works, or inability to be accessed. While duplicates were eliminated, further narrowing occurred by removing articles based on relevancy from reading the abstract. If the abstract did not provide enough information, the entire study was read by the researcher to determine relevancy. Included studies pertained to the intended population of individuals or students with disabilities including those identified by authors as being in a special education classroom, special needs classroom, or students having learning disabilities, autism, Down syndrome, intellectual disability, developmental delay, or cognitive developmental delay. Researchers whose works were included also focused on either time management or the use of AT for the purpose of time or task management. The classroom-type setting and age of the students were not used as excluding factors. Examples of non-relevant articles removed included but were not limited to an article focused on time management of neurotypical adults without the use of technology and a study of eye gaze technology for individuals with ID in video games. Only one article was inaccessible, it was published in South Africa and was not available through the inter-library loan at the time the literature review was conducted. The final results consisted of 18 relevant articles and only five empirical research studies conducted specifically including all criteria. A summary analysis of these five key studies is included in Table 1.
<table>
<thead>
<tr>
<th>Reference/Location</th>
<th>Population/ Sample</th>
<th>Measures</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finn et al. (2015)</td>
<td>ASD</td>
<td>Vibrating prompt watch-WatchMinder</td>
<td>WatchMinder was an effective prompting tool that contributed to their increased on-task behavior. “All participants were able to increase their productivity and independence” (p.1414).</td>
</tr>
<tr>
<td>Southeast, USA</td>
<td>Elementary 4 students</td>
<td>On task</td>
<td></td>
</tr>
<tr>
<td>Green et al. (2011)</td>
<td>Intellectual disability 1 female</td>
<td>Vibrating watch-WatchMinder2</td>
<td>“After intervention the participant showed an immediate and drastic change in performance once she began wearing the vibrating watch” (p.17).</td>
</tr>
<tr>
<td>Midwest, USA</td>
<td>22-year-old</td>
<td>On time management</td>
<td></td>
</tr>
<tr>
<td>Janeslätt et al. (2014)</td>
<td>Intellectual disability, ASD, spina bifida, and cerebral palsy 30 males 17 females Ages 6 - 11</td>
<td>Various time aides On time management</td>
<td>“This study provides evidence time-processing ability and managing one’s time can be improved by intervention using time aids” (p. 188).</td>
</tr>
<tr>
<td>Legge et al. (2010)</td>
<td>ASD and other disabilities 3 males 1-6th Grade 2-5th Grade</td>
<td>Vibrating MotivAider device Self-monitoring on-task behavior</td>
<td>“All three students in the study showed immediate and substantial increases of on-task behavior” (p. 48).</td>
</tr>
<tr>
<td>Van Laarhoven et al. (2009)</td>
<td>Intellectual disability 1 male</td>
<td>Video iPod prompting Employment tasks</td>
<td>“The introduction of video prompts delivered on the video iPod was associated with sharp increases in independent responding” (p.132).</td>
</tr>
<tr>
<td>Midwest, USA</td>
<td>17-year-old</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The overall theme of these articles reflected the need for researchers and teachers to find AT to assist students and individuals with time management skills. While the studies ranged from getting students to begin a task on time to helping them stay on task through the duration of an assigned time, all the researchers noted a need for students to receive assistance using AT to effectively manage time. All researchers reported positive outcomes for their participants quantitatively and demonstrated those involved supported the use of the device for time management. Three themes emerged across the studies related to (1) levels of technology from low to mid-range technology, (2) research on wearable devices, and (3) future research showing trends of combining various AT tools. The five studies identified are presented within these three categories.

**Low and Mid-Range AT for Time Management**

Janeslätt and colleagues (2014) in Sweden conducted an empirical study using various low to mid-range AT devices to assist children with intellectual disability to improve time management skills. These devices included an AT tool called a Handi II, wristwatches, alarm clocks, and paper style date calendars. The researchers found every individual with an intellectual disability had different learning needs to understand and comprehend time. The evidence from this study showed that time-processing and time management could be improved with the use of low to mid-range priced AT aides.

**Wearable AT for Time Management**

An emerging theme found for students with disabilities was the use of wearable devices for AT. A study by Legge et al. (2010) on self-monitoring of on-task behaviors used a device
called MotivAider, which clips to a waist band with vibrating capabilities. These researchers found this device increased the on-task behavior of all three participating students (all male) through self-monitoring. The researchers also found all students increased their on-task behaviors from baseline to fading and through the maintenance phases. While student reactivity would normally be a concern in this study due to participants self-reporting their data, Legge and colleagues reported a satisfactory interobserver reliability rating. The authors also reported a positive response to the MotivAider reiterating the willingness of the students to adopt and use new technology to improve their lives in various aspects. The MotivAider showed limitations in long-term use and the ability to adapt to participants’ needs in other areas (Legge et al., 2010).

Finn et al. (2015) also used a vibrating prompt reminder, WatchMinder, with four elementary students with autism spectrum disorder (ASD) in a multiple baseline study across settings to measure on-task behavior and independence in the classroom. The researchers’ findings in this study showed wearable AT, such as a watch, was effective in increasing student on-task behavior, productivity, and independence.

Green et al. (2011) examined use of a wearable AT device for an older student in a transition-type program. In this single case study, a 22 year-old female participant with an intellectual disability was participating in an on-campus internship and taking college classes. The researchers implemented an ABAB design study providing the participant with a vibrating WatchMinder2 device during the treatment phases to assist her with her time management of getting to class on time. During treatment phases, the WatchMinder2 provided vibrating prompts on her wearable wrist device reminding her to leave her internship at a given time to arrive class on time. The researchers’ outcomes showed a significant, “immediate and drastic change in performance once she began wearing the vibrating watch” (Green et al., 2011, p. 17). The
authors stated their findings have limited generalizability and additional research is needed to support the hypothesis that vibrating watches could assist individuals with intellectual disability in improving time management skills. The authors also noted such devices could ultimately be cost-effective with long-term use by individuals with disabilities leading to a higher rate of employment and increased independence (Green et al, 2011).

Combining AT for Employability

Previous research studies including populations of students with disabilities using AT for time management have largely been with simple devices such as a vibrating bracelet or vibrating clip-on device, requiring limited user interaction. Van Laarhoven and colleagues (2009) maximized the use of a more complex smart device in their research by merging the new capabilities of the hand-held video iPod with previous studies supporting video instruction. The researchers cited several other studies using video modeling and prompting to improve independence and employment skills of individuals with disabilities. In the Van Laarhoven et al. (2009) study a video iPod was used as an AT device by a participant playing step-by-step instructional videos of job tasks assigned during work. The participant’s supervisors stated his overall work production and independence were drastically improved with overall social validity stated as extremely high. The positive outcomes and social validity in this study provided evidence that using a combination of AT or potentially more complex devices could produce positive results for individuals with disabilities. However, using more complex tools could have barriers, Van Laarhoven and colleagues (2009) acknowledged a limitation of their work was the need to first train the participant on how to use the iPod Video. The researchers did note, however, many smart devices produced today are more similar than different in nature of options
and uses. This more universally designed platform could provide some familiarity and a foundational understanding of any tool for participants in future studies.

**Overall Relationship of these Studies to Proposed Research**

Each study referenced in Table 1 resulted in a positive change in the targeted behavior by using AT or smart technology for an individual with a disability. Despite limited presence of literature in this area at this time, in all empirical studies the researchers noted a call for further research. Each researcher specifically called for replication of AT devices involving various settings and measures of use, with a need for replication involving specific disability populations.

The researchers collectively mentioned the increasing affordability of technology being another reason for increased research in this area. While very basic and simple devices can be more cost-effective, devices with advanced functionality or multiple and future reminders despite being more costly are decreasing in price and increasing in access each year. Echoing the literature from this area, further research is essential.

**Summary**

The systematic review of the literature indicated from key studies that students with disabilities can use AT to learn employment skills, including time management. A need exists for additional research using AT for students with disabilities in educational and employment-type settings. The research previously conducted with students with disabilities using AT for time management occurred with low or mid-level technology devices such as a paper calendar, visual schedules, vibrating clip-on device, or preprogrammed vibrating wrist device. Only one case
used an Apple product, incorporating an iPod Video to assist with increasing overall timely work productivity (Van Laarhoven et al., 2009). New high-tech AT and smart wearable devices have yet to be incorporated into any known empirical studies for students with disabilities aligned with time management. Furthermore, no researchers have used an Apple Watch to assist with time management for educational or employment purposes for students with disabilities. Across the literature a need for additional research using AT for students with disabilities in educational and employment-type settings is evident (Finn et al., 2015; Green et al., 2011; Janeslätt et al., 2014; Legge et al., 2010; Van Laarhoven et al., 2009).
CHAPTER THREE: METHODOLOGY

Introduction

In this chapter, the researcher presents the methodology of this study. The researcher conducted a systematic replication study based on a study by Green et al. (2011) through a single subject ABAB withdrawal design to investigate the effectiveness of a wearable assistive technology (AT) smart watch (Apple Watch) using a preprogrammed schedule through the Apple calendar application emitting haptic vibrations, chime sounds, and digitally visual display of alert reminders to improve time management skills of students with disabilities rotating through employment skills stations. After establishing a stable baseline, each participant was provided an Apple Watch during the implementation phase to increase their time management in transition to their pre-scheduled employment skills stations.

Problem Statement and Research Questions

According to data provided by the 2018 Disability Status Report by Cornell University, 5.8 million individuals with disabilities of working age are unemployed (Erickson et al., 2020). Researchers have suggested employed individuals require time management skills to be successful in the workplace (e.g., DiPipi-Hoy et al., 2009; Lindsay et al., 2012; Morash-Macneil et al., 2018). With the advancement of AT, several researchers found promising results with the use of AT for time management for individuals with disabilities (Finn et al., 2015; Green et al., 2011; Legge et al., 2010). However, generalizations about the impact of time management from these studies is limited due to the small sample sizes, lack of replication, wide age range of participants, and various types of settings where the studies were conducted (see details in Table 1). The researcher in this study investigated the use of a newer AT device not currently
represented in existing research, the Apple Watch, and the impact of its use on time management for three individuals with disabilities in a career training program (CTP) on their high school campus.

The research questions guiding the research were:

1. To what extent do calendar alerts on an Apple Watch affect the time of arrival to a career training program employment skills workstation for students with disabilities?
2. What are the perceptions of students and teachers regarding the goals, use, and outcomes of the implementation of a smart watch for time management as measured by a survey?

Institutional Review Board (IRB) approval from the university (see Appendix A) and school district, parent approval, and participant consent were obtained prior to data collection. An Apple iPad using a web-based software tool called Qualtrics®, disguised to imitate a time clock, was used to collect the arrival time of participants to each station. Using Qualtrics as a time clock for the purposes of participants checking in at their stations, ensured reliability and accuracy of the arrival time data collection. The teachers located at each station were responsible for making sure students clocked in upon their arrival as a requirement prior to the study.

Research Design

A single subject withdrawal design across participants was used following an ABAB design. The researcher implemented two baseline phases (A₁ and A₂) and two intervention phases (B₁ and B₂). The first baseline phase (A₁) reflected baseline data collected during business as usual to determine each student’s current level of time management. These
procedures aligned with What Works Clearinghouse: Standards Handbook 4.0 (2017), that a minimum of five data points should be collected with no upward trend in the data.

During the baseline phase (A₁), the Apple Watch was not provided and each participant’s arrival time to each station was recorded as business as usual. The introduction of the Apple Watch during the intervention phase (B₁) provided the first look at the magnitude in the data. The Apple Watch was rescinded during the return to baseline phase (A₂). The reintroduction of the Apple Watch in the final phase (B₂) allowed for evidence of an intervention effect. The ABAB withdrawal design method was selected based on ease of implementation and strong experimental control but not without first weighing the risk of reversing a potentially effective intervention (Byiers et al., 2012).

Prior to the first intervention phase (B₁), participants were given a brief tutorial on what an Apple Watch does, what to expect, the alerts the watch produces and were required to demonstrate mastery of checking and dismissing the calendar alerts presented on the watch after a demonstration by the researcher. Participants demonstrated mastery by being fitted with the watch in the presence of the researcher while a test alert was emitted to the watch and the participant heard the chime, felt the haptic, and saw the displayed alert, then successfully dismissed the alert by either covering the watch with their other hand, pushing the side button of the watch, or hitting the Dismiss button on the face of the watch with the alert.
Participants

The study participants \( (n = 3) \) were high school age students (17 to 18 years old) meeting the following criteria: (1) current method of instruction was through Access Points, (2) participant in the school’s CTP located on the school’s campus, (3) ability to wear a wrist watch for an extended period of time, and (4) ability to use touchscreen-type technology. Access Points is defined as “academic expectations written specifically for students with the most significant cognitive disabilities, reflect the essence or core intent of the standards that apply to all students in the same grade, but at reduced levels of complexity, and ensure all students are academically challenged and taught to high standards” (Florida Department of Education, 2021). Therefore, the population of students involved in this study were following an educational program based an IEP specifically exempting them from passing the standard curriculum for a diploma. Students who have sensory disorders, an emotional disturbance, or a 504 plan were excluded from participation.

Characteristics of the study participants are presented in Table 2. Pseudonyms were used for this study. The specific diagnosis of each participating student was not provided to the researcher following the guidance of the IRB and school policies to protect student privacy. Therefore, the level of access points curriculum the participant’s accessed identifies their need for vocational support were a clear component of each students’ IEP.
Table 2  
Study Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Sex</th>
<th>Race</th>
<th>Curriculum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margaret</td>
<td>18</td>
<td>F</td>
<td>Black</td>
<td>Access Points</td>
</tr>
<tr>
<td>Cynthia</td>
<td>17</td>
<td>F</td>
<td>White</td>
<td>Access Points</td>
</tr>
<tr>
<td>Patricia</td>
<td>17</td>
<td>F</td>
<td>Black</td>
<td>Access Points</td>
</tr>
</tbody>
</table>

**Setting**

All participants \( n = 3 \) completed baseline and intervention phases of the study by participating in multiple employment skills workstations while being supervised at all times by a school instructor, administrator, or other school personnel in a joint middle and high school in the Southeastern United States. The employment skills workstations were located on both the first and second floors of a two story school building; three stations upstairs and four stations downstairs. The employment skills workstations provided various employment skills trainings predetermined by the school’s CTP transition teacher and school principal as a part of the overall school CTP expectations and independent student goals. This CTP consisted of seven workstations: Culinary Assistant (see Figure 2), Administrative Assistant (two stations), Educational Assistant (see Figure 3), Computer Skills, Financial Literacy (school store: see Figure 4), and Physical Education Assistant. Students worked on a variety of different career skills and were given responsibilities based on that station (see Table 3). Each student attended four of the seven stations on any given day based on their career interests and goals which were predetermined by the CTP teacher and reflected on their CTP schedule ensuring they were only assigned to stations based on their goals. Each workstation within the school was supervised by a
teacher or school personnel who verified student’s clock in on arrival and conducted assigned tasks. The time clock was located at the entrance of each station in direct view of the station teacher. The researcher was present on site every day of the study. Every day of the study the researcher verified the time clocks were in their correct locations, charged and correctly connected to the school wi-fi to ensure time clock data was recorded without fail. During data collection, the researcher also confirmed each student’s time clock data was properly recorded at each station after the appropriate start time of the station. Each day during the implementation phases, the researcher also made certain the watches were correctly synchronized to the CTP schedules.

Figure 2: Cafeteria
Figure 3: Educational assistant

Figure 4: School store
<table>
<thead>
<tr>
<th>Station (Location)</th>
<th>Examples of Responsibilities / Skills Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culinary Assistant (Cafeteria)</td>
<td>Sanitation, meal preparation, proper temperature checks of food, customer service, kitchen equipment understanding</td>
</tr>
<tr>
<td>Administrative Assistant x2 (Front Desk/CTP Assistant)</td>
<td>Greeting visitors, collect and distribute teacher mail, organize paperwork, filing, using office technology (copier, etc)</td>
</tr>
<tr>
<td>Educational Assistant (Classroom)</td>
<td>Distributing/collection student iPads, classroom organization, leadership, assist in supervision during lessons</td>
</tr>
<tr>
<td>Computer Skills (Classroom)</td>
<td>Checking, creating, sending/receiving emails, Microsoft office (Word, Excel, Power Point), basic information search</td>
</tr>
<tr>
<td>Financial Literacy (School Store)</td>
<td>Counting money, managing a cashbox, maintaining inventory, restocking, customer service</td>
</tr>
<tr>
<td>Physical Education Assistant (PE Class)</td>
<td>Understanding and prompting health and fitness, leadership, maintaining equipment, safety, supervision</td>
</tr>
</tbody>
</table>

**Instruments**

The intervention instrument was the Apple Watch Series 6 provided during the intervention phases (B₁ and B₂) of the study. The Apple Watches were preprogrammed with the participant’s CTP workstation schedule. This Apple Watch provided a preprogrammed alert reminder for participants 3 minutes before their workstation began and then a final alert reminder 1 minute before their station began. This procedure was repeated for students’ four stations per day during the intervention phases of the study (B₁ and B₂).

**Dependent Measure**

A data spreadsheet was downloaded from the Qualtrics website with the time of arrival of each participant to each station (see Figure 5). A minimum of five data points per participant...
were collected in each phase of the study. Each participant was given two alerts to move to the next station through the vibration, sound, and display of the Apple Watch during both intervention phases. During each phase of the study, participants clocked in using the time clock at the station which recorded their arrival time. A time interval of (+x) was recorded if the participant clocked in past the assigned arrival time and a (-x) time interval indicated a student arrived before the assigned arrival time. For example, if a participant was to arrive at 10:30 but arrived early at 10:27, a (-3) rating was assigned. If they arrived at 10:35 then a (+5) was recorded. The participants’ arrival at one station was considered one session. The teacher or school personnel assigned to each station was responsible for ensuring the student clocked in at their time of arrival. The assigned school personnel at each station did not prompt the participant to arrive at any time but did ensure the participant clocked in upon arrival if it was observed they had not done so.

<table>
<thead>
<tr>
<th>Recorded Date</th>
<th>01 - Who is Clocking-in?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 19, 2021 11:50 AM</td>
<td>Cynthia</td>
</tr>
<tr>
<td>Apr 19, 2021 11:50 AM</td>
<td>Patricia</td>
</tr>
<tr>
<td>Apr 15, 2021 1:14 PM</td>
<td>Margaret</td>
</tr>
</tbody>
</table>

Figure 5: Qualtrics Example

29
Independent Variable

The independent variable in this study was the intervention of calendar application alerts through the use of an Apple Watch, a wearable smart watch. The watch provided a haptic vibration, audible sound, and visual display of alert reminders for time management purposes. All other prompts and capabilities of the watch were silenced or simply not utilized for this study. Through the natural use of the watch, additional background data were automatically collected but were not identifiable by participant and were not used in this study. An example of background data collected was geographical location using wi-fi technology, which did not change as the participants did not leave the school campus, and the watches did not go home with the participants. These background data were not identifiable by participant as the watch was not programmed using participants’ names. The participant using each watch was coded through a deidentified structure. In the interest of transparency, the researcher was unable to opt out of being provided the extraneous data collected by the Apple Watch the when a summary of use of the watch was downloaded. However, the data were not used of analyzed, were deleted, and the Apple Watch was reset to factory settings at the completion of the study with no identifying or connecting supplemental information to participants of the study.

Procedure

This study was conducted using an ABAB withdrawal design across subjects. All participants began the baseline phase ($A_1$) at the same time. The researcher collected data in the baseline phase to establish trend data. The intervention phase ($B_1$) followed. During the
treatment phases (B₁ and B₂), the Apple Watch was provided to the participants for use of assistance with time management. A minimum of five data points per participant were collected in both baseline and treatment phases.

Sessions

Students participated in the CTP three days per week: Monday, Tuesday, and Thursday. Each participant rotated through four workstations each day. Participants arrived at the CTP and were provided a station schedule by the CTP teacher assistant. Participants were then expected to report to their first employment skills workstation. Approximately 7 minutes were provided to move from the classroom to the CTP station, this was ample time based on the locations of the stations and characteristics of the participants. Participants then rotated through four assigned stations according to their schedule.

An artificial ceiling was put in place as the maximum amount of time recorded before or after arrival and designated as (+5) minutes or (-5) minutes. The 5-minute timing was based on a precedent set by Green (2011). This artificial ceiling ensured students did not miss their employment skills training entirely as the point of the CTP was for the students to be present at their stations to practice their skills. The 5-minute window was approved by the head CTP teacher as providing opportunity for participants to be late due to a bathroom break, talking to friends, or simply losing track of time. If a student arrived to their assigned station more than 5 minutes before or after the scheduled start time, 5 minutes was the amount of time recorded. To
ensure students gained CTP skills, the school personnel prompted the student after 5 minutes as the AT device no longer provided prompts.

Each station assigned to a participant was considered a session and each session a potential data point. Station assignment and order was determined by the head CTP teacher based on students’ goals and interests and schedules were distributed by the CTP teacher assistant. The duration of the study was four weeks and alternated between baseline, treatment, baseline, and treatment as data were collected based on the guidelines of What Works Clearinghouse: Standards Handbook 4.0 (2017).

**Baseline**

During baseline sessions the CTP teacher assistant provided participants with a schedule of their assigned stations each day with the assigned time they were to begin each station. The times did not change from day-to-day, but the stations changed each day. The CTP teacher assistant provided verbal prompting to a student who had not made it to their station after 5 minutes; this aligned with the 5-minute artificial ceiling set by the researcher. Time was set as an artificial ceiling following a precedent set by Green (2011). This artificial ceiling ensured students did not miss their employment skills training entirely as the point of the CTP was for the students to be present at their stations to practice their skills. The 5-minute window was expressed by the head CTP teacher as being ample opportunity for participants to be late due to a bathroom break, talking to friends, or simply losing track of time. If students’ arrival time at the workstation was recorded by the time clock as beyond 5 minutes late, the data point was only
recorded as plus five (+5) minutes, likewise if they were early to a station by 5 minutes or more the data point was recorded as minus five (-5) minutes. Baseline phase (A1) data for one example participant is presented in Table 4. Each phase was considered complete if a minimum of five data points were stable with a reoccurring late or on-time trend.

Table 4
Baseline (A1) Example of Data Reporting Structure

<table>
<thead>
<tr>
<th>Baseline Phase</th>
<th>Station Start Time</th>
<th>Participant Arrival Time</th>
<th>Time Difference (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 1</td>
<td>10:52</td>
<td>10:57</td>
<td>5</td>
</tr>
<tr>
<td>Session 2</td>
<td>11:50</td>
<td>11:51</td>
<td>1</td>
</tr>
<tr>
<td>Session 3</td>
<td>12:29</td>
<td>12:34</td>
<td>5</td>
</tr>
<tr>
<td>Session 4</td>
<td>1:05</td>
<td>1:10</td>
<td>5</td>
</tr>
<tr>
<td>Session 9</td>
<td>10:52</td>
<td>10:56</td>
<td>4</td>
</tr>
<tr>
<td>Session 10</td>
<td>11:50</td>
<td>11:53</td>
<td>3</td>
</tr>
<tr>
<td>Session 11</td>
<td>12:29</td>
<td>12:34</td>
<td>5</td>
</tr>
<tr>
<td>Session 12</td>
<td>1:05</td>
<td>1:10</td>
<td>5</td>
</tr>
</tbody>
</table>

Introduction of the Apple Watch

Study participants were introduced to the Apple Watches following the framework of the Cycle of Adoption of Assistive Technology for students with intellectual disability by Kintsch and DePaula (2002). Step 3 in this framework is the Learning Phase, which requires the user to learn to use the device and for the researcher to assess the user’s learning style. Prior to the first employment skills session of the treatment phase each participant was assigned and fitted with an
Apple Watch by the researcher. The researcher provided participants with a training session lasting 5 minutes on how to view the time and dismiss the calendar alerts. The researcher did not provide any training on any other applications on the watch as no other features of the watch were accessible due to the explicit focus of the study. To address the users’ learning styles, as indicated in the Cycle of Adoption framework, the researcher made any adjustments to the physical fitting of the watch on the users’ wrists and any settings the students preferred or did not prefer based on individual needs. Such settings included the option for analog, digital, or voice output for the watch’s time function based on users’ understanding and needs. The watch made three distinct notifications in the form of haptic vibrations, audible chime, and digital visual alert on the display screen. These features could be altered based on students’ needs by the researcher adjusting the settings on the watch. Unless a change was requested, the participants’ notification types were turned on and set to the default setting. As demonstrated prior to intervention, participants were able to dismiss an alert by (a) holding up their wrist to look at the watch and pressing ‘Dismiss’ with their finger, (b) pressing in on the side button of the watch, or (c) using the palm of their opposite hand to cover the face of the watch.

Setting Up the Apple Watch

All scheduled dates and times of the employment skills training sessions were provided to the researcher by the head CTP teacher. The assignment of station schedules occurred in advance for purposes of preprogramming the watches with all necessary information prior to the treatment phases. Each watch was individually paired with the researcher’s Apple iPhone and coded based on the color of each watch band. The standard black silicone band, which comes
with the Apple Watch, was replaced with one-size fits-all hook-and-loop bands of distinct colors including black, purple, and red. The default settings for each Apple Watch were set and updated prior to the study. All watches were set to a default setting of English for this study. All watches were paired and synced to the researcher’s iPhone 11 Pro Max, Apple ID, and iCloud accounts. The researcher manually set up each watch individually to ensure it only synced calendar data through Apple’s calendar application. The settings of the standard applications on the Apple Watch, which cannot be deleted from the watch, were each individually opened in the Apple Watch application on the researcher’s iPhone and checked to ensure all notifications and data collection were turned off. Additional settings, such as Apple analytics feedback and locations services were also turned off. Some applications preinstalled on the watch could not be removed or disabled, such as the compass application which collected no data. During the set-up of the watches, all text was set to the largest viewing size with sounds and vibrations being set to the highest level, and with all notifications turned off except for those in the calendar application. The Apple Watch also provided numerous watch face options to show the current time. Unless changed by the participant or at a participant’s request all watches were set to the digital ‘X-Large’ face option by the researcher. The researcher also ensured all watches were updated with the most recent software at the time of the study, watchOS 7.2 by Apple Inc.

Calendar Notifications

Advanced calendar settings were controlled on the iPhone and synced to the Apple Watches. Under the calendar options, ‘Notifications’ were set to ‘Custom’; ‘Allow Notifications’ were set to ‘On’; ‘Upcoming Events’, ‘Invitations’, ‘Invitee Responses’, and ‘Shared Calendar
Alerts’ were all set to ‘On’; ‘Notification Grouping’ was set to ‘Automatically’; and the ‘Calendars’ chosen to be synced to the watches were set exclusively to the ‘CTP’ calendar, created by the researcher on the researcher’s iCloud calendar account for all training sessions the participants were to attend. The master ‘CTP’ calendar is where each session was created and added as an event with event reminders and notifications turned on. When the station sessions were created as events on the master ‘CTP’ calendar, the event was synced to participants’ Apple Watch calendar. An event on the calendar was created for each station the participants attended for each day of the study. The calendar event for each station session had two set for 3 minutes before the start of the station and 1 minute before the start of the station. This setting was preset for all four station sessions each day. In the creation of each calendar event for each station, a custom alert was created due to the only options immediately available to select being in increments of 5 minutes. The procedures used for this option were to select a ‘custom’ alert and then input ‘3’ for the number of minutes before the event the alert is set to go off and then selecting the ‘prior to time of event’ alert option. A custom alert was then created to add a ‘1 minute before’ alert; these settings were all created by the researcher. Both alerts were created with the ‘message with sound’ option selected for the alert. These alerts also appeared on the display of the watch with a haptic vibration automatically except when the setting was turned off manually for one student at her request prior to phase B2. The audible alerts were not found to be loud enough to disturb others. Participants reacting to other students leaving for their station was not of concern due to variability of schedules and movement of other students in the class heading to various locations throughout the school.
**Intervention**

During the treatment phase (B₁), participants were provided an Apple Watch for their employment skills training sessions and instructed to follow the alert reminders provided by the Apple Watch to ensure they were not late in arriving at their next workstation. Participants engaged in the exact same schedule format during the intervention phase as during baseline. The Apple Watch provided participants with reminders when they needed to arrive at their workstation. The time clock continued to record the arrival time of each participant at their station. The researcher continued to monitor the data recording site to ensure all data were recorded appropriately. Example of intervention phase data reporting are displayed in Table 5. The artificial ceiling was still applied if a participant had arrived to their station more than five minutes late or five minutes early in intervention.

<table>
<thead>
<tr>
<th>Intervention Phase</th>
<th>Station Start Time</th>
<th>Participant Start Time</th>
<th>Time Difference (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 13</td>
<td>10:52</td>
<td>10:50</td>
<td>-2</td>
</tr>
<tr>
<td>Session 14</td>
<td>11:50</td>
<td>11:49</td>
<td>-1</td>
</tr>
<tr>
<td>Session 15</td>
<td>12:29</td>
<td>12:27</td>
<td>-2</td>
</tr>
<tr>
<td>Session 16</td>
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Reliability and Validity

The results of the participant data were validated through the use of a web-based data collection system, Qualtrics. The data were then downloaded and transferred to an excel spreadsheet for analysis. A research assistant verified and confirmed all data were downloaded and imported correctly. To add to reliability and validity of the time clock data, each station teacher ensured students were clocking in correctly at the moment of their arrival. The researcher also shadowed station sessions to ensure station teachers were verifying participants were clocking in. Furthermore, the researcher and research assistant verified in Qualtrics after every session that participants clocked in under the correct name and at the correct station time clock. This validation of the participant data was conducted by the researcher and a research assistant by cross referencing student’s work schedules and the name clocked in using the Qualtrics time clock. The researcher set an acceptable level of 80% inter-observer agreement based on the guidance of Hartmann et al. (2004) using point-by-point agreement. Inter-observer agreement was determined using a point-by-point method. To determine the percentage of agreed-upon points, the total number of agreements between the observers was divided by the total number of agreements plus disagreements, and multiplied by 100. A minimum of 80% agreement was set for this study, with a preferred agreement of 90%.

Data Analysis

The data analyses were conducted using visual analysis of the ABAB withdrawal design graphs and a calculated effect size. Success of the intervention was determined by the participants’ increase in accuracy of on time arrival and effect size. A visual analysis of the data provided insight into stability, trend, and magnitude of differences in treatment to baseline phase.
The researcher used a single subject effect size calculator and the data points collected to determine the effect size of the study.

The participants and station teachers at the school were asked to complete a survey to gauge the satisfaction of the goals, procedures, and outcomes of the study (see Appendix C). The survey was designed using a four-point Likert scale. Participants and teachers were asked to complete this survey on the last day of the study.

**Anecdotal Notes**

The researcher took notes daily on any statements or observations made by each participant. These notes were used to inform the discussion of the outcomes of the study. These anecdotal notes along with analyses of the ABAB design will be described in Chapter 4. In Chapter 5, the researcher will explain the relationship of the findings to past research, current issues in time management and employability, and future implications of the use of AT devices for time management and employability for people with disabilities.
CHAPTER FOUR: RESULTS

Introduction

Time management is considered one of the top five attributes employers look for in a future employer (Rhew et al., 2019). People with disabilities often lack the mastery of time management skills needed to be successful when they are employed (DiPipi-Hoy et al., 2009), this employment skill may be a contributing factor to the statistics of why a marginalized population, individuals with disabilities often are unemployed or underemployed (Erickson et al., 2020). Studies by Maich et al. (2019) and Morash-Macneil et al. (2018) support the idea that individuals with disabilities could increase critical job readiness skills, such as time management, using assistive technology (AT). Increased time management could lead to a better pathway for employment, productivity, or even higher wages (Kelly, 2002). The researcher in this study attempted to address the issue of time management skills using a wearable AT device, the Apple Watch. The participants in this study were students with disabilities participating in a high school career training program (CTP) with goals of employment post-graduation. Participants were identified as needing assistance with time management skills. The researcher provides the results aligned with each of the following research questions:

1. To what extent do calendar alerts on an Apple Watch affect the time of arrival to a career training program employment skills workstation for students with disabilities?

2. What are the perceptions of students and teachers regarding the goals, use, and outcomes of the implementation of a smart watch for time management as measured by a survey?

The researcher employed a single subject experimental research case study following an ABAB withdrawal design ($n = 3$). Each student was given an Apple Watch during both intervention phases as AT to support time management using Apple’s Calendar application.
Participant results are individually discussed and changes in behavior are presented through a visual analysis of each participant’s graph.

Given the nature and culture of the participating school and during the time of a pandemic, video recordings for inter-observation agreement and reliability were denied. In lieu of video recordings, the arrival time of students was recorded by a time clock on an iPad. Each student “clocked-in” when they arrived at their respective career station. Baseline data were collected during the initial baseline phase (A1) by recording students’ arrival times to their workstations without the intervention of prompts and reminders from their CTP teacher assistant. Students were prompted by the teacher assistant if they exceeded an artificial ceiling of being 5 minutes late to a station; ensuring students did not entirely miss essential career skills training. When the first intervention phase (B1) began, each participant was given an Apple Watch. The Apple Watch emitted two alert notifications to participants at 3 minutes and 1 minute prior to their scheduled career station start time. The Apple Watch was then rescinded during return to baseline phase (A2) and again provided during the return to intervention phase (B2).

Before baseline began, each participant was asked to demonstrate mastery of the time clock using the iPad. All participants verbally confirmed and physically showed the researcher they could recognize and identify their name located on the time clock, physically click their name on the screen, and hit the enter button to ensure the correct arrival time to was recorded. All participants completed this 10-minute training session with 100% accuracy. The CTP teacher assistant also confirmed students knew the location of each of the workstations and how to physically navigate to each station.

Prior to intervention, participants were provided an Apple Watch with preset calendar alerts synced to the watch. In their CTP class, prior to the start of their employment skills
workstations, each participant was fitted with an Apple Watch and adjusted for comfort. Once all participants were comfortably fitted with the watch, a test alert was sent and each participant indicated they heard, felt, and could see the alerts. All participants also demonstrated ability to silence and dismiss the alert.

During Baseline (B1), each student was observed for a minimum of six (6) sessions, then the intervention of using the Apple Watch to prompt them to arrive on time occurred for eight (8) sessions during (A1), during the return to baseline (B2) students completed eight (8) sessions without use of the watch, then during intervention phase two (A2) students again wore the Apple Watch. Baseline phase A1 took six (6) sessions for one participant and eight (8) for the other two participants to record enough data points for stability. This phase took longer than expected as each participant was absent at least one day during baseline.

During baseline (A1), all participants were observed struggling tremendously to follow their CTP schedule in a timely manner without any intervention or assistance. All participants were late to their station every time with a majority of the time only making it to their assigned station after being prompted by the teacher assistant after being at least 5 minutes late. One participant was only late by 1 minute during the first baseline session as they saw a teacher assistant that works at the students upcoming assigned station in the hallway. The sight of the teacher assistant appeared to immediately remind the student, with no prompting, to head to their station. During the intervention phases B1 and B2 each participant was able to transition to their assigned station independently and successfully and clock-in without being late during any session.
Single Subject Results per Participant

Margaret

Margaret was an 18-year-old female participant. During the baseline phase A1, she was late 100% of the sessions with prompting needed after 5 minutes during 50% of the sessions. For one session she arrived only one minute late after seeing a teacher assistant associated with the station she was scheduled to be at walking by her classroom. For all other sessions during baseline phase (A1), Margaret was a minimum of three minutes late 88% of the time and reaching or exceeding the maximum five minutes late (ceiling) for 50% of baseline sessions. Margaret was absent during the second day of data collection but was still able to complete eight consecutive sessions and establish baseline before moving from A1 to intervention B1.

The researcher observed Margaret as being consistently late possibly due to her constant use of her laptop. She would either realize she was late or was prompted to head to her station after being five minutes late. One session when she was late, she was observed chatting with a non-CTP classmate who was in the classroom. Margaret was consistently late to her station for eight consecutive sessions establishing a stable trend of data for baseline.

When Margaret was presented the AT device, a visual analysis revealed an immediate on-time trend in the data. The on-time trend observed was maintained throughout the use of the Apple Watch intervention. Throughout this phase, Margaret was on time or early to her station for all eight sessions. It is worth noting that the sessions in which Margaret was scheduled to report to the classroom of the CTP teacher assistant for computer skills training, she appeared to have much more willingness to arrive quickly in both baseline and intervention phases. The researcher observed a close friendly relationship between Margaret and the teacher assistant in the room, which may explain her attentiveness to arrive on time throughout the study. Through
the visual analysis of the intervention data, Margaret may have been more attentive to the first alert on the watch during the second intervention phase (B2) compared to that of the first intervention phase (B1). This fact could be contributed to a learned behavior and familiarity of the watch in her phase (B2) as she often arrived earlier to her sessions than during intervention phase B1.

Effect and magnitude are visually apparent when the intervention began through the visual analysis of the graphed results in Figure 6. Following the recommendations of Scruggs and Mastropieri (1998) the percentage of non-overlapping data (PND) was found to be highly effective (1.0). Margaret clearly benefited from the use of the Apple Watch as an AT for time management in her CTP.

![Figure 6: Results of Margaret's arrival times](image)

Cynthia

Cynthia was a 17-year-old female student. Cynthia was absent the first day of data collection but was present for the completion of eight consecutive sessions and established a steady baseline before moving to intervention. Cynthia also left early the last day of the study, completing only six sessions during intervention B2. Cynthia was described as a non-self-starter.
by the CTP teacher assistant and needing to be prompted and reminded where and when she needs to be somewhere. This lack of initiative to be on time was evident during baseline (A₁) as she was late to every session. Cynthia met or exceed the 5-minute late mark for five of the eight sessions (62.5%) during both baseline phases (A₁ and A₂) when there was no intervention present. The researcher noted and confirmed that Cynthia did better by matching the numerical time when she sees it listed on her schedule with that of the digital clock on her phone. Cynthia stated she would often see the time on her schedule and when it showed up on her phone she would then head to her station, causing her to be late each time due to her lack of understanding of the concept of time.

A visual analysis of Cynthia’s graph shows a large response magnitude between baseline A₁ and the intervention phase B₁. The use of the Apple Watch was found to be beneficial to Cynthia as she arrived on time to her station every session during the intervention phases. Cynthia requested at the beginning of the second intervention phase (B₂) that the haptic alert be turned off. She stated it bothered her and preferred only the sound and the visual display on the watch when it was time to go to her station. The researcher did not see any difference in reaction or timeliness for Cynthia between intervention B₁ to intervention B₂ as it related to the watch’s alerts. In fact, Cynthia’s average arrival time improved during the second phase of intervention dismissing the researcher’s concerns for changing watch setting preferences in the middle of the study. The significant positive change in the data when the intervention of the Apple Watch was deployed is evident in the visual analysis of the graph seen in Figure 4. A The use of the Apple Watch as an AT for time management for Cynthia was successful.
Figure 7: Results of Cynthia's arrival times

Patricia

Patricia was a 17-year-old female student. Patricia was absent during the first day of data collection and then late the second day but was able to complete six sessions to establish a baseline (A1). After establishing stability in phase A1, Patricia moved into intervention phase B1 at the same time as her peers. Patricia, like her peers, also was consistently late for every session during baseline. She stated to the researcher, and was known by the CTP teacher assistant, to understand time management but was easily distracted. According to one station teacher, Patricia liked portraying the persona of being more independent than her peers but would often quietly seek out support from teachers without drawing attention. The researcher noted Patricia often was sporadic in attention and inconsistent with her focus. The researcher noticed she often focused on social media on her phone and lots of small talk and conversations with anyone willing to give her attention. In one instance during baseline A1, Patricia was 20 minutes late to her station (Session 1). When the researcher did not see a time clock check in after her being 10 minutes late, the researcher went to the assigned station to determine if an issue existed with the time clock. Patricia was not at the station and was found talking to a friend she happened upon in
the hallway on the way to the assigned station. While Patricia’s arrival times were inconsistent, she was consistently late during every session of baseline both phases A₁ and A₂.

Evident response magnitude occurred when the intervention was introduced noted through a visual analysis of the graph in Figure 8. The implementation of the Apple Watch gave Patricia the subtle prompts she wanted without drawing too much attention. While the interference of noticeable distractions with Patricia’s ability to transition to her employment skills workstation decreased, the second alert on the watch indicating only one-minute left appeared to make the difference for Patricia during intervention. She stated the first alert told her to “Get up!”, and the second alert told her to “Hurry up!”. Patricia stated with the reimplemention of the watch in phase B₂, she tried her best to get to the station right after the first alert. This change in her behavior is evident when examining phase B₂ data as she was often earlier to her station compared to phase B₁. This change could be seen as learned behavior or reactivity as she may have altered her performance in attempting to be more prompt after becoming familiar with the watch or because she was more aware of being observed when she was wearing the watch. Additionally, the researcher noticed Patricia had some kind of alarms going off on her phone during the return to baseline phase A₂ when the Apple Watch was rescinded, but this use of an alarm could not be confirmed as having anything to do with the study. Patricia did state it was for another purpose, when asked by the researcher. The researcher believes she was trying to imitate the absence of the watch with the alarms on her phone.

Effect and magnitude were immediately apparent for the intervention on Patricia’s arrival time when the intervention began through researcher observation and visual analysis of the graphed results seen in Figure 8. The PND was found to be 100% suggesting the treatment was
highly effective. Patricia noted she felt she clearly benefited from the use of the Apple Watch as an AT for time management in her CTP.

![Graph: Patricia's arrival times](image)

**Figure 8: Results of Patricia's arrival times**

**Visual Analysis of All Participants**

A minimum of four phases with five data points collected for each participant during each phase, as met in this study, meets the What Works Clearinghouse (2017) reversal/withdrawal standards without reservations (p. A-5). Six features were assessed individually and collectively to determine if the results from this single-case study demonstrated a casual relationship represented through evidence ratings. These features of level, trend, variability, immediacy of the effect, overlap, and consistency of data was reviewed within similar phases (What Works Clearinghouse, 2017, p. 98). In this study trend was established as consistently on-time or consistently late. The data in Figure 9 shows each student’s averages for late time of arrival to their stations in phase $A_1$ at 4.1, 4.3, and 4.3 minutes respectively. The range in baseline phase $A_1$ for Margaret was 1-5 minutes late and 3-5 minutes late for both Cynthia and Patricia. Overall, the data presented in baseline $A_1$ for all participants established a clear stable
pattern of tardiness considered unacceptable if left unaddressed, potentially impacting future employability.

![Graph showing combined results of all participants' arrival times.](image)

Figure 9: Combined results of all participants' arrival times

Continuing with the visual analysis, level, trend, and variability of each phase differed in slope, mean line, and overall visual presentation. Significant differences existed between the
response magnitude for each phase of all three participants. Additionally, no overlapping data points occurred resulting in 100% PND for each participant, which is seen as a highly effective treatment (Scruggs & Mastropieri, 2001).

**Inter-Observer Agreement**

Participant arrival times to their workstations were collected electronically using a time clock on an iPad through a web-based software tool, Qualtrics. A survey was created in Qualtrics disguised as a time clock allowing students to see their name on the iPad (see Appendix B). Students then selected their name and hit enter. Their arrival time was instantly time stamped similar to the protocol for a typical job. Psychometric properties of Qualtrics were not of concern to the researcher as computer and e-based data capturing systems are typically used with confidence in research due to the unbiased electronic recording of data (Morley et al., 2015). Out of due diligence, the researcher cross checked and verified with station teachers approximately 50% of the sessions to ensure student arrivals were recorded immediately using Qualtrics. The researcher and research assistant verified the data collected in Qualtrics was correctly recorded based on the session and the name of the assigned career station. All data recorded were checked and cross referenced with students’ schedules and agreement using point-by-point agreement was found to be 100%.

**Social Validity**

Participants and their teachers who assisted with their assigned workstations were asked to answer survey questions (see Appendix C) regarding their satisfaction, thoughts, and feelings towards the outcome of the study. Participants and teachers answered the same questions. Five
statements were posed using a four-point Likert scale: (1) participation has helped increase overall time management skills; (2) self-awareness of time/time management has increased; (3) self-initiation of more time related inquiries have increased; (4) generally attempting to be more on time to things outside of school; and (5) increased positivity towards time management. Each of these statements elicited a response with: (a) no, it has gotten worse (score of 1); (b) no, it has stayed the same (score of 2); (c) yes, somewhat better (core of 3); (d) yes, significantly improved (score of 4). Two additional questions were asked in a yes or no format: (1) Has you/your student benefited from this intervention? (2) Would you recommend this intervention for other children/students? Finally, participants and teachers were asked to provide any additional comments. The average score by participants (n = 3) was 4.0, indicating the participants felt they significantly improved in all areas. All three answered they felt they benefited from this study intervention, and they would recommend the study intervention to other students. The average score by teachers (n = 2) was 4.0, indicating teachers felt participants significantly improved in all areas. However, question four was not completed by either teacher due to the lack knowledge of students’ behavior outside of school. The participating teachers both indicated on the survey they felt the students benefited from this intervention and would recommend this study intervention to other students.

All students indicated they liked using the Apple Watch for time management, and they felt the watch kept them on time with their CTP schedule. One student stated they wish they could keep the watch and use it outside of school. All station teachers who participated in the study agreed they noticed an improvement in arrival time on days the students were using the watch and felt that the Apple Watch was a great AT tool for each participating student.
Conclusion

Students with disabilities participating in a CTP in a high school setting used an Apple Watch as an AT device for time management to assist with improving their arrival time to each career skills station. All students ($n = 3$) significantly increased their arrival times between baseline phases and intervention phases with the assistance of the Apple Watch. Stable level, trend, and variability between each phase were observed in each individual participant’s graph and the combined group graph for ease of visual analysis (Figure 9).

All participants indicated a positive perception towards the goals, uses, and outcomes of the Apple Watch as an AT device for time management. During the study, one student indicated she did not like the vibration of the watch. When the vibration was turned off in the Apple Watch settings the change did not appear to have an impact on the student performance. Another student indicated she wished she could keep the watch for herself because she liked it so much. She shared she wanted to use it for more than just the study. Although unconfirmed, the researcher believes the third student was seen possibly trying to replicate the alerts of the watch on her phone during the second baseline phase A2. Station teachers also indicated a positive perspective of the students’ goals, uses, and outcomes of using the watch for time management. One teacher stated she wished funding was available for any student who wanted an Apple Watch to use all the features. She specifically mentioned the health applications as many students with disabilities in her class “often struggle with health concerns in the classroom as well.”

A visual analysis and PND were used to determine effectiveness of the study (Scruggs & Mastropieri, 1998; What Works Clearing House, 2017). Each phase of the study for all three students clearly demonstrated level and trend variability. Through visual analysis a clear response magnitude was observed at the onset of intervention phase B1 for all students. An
immediacy of effect also can be seen in the data of each student across each of the subsequent phases. According to Scruggs and Mastropieri (2001), the PND can be used as a “meaningful index of treatment effectiveness” (p. 241). All three graphs showed 100% of non-overlapping data or a PND score of (1.0), indicating a very effective treatment for all three participants. Procedural reliability and fidelity were met by ensuring the use of the Apple Watch was provided to the students during intervention phases according to study procedures. Each Apple Watch was checked for updates and ensured to be correctly synced to match the CTP schedule for the day prior to being given to the students and checked for correct fitting to students’ wrists.

Time management skills are a critical area of need for students with disabilities (Morash-Macneil et al., 2018). Students also need instruction and opportunities to practice their time management skills in school (Brendle et al., 2019). Students in this study were provided an Apple Watch as an AT device to assist them with time management. Further discussion of participants’ results, limitations, and implications for future research is included in Chapter 5.
CHAPTER FIVE: DISCUSSION

Introduction

The results of this study provide emerging themes to consider related to employment of students with disabilities and the use of assistive technology (AT) to increase skills for future careers. In this study three high school students used AT to assist with time management related to their schedule in a career training program (CTP) located on the school campus. All three students were receiving instruction in the State of Florida Standards Access Points (Florida Department of Education, 2021). All students successfully completed each of the four phases in the study; baseline, intervention, withdrawal, and re-implementation of treatment using an AT device, a smart watch, to arrive to their CTP workstations on time.

The researcher investigated the following questions and discusses the findings aligned with each:

1. To what extent do calendar alerts on an Apple Watch affect the time of arrival to a career training program employment skills workstation for students with disabilities?
2. What are the perceptions of students and teachers regarding the goals, use, and outcomes of the implementation of a smart watch for time management as measured by a survey?

Research Question 1: Apple Watch

Through the first research question the researcher sought to determine if participants were able to use the Calendar application on the Apple Watch to increase their on-time arrival time to their employment skills workstations. Although the participants \( n = 3 \) in this study had varying abilities, all had goals of employment post-graduation and possessed similar understanding of
time and time management. These three participants demonstrated the ability to read time, digitally, but struggled to manage time efficiently and one lacked a deeper concept of time.

Research Question 2: Perceptions

The researcher conducted this study under the assumption most future careers for students with disabilities would require explicit attention to time management (DiPipi-Hoy et al., 2009). As time management is deemed a critical job skill (Brendle et al., 2019), students who are in CTPs and who have a desire to obtain a job need to master this basic skill.

Over the last 45 years, since the passage of Public Law 94-142, the Education for All Handicapped Children Act (1975), an increasing push in the field has emphasized educational outcomes for students with disabilities. Numerous laws have increased access and supports to achieve this goal with the passage of acts including the Technology Related Assistance to Individuals with Disabilities Act (Tech Act) of 1988, defining AT and the Disabilities Act (ADA) in 1990; these laws provide better access and protection for individuals with disabilities in employment settings and tools to support better educational outcomes. Both the push for AT support and employment protections as well as multiple reauthorizations of the Individuals with Disabilities Education Act (IDEA; 2004) have improved outcomes, access, and accommodations for individuals with disabilities. Although, another reauthorization of IDEA is overdue, with the last occasion over 17 years ago, the preliminary findings from this study show a need for this legislation to be further reaching. The next reauthorization should include increased funding towards research and the accessibility of more emerging AT to support education, employability, independence, and quality of life of individuals with disabilities. Society is slowly growing more accepting and supporting of people with differences in preK-12, postsecondary education (Becht
et al., 2020), and employment. An increase in use of AT to supplement and improve both educational and employment outcomes is critical. Enhancing skills, such as time management in the workplace could increase employability for individuals with disabilities. Using AT to teach targeted skills, such as time management needs to be a focus in federal legislation and educational outcomes.

A highly socially valid outcome of this study was how the use of AT increased a skill of arriving on time while students expressed their enjoyment of using the AT device. These outcomes should be seen as encouraging for use of AT in similar settings and to support acquisition of other skills for students with disabilities. Given the overwhelming positive feedback from students and teachers, the use of AT like the Apple Watch also should be strongly considered in other aspects of life such as postsecondary education, independent living, and community participation.

Each participant progressed through each phase of the study without issue. Every participant was late to all sessions of baseline and either early or on time during every session of intervention. Each participant had their individual perceptions of the watch, but all were positive. Margaret consistently commented how much she loved the watch and wanted to keep it. Patricia mentioned several times during the first intervention phase (B₁) how she liked the one-minute alert because that meant “Hurry up!”. The data shows a trend indicating participants independently arriving at their CTP stations on time or early 100% of the sessions when using a smart watch with the use of the Calendar application as an AT device for time management.
Conceptual Framework Reflection

In the review of literature, Kelly (2002) suggests increasing time-management is one piece of an overall time use efficiency (TUE) framework to assist people in making the best use of their time while improving work performance, being more productive, increasing self-discipline, and increasing motivation. Following the Cycle for Adoption of Assistive Technology framework, Kintsch and DePaula (2002) stated that “assistive technology must be aesthetically pleasing, age appropriate, fashionable, and culturally and socially acceptable” (p. 6). The authors quoted King (2001) stating if assistive technology looks “handicapped” it will not be adopted (p. 6). The use of the smart watch as an AT device for time management meets the expectations of TUE by assisting in making the best use of the participant’s time, and the Cycle for Adoption of Assistive Technology by successfully passing through each phase of adoption process.

Time Use Efficiency

The lead teacher shared with the researcher that all students desired to participate in the CTP as they were involved in the decision-making process of what skills and stations they wanted to work on daily. For this group, employability was a goal. This desire and willingness to participate in the CTP, and furthermore, this study could be seen as meeting the requirement for positive work habits in the TUE framework set forth by Kelly (2002). The willingness of the participants to follow their own schedule in a timely manner when the AT was provided demonstrated their taking initiative aligned with the TUE framework as these participants could have simply dismissed and ignored the alerts on the watch if there was no desire to increase their proficiency in this critical employment area.
Cycle of Adoption of Assistive Technology

The four stages of the Cycle of Adoption of Assistive Technology by Kintsch and DePaula (2002) are the (1) development phase, (2) selection phase, (3) learning phase, and (4) integration phase. With no known AT currently being used by the school or student participants prior to the study, the researcher began following the framework at the development phase.

Development Phase

Using the current literature and firsthand professional observations by the researcher in the field, AT is a requirement in assisting individuals with disabilities in closing gaps in skills and learning compared to their neurotypical peers. While the literature offered various AT devices for consideration, newer and more advanced technology seemed to be missing. Therefore, in this phase the researcher decided to develop this intervention study using the smart watch, for which research is currently missing in the literature for students with disabilities.

Selection Phase

As time management is critical to employability, the use of the smart watch or a similar AT device on the market could potentially close this gap. The researcher chose to use the Apple Watch as the AT device of choice for this study due to its social popularity, countless accessibility features, and absence of research. The students selected were convenient and not the originally intended population. However, the selection of this group of students provided many interesting thoughts about the need for earlier intervention in selecting AT devices while students are in the primary and secondary education setting.

Learning Phase

This phase produced learning for both the researcher and the participants. All concerns of the students’ ability to master the use of the watch for the purpose of the study were dismissed
quickly as all students mastered the use of the watch almost immediately. Participants showed immediate acceptance and adoption of the device. If anything, the participants expressed a desire, and may have been expecting to use more features of the watch beyond the calendar alerts. Only one student requested the haptic vibrations be turned off prior to the second intervention phase, which was easily accommodated. The more surprising finding was the hesitance of the teachers within the school, and their lack of interest to interact with or to learn about the device, despite their positive outlook on the smart watch from the social validity surveys. The teachers were not willing to learn to use the device and to customize it in the learning phase. No participating teacher or station teacher were interested in doing so, which was surprising. Only a handful of teachers with whom the researcher interacted within the school, who were not a part of the study, were interested in learning more and asked to interact with the watch. If teachers are not willing to adapt to new AT for students with disabilities, students who have gaps in learning and crucial employment skills will not have the opportunity to use emerging tools for employment. “To be successful amidst these changes, teacher educators should actively engage technology in their professional work” (O’Brien et al., 2011, p.35). Assistive technology, such as a smart watch, is a Universal Design for Learning (UDL) tool that can be customized for each individual user to ensure accessibility in an infinite number of settings and situations. This type of tool and how to impact learning and employment outcomes should be part of the learning phase for students, but also for both preservice and in-service teacher preparation to ensure students have access to socially appropriate and new ways to ensure mastery of critical skills.
Integration

The smart watch was integrated and used as an AT device in an education CTP employment work setting, but no generalization to actual employment settings were made at this time due to the school year ending and an ongoing pandemic. Further integration should occur using additional activities and environments as suggested by Kintsch and DePaula (2002) in education and employment settings. “Expanding the AT tool capabilities” (see Figure 1) of the framework should include the countless other features provided on the Apple Watch and compatible applications. Due to the never-ending cycle of advancements in technology, the researcher firmly believes to support further integration, early research should be continuously funded and conducted as new technology emerges to determine the application for students and individuals with disabilities to improve education, employment, independent living, and community life.

Discussion

Time Management using AT in Employment and Educational Settings

In a thorough review of the current literature, the Apple Watch was not used in any of the studies focused on individuals with disabilities in an educational setting (Finn et al., 2015; Green et al., 2011; Legge et al., 2010). Each of the studies in the literature review included an education setting focused on time management but none focused on a secondary education setting to improve employment skills training. As secondary schools often aim to prepare students for post-school employment outcomes, students need experience with using commonly accepted emerging technologies and AT devices aligned with support gaps in skills critical to workforce behaviors. Individuals who lack time management skills need supports to be successful in the
workplace, and any AT, such as a smart watch, should be considered as a tool for virtual coaching and support for success. The cost of any AT that supports an individual’s success should be deemed an investment into the future of the individual and the local economy. The findings of this study strongly support Morash-Macneil (2018) noting time management as a critical need for individuals with disabilities in an employment type setting, and yet, the field currently has only human coaches. The outcomes of this study support the findings of Green (2011) and Brendle (2019) stating that increasing the accuracy in arriving to assigned employment tasks using time management skills are a critical factor for success in future employment as a quality job indicator. The outcome of this study was the simple prompt from an AT device did change this behavior repeatedly for all three participants and over a very short amount of time with zero time invested by a teacher or a job coach.

This CTP and study directly support Lindsey et al.’s (2012) call for providing an opportunity for individuals with disabilities to practice their time management skills in a workplace setting. In many cases, a faux setting for students in secondary education may be the best setting to learn and master a new skill, such as time management. Every individual with a disability who struggles with time management and has a goal to seek employment following graduation from high school could potentially benefit from an AT device for time management prior to starting employment.

Low and Mid-Range AT for Time Management

The mid to high range technology of today will be quick to fall to more of a low to mid-range AT soon; becoming more affordable and accessible even for those who might have a lower socio-economic status (SES). It took less than one hundred years for the automobile to go from concept to a global asset for billions of people. It will take even less time for current high-range
AT devices, such as personal virtual assistant (i.e., Alexa), high power laptops, Extended Reality (XR), Virtual Reality (VR), Augmented Reality (AR), self-driving cars, and global satellite internet to reach those of lower SES. This same pathway could emerge for AT for individuals with disabilities. Just as the field of exceptional education continues to advocate for a younger age for transition goals, the critical job skills such as time management need to be taught as early as possible.

Wearable AT for Time Management

While the Apple Watch has been in society for approximately six years, other cutting edge wearable devices are quickly becoming more mainstream with continuous advancements and new features being added each year. Many of these devices are already being used in educational settings to advance the education of students with disabilities. The bug-in-ear technology has been used for remote coaching of novice teachers (Garland & Dieker, 2019), VR goggles are being used to coach preservice teachers on employment skills needed in an employment setting (Dieker et al., 2019), a wearable glasses device with a bug-in ear called AIRA is being used to assist people who have visual impairments to see what is occurring around them (Lannan, 2019), and other XR/VR/AR headset and wearable type devices are being used to help teach students with disabilities various science, technology, engineering, and mathematics (STEM) related subjects in the classroom (Brown et al., 2020). The beauty of these wearable AT devices is they allow for more sophisticated skills trainings and some even present a non-intrusive option (i.e., bug-in-ear, glasses, watches) for more discreet support and less human capital (e.g., job coach) costs while promoting independence.
Combining AT for Employability

The availability of AT tools in an employment setting should always be transparent, provided when needed, and faded as rapidly as possible. Just as a tall person may choose not to use a ladder to put a box on the top shelf at work, a ladder should always be available in the event another employee needs it to fulfill the same job duty. This same type of mindset, reflecting universally designed approaches (Gill & Douthwaite, 2012), should apply to any type of AT that could be used to improve accessibility, equality, and critical skill for sustaining employment. Employers should adopt a UDL mindset with their employees (Bartlett et al., 2019; Gill & Douthwaite, 2012) by encouraging all individuals to use AT devices; potentially improving the productivity of their employees and overall profit margins of the company with very small investments.

New legislation could strengthen laws, like the Tech Act of 1988 and ADA of 1990 that protect individuals in the workplace, to now include AT being purchased for employees by employers who support those with disabilities using newly emerging technology to ensure their success and providing tax incentives for such initiatives. An investment of a $300 wearable AT device, ensuring an employee follows their work schedule, means there is a current 15.3% federal social security and Medicare withholdings (irs.gov) per paycheck; potentially leading to individuals who receive social security disability income no longer needing this support. The government’s return on investment (ROI) is approximately 1,591% (or $4,473.60) per year if the individual is a full-time minimum wage employee at $15 per hour versus the annual cost of $14,025.50 to support someone who is unemployed. This ROI figure shows a small investment of even $300 could ensure any employee is not being fired and going home to draw unemployment. This logic of providing a device for students with disabilities who often struggle
with decision making and executive functioning skills (Vasquez & Marino, 2021) could support individuals in these critical employability areas. These devices could ultimately be cost-effective with long-term use leading to higher rates of employment and increased independence.

Future Implications

The researcher found a smart watch as an AT device did positively affect individuals arriving to a job-related task on time in a school CTP setting. The next step in this line of research is to use this same AT device in an employment type setting for time management and other job-related purposes. Specifically, time management skills could directly impact the employability of individuals. The researcher in this study suggests students with disabilities who seek employment, who struggled in the past, could be successful if provided the right AT support. The participants in this study mastered and adapted to the smart watch with ease indicating individuals with disabilities could potentially use additional or multiple features on the smart watch independently or even master more complex AT with limited training.

This study adds an additional AT device to the literature for use by individuals with disabilities in school and potentially employment settings. Participants expressed their overall satisfaction with the watch while one participant was able to request an adjustment of the accessibility settings on the watch to their personal preference of no vibration. This personalization specifically adds to the literature as previous studies used wearable AT only focused on the vibrating alerts. When participants were using the watch during intervention, the CTP teacher assistants were able to focus on other students’ needs while the participating students independently followed their station schedule through the alerts on the watch. Additional features of the watch in a place of employment could allow employees to focus more
on their own responsibilities and be more productive themselves rather than seeking support from a job coach or other employees to ensure they deliver on their responsibilities. One teacher at an employment skill workstation mentioned how she was free of the burden of ensuring students transitioned to their next station appropriately. The functionality of Qualtrics as a time clock on the iPad also could be used by all students in employment training settings, similar to the students who were using the time clock prior to the study to provide a realistic tool for “clocking-in” and for students to potentially reflect upon their rate of punctuality to job site activities. As AT was found in one study to increase independence and productivity (Finn et al., 2015), this same approach could be deployed in the workplace for individuals to increase independence and productivity potentially resulting in higher profits for businesses.

Past researchers have shown incorporating wearable AT produced more independence (Finn et al., 2015; Van Laaroven et al., 2009), thus future research should focus on AT for assistance with time management in the real workplace. Numerous employment settings require individuals to follow a predetermined work schedule while at work or to transition through an assigned list of tasks timely and independently (Janeslätt et al., 2014). Another setting to consider would be for students with disabilities in a postsecondary setting on a college campus to use the AT device to assist with managing the many aspects of college living including the time management of a class schedule, social engagements, and internships or employment.

The quick and immediate mastery by the participants during training of a single aspect of the AT device suggests future research should be conducted on the use of additional and multiple applications used simultaneously on the smart watch by individuals with disabilities. The access to Apple products and their operating systems in society have become much more widely known and replicated providing greater familiarity and ease of use of new technology. This more
A universally designed platform could provide a foundational understanding of any tool for participants in future studies.

Future research should also include a smart watch for other school uses, as suggested by a participating teacher in this study, such as managing their entire school schedule in the absence of a bell; to support students who have a unique school or hybrid academic and employment schedule; or to help student manage medical or outside-school needs. This approach could include students who participate in work release, extracurricular school activities, and sports. Feedback by another participating teacher included the possible future implications of using the smart watch as an AT device for discretely monitoring student health in the classroom as needed by the teacher or parents from afar. This approach to use could include students with all disabilities such as those with intellectual disabilities, behavioral issues, mental health conditions, or even medical conditions such as diabetes.

**Limitations**

Due to the health crisis of COVID-19, the researcher was required to adapt the research focus from an inclusive college and workplace setting for students with disabilities to an educational setting with a slightly different population and setting. Prior to COVID-19, this study was expected to be conducted with young adult students with intellectual disability (ID) in a postsecondary program on a university campus focusing on time management in a college setting. Given the health restrictions of the university campus and lack of students attending classes in person, the inclusive postsecondary education program was no longer an option. Given this limitation of a global pandemic, the researcher adapted the study to focus on a slightly younger age group and moved from a collegiate setting to a CTP in a local high school. Lastly,
the focus on time management was changed from arrival time to the arrival
time to employment skills workstations, but the overall goal of the study focused on arrival time
was consistent.

The results presented from this single subject withdrawal study come with limitations and
should be reviewed with caution. One limitation commonly associated with ABAB design is the
withdrawal of an effective intervention could be seen as unethical (Ledford & Gast, 2018).
However, the authors go on to say that it could be seen as very reasonable when its being used to
evaluate the effectiveness of AT. This study was conducted with only three participants out of
the anticipated and desired six. Only three students participated due to all others either not
meeting the inclusion criteria, not being interested, or having already mastered time
management. The small sample size presented in this study poses a limitation, a larger sample
size should be used in future studies. Only one recent study in the literature review had more
than four participants and focused on task management for students with disabilities, not
wearable AT technology (Janeslätt et al., 2014).

The setting of the study was a limitation based on the small size of the school campus as
compared to more traditional campuses. This inclusive charter middle and high school located
near the downtown area of a major metropolitan city in the southeast of the United States had
less than 100 students and included students in Grades 6 to 12 (ages 10 to 22). The physical
aspect of the school was two stories with each floor being about half the size of typical grocery
store or a full grocery store in total. The size and layout of the campus made it very quick and
easy to walk from one end of the top floor to the bottom adjacent corner using the stairs,
especially for young, physically capable students. Based on this limitation along with the
suggestion from the CTP teacher, the researcher reduced the number of alerts on the watch from
three to two as the distance and time it took to get from one station to the next was less than on a full university campus as originally anticipated. The 1-minute and 3-minute alerts were not altered, however a planned five-minute alert was eliminated.

The researcher did make note of a possible extraneous variable during baseline phase A₁ (Gall, et al., 2007). During the initial baseline phase, state standardized testing was occurring in the school. This fact was not made known to the researcher until the third phase of the study as the researcher was being made aware of future upcoming testing days. While this environmental event was of concern to the researcher, this variable did not appear to influence the participants’ behavior in any way that could have affected the observed effects of the treatment variable (Campbell & Stanley, 1963).

Conclusion

All students with and without disabilities should be prepared to enter employment with basic time management skills to be productive and successful employees (Green et al., 2011). The researcher in this study extended the current literature focusing on students with disabilities using AT for time management (e.g., Finn et al., 2015; Green et al., 2011; Janeslätt et al., 2014; Legge et al., 2010; Van Laarhoven et al., 2009). Past studies have focused on a wearable AT device only capable of specific or limited functions. The Apple Watch has an infinite number of other features that could also be used in future studies to improve the lives of individuals with disabilities as an AT device for other areas. The strength of using AT devices allows for individuals to customize these tools to address areas of deficit and to personalize these tools to address potential gaps in their ability to manage tasks based upon their needs. Students with disabilities need to work on core skills for employment while maintaining independence. The
increase in time management and other employment skills using AT could lead to better and higher productivity and TUE in the workplace (Kelly, 2002).

In the healing phase of COVID-19, as disability advocates begin to look back on the changes, immediately everyone, including those with disabilities, were asked to work from home, in small quarters with the expectation of access to the tools needed to stay employed remotely. Many people living with disabilities or working in the field now look back on this shift to remote learning and remote working seeing many jobs and employment opportunities that were deemed impossible for people with disabilities due to access were made accessible almost overnight. The computers and laptops employers immediately provided to their employees for them to begin working remotely is the epitome of AT. This shift in practice and thinking is the exact mental approach in both product and process employers need to take to ensure those with disabilities are successful in the workplace. How this shift and lessons learned will further impact future use of technology and employability is yet to be seen.

In the age of technology, AT will continue to evolve daily. Society needs to find ways to deploy AT supports where possible to assist in closing the employment gap between individuals with and without disabilities. Improving students’ employability skills using AT in college, the workplace, or in a CTP on a high school campus could have both economic and social impacts. Finding the right fit for AT as early as middle or high school should be an expectation to allow for earlier opportunities to adjust, learn, and master the AT device’s implications before entering the job market thus making students more employable. Adequate financial support is still needed for those with lower SES as AT is currently difficult to access in school or too expensive for families, but if legislation could support these tools through vocational rehabilitation support,
much like a job coach, covering the cost of these devices could immediately offset the cost with a high ROI rate by requiring far less supports of the job coach.

Continued research on the use of AT to determine the effectiveness for students with disabilities in various skill areas and the ROI for employment could lead to further support for these tools. Supporting students with disabilities in using AT to improve or supplement various skills needed for employment, education, independent living, and quality of life could increase their value as a contributing, self-sustained, satisfied, and member of society.
APPENDIX A:
INSTITUTIONAL REVIEW BOARD CONSENT
March 5, 2021

Dear Jonathan Solomon:

On 3/5/2021, the IRB reviewed the following submission:

<table>
<thead>
<tr>
<th>Type of Review</th>
<th>Initial Study</th>
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<tbody>
<tr>
<td>Title:</td>
<td>Using Wearable Assistive Technology to Improve Time Management of Students with Disabilities in an Employment Training Setting</td>
</tr>
<tr>
<td>Investigator:</td>
<td>Jonathan Solomon</td>
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<tr>
<td>IRB ID:</td>
<td>STUDY00002698</td>
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<tr>
<td>Funding:</td>
<td>None</td>
</tr>
<tr>
<td>Grant ID:</td>
<td>None</td>
</tr>
<tr>
<td>IND, IDE, or HDE:</td>
<td>None</td>
</tr>
<tr>
<td>Documents Reviewed:</td>
<td>• HRP 251 - Faculty Advisor Review Form, Category: Faculty Research Approval; • Assent Form, Category: Consent Form; • COVID Policy, Category: Other; • HRP 502 - IRB - SolomonJonathan, Category: Consent Form; • HRP 502b - IRB - SolomonJonathan, Category: Consent Form; • HRP 503 - IRB - SolomonJonathan, Category: IRB Protocol; • Interest/Recruitment Form, Category: Recruitment Materials; • Observation Spreadsheet, Category: Other; • Post Study Survey, Category: Survey / Questionnaire</td>
</tr>
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</table>

The IRB approved the protocol from 3/5/2021 to 3/5/2022.

In conducting this protocol, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system. Guidance on submitting Modifications and a Continuing Review or Administrative Check-in are detailed in the manual. When you have completed your research, please submit a Study Closure request so that IRB records will be accurate.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Gillian Bernal
Designated Reviewer
APPENDIX B:
QUALTRICS WEB BASED DATA COLLECTION SOFTWARE TOOL USED TO DISGUISE AND IMITATE AN EMPLOYMENT WORKPLACE TIME CLOCK
<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Patricia</td>
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<tr>
<td>Margaret</td>
<td></td>
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<tr>
<td>Cynthia</td>
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<td>Other</td>
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<td>Other</td>
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APPENDIX C:
SOCIAL VALIDITY SURVEY (PARTICIPANTS AND TEACHERS)
# STUDY SURVEY

Default Question Block – Survey questions to be read to participating student and teacher.

Please indicate who is completing the survey. (Circle one)

<table>
<thead>
<tr>
<th>Participating Teacher</th>
<th>Participating Student</th>
</tr>
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</table>

Please rate the following regarding yourself/student since participation in Employment Skills Training sessions with the assistive technology; Apple Watch:

<table>
<thead>
<tr>
<th>Participation has helped increase their overall time management skills.</th>
<th>No, it has gotten worse</th>
<th>No, it has stayed the same</th>
<th>Yes, somewhat better</th>
<th>Yes, significantly improved</th>
</tr>
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<tbody>
<tr>
<td>Self-awareness of time/time management has increased</td>
<td>No, it has gotten worse</td>
<td>No, it has stayed the same</td>
<td>Yes, somewhat better</td>
<td>Yes, significantly improved</td>
</tr>
<tr>
<td>Self-initiation of more time related inquiries have increased</td>
<td>No, it has gotten worse</td>
<td>No, it has stayed the same</td>
<td>Yes, somewhat better</td>
<td>Yes, significantly improved</td>
</tr>
<tr>
<td>Generally attempting to be more on time to things outside school</td>
<td>No, it has gotten worse</td>
<td>No, it has stayed the same</td>
<td>Yes, somewhat better</td>
<td>Yes, significantly improved</td>
</tr>
<tr>
<td>There are increased positivity toward time management</td>
<td>No, it has gotten worse</td>
<td>No, it has stayed the same</td>
<td>Yes, somewhat better</td>
<td>Yes, significantly improved</td>
</tr>
</tbody>
</table>

Has you/your student benefited from this intervention? Yes / No

Would you recommend this intervention for other children/students? Yes / No
REFERENCES


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