CALIFORNIA STATE UNIVERSITY SAN MARCOS

PROJECT SIGNATURE PAGE

PROJECT SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE

MASTER OF ARTS

IN

EDUCATION

PROJECT TITLE: Implementing Assistive Technology Strategies for Appropriate and Effective Use

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DATE OF SUCCESSFUL DEFENSE:

THE PROJECT HAS BEEN ACCEPTED BY THE PROJECT COMMITTEE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN EDUCATION

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IMPLEMENTING ASSISTIVE TECHNOLOGY STRATEGIES FOR APPROPRIATE AND EFFECTIVE USE

By

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A Project Paper
Submitted in Partial Fulfillment of the
Requirements for the
Master of Arts Degree
in

Education

California State University San Marcos

Summer 2018

ABSTRACT

As technology becomes integrated and implemented within school curriculum, there is a constant need to understand the technology that is introduced to the classroom environment and how it can be used to help a student achieve their academic goals. Students with physical disabilities sometimes need assistance from technology to be able to achieve those goals, but need proper guidance to increase their ability to effectively and appropriately use that assistive technology device and/or service. In this project, a pamphlet was designed to help provide a resource for educators strategies on how to ensure that their students are effectively and appropriately their assigned assistive technology device and/or service. There are various assistive technology software and hardware that can be beneficial for students with physical disabilities, especially when an educator spends time with familiarizing and learning the assistive technology that their students use. The pages of the pamphlet are showcased in this project, detailing steps on tracking assistive technology implementation as well as supply knowledge on resource sites and a few assistive technology devices that educators may encounter. After designing and creating the pamphlet, while still providing knowledge for readers about assistive technology and how to ensure effective and appropriate use of the device and/or service, had limited space to ensure that the knowledge is enough to interest educators in the topic of assistive technology.

Keywords: Assistive technology, education, learning aid, pamphlet, special education, teaching strategies

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CHAPTER ONE: INTRODUCTION

The use of technology in the classroom for students with disabilities and limitations have proven to yield positive results (Connor et al., 2010; Garret, 2007; Mezei, 2009; Obringer et al., 2007). More specifically, the use of assistive technology (AT) for computing devices has become a much needed resource for students with disabilities and physical limitations who have difficulty with operating a computing device due to the lack of fine motor skills. AT for computing devices can be defined as software or hardware created for the educational needs of students with disabilities and are usually commonly found tools that students use, such as instructional software and spell check (Flanagan, Bouck, & Richardson, 2013). As educators strive to implement the use of technology in their classrooms, students that are lacking the fine motor skills to utilize these devices, such as computers, for education-related tasks are not able to achieve their academic goals without the use of AT (Obringer et al., 2007). Without proper guidance or instruction in utilizing AT in an appropriate and efficient manner, these students cannot realize the benefits that the AT provides, continuing to struggle with assignments and learning (Flanagan, Bouck, & Richardson, 2013).

Not only does it take proper guidance and instruction to teach students with special needs how to use the assistive technology provided, teachers will also need to learn about the different types of AT that are appropriate for their students needs. Sometimes a student with limitations will need multiple types of AT software and/or hardware in order to use a computer's keyboard and mouse or software (i.e. word processing applications, Powerpoint, Excel, etc.) In the 21st century, the use of computer and keyboard are more prevalent not only in schools, but in careers and personal home use. It is imperative that students with disabilities receive the best possible

assisting technology and be provided with the knowledge of that technology, allowing them to be able to produce coherent, high quality writing products and completing computer-based assignments with the relatively same ease as their peers.

PURPOSE OF THE PROJECT

The purpose of this project is to provide teachers with a resource on tools and strategies to help accommodate students with disabilities in efficiently using computing devices. Recent research has indicated that the use of AT (for computing devices) for students with physical disabilities has helped them with utilizing a computing device and completing computer-based assignments (Garrett, 2008; Mezei, 2009; McCormack, 1990; Obringer et al., 2007; Pouplin, 2016; Simpson, Gauthier, & Prochazka, 2010; Zhou et al., 2011). Assistive Technology has been dated since the early 2000's and has continually progressed as technology has advanced, which has inspired applications that can commit complex tasks. The project will be a guide/pamphlet for teachers and administrators that will address the available assistive technology to date, how to utilize them for students with a variety of physical disabilities, and the strategies to educate students with disabilities on how to use them. It will be important to describe all available assistive technology, giving a detailed description and a list of its functions for teachers to decipher how to best utilize that technology based on the type of disability. In order for teachers to determine the best assistive technology, a list of strategies will also be included in the guide/manual that will help them identify their students limited motor functions, how to coordinate with an Individualized Education Plan (IEP) specialist to support the needs of the student, and identifying the best AT to meet the student's needs to utilize that computing device. The guiding question that will be focused on within this project design is: What are some strategies teachers can implement to ensure that students with physical disabilities involving fine

motor skills are properly assessed and provided with appropriate and effective assistive technology for computer use?

LITERATURE REVIEW

The focus on the impact of Assistive Technology in the classroom for students with physical disabilities is essential as the literature prescribes. Keyboarding and efficient use of computing technology has become a necessary life skill where computers and electronic devices have become commonplace in today's society. Students with physical disabilities have had struggles and difficulties that have made typing efficiently almost impossible, as this skill has become increasingly important as these students progress and transition into the workplace. Since then, there have been AT devices and software that are designed to assist students with physical disabilities.

In the review of the literature, I will be discussing the various AT software and hardware programmed to provide assistance to students with physical disabilities. The literature provided explores the different types of AT software and hardware from tooth-click detectors as a replacement for computer mouses to speech recognition software as a writing tool on word processing applications (Garrett, 2007; Simpson, Gauthier, & Prozchaka, 2010). The in-depth research into the applications of these AT resources will provide the benefits and deficits of the AT software and hardware described (McCormack, 1989; Alsakhawi & Alsakhawi, 2017; Garrett, 2007; Mezei, 2009; Obringer et al., 2007; Lupasc, 2015; Simpson, Gauthier, & Prochazka, 2010; Simpson et al., 2010). Finally, the literature will explore the general knowledge of AT in educators, as well as the impact of having educators with the necessary knowledge of AT to help students with physical disabilities (Connor et al., 2010; Zhou et al., 2011; Flanagan, Bouck, & Richardson, 2013; Knighton, 2013).

METHODOLOGY

In order to address the research question previously stated, a resource guide needs to be established. Each technology has been analyzed to measure its effectiveness and accessibility of both physical and software technologies. Along with the different types of Assistive Technology, the researcher has also analyzed the strategies implemented alongside the technology to provide teachers and administrators a guide to teach students with physical disabilities how to use the assistive technology based on the severity of their motor impairment.

The pamphlet will be designed through the analytical research of the literature presented, as well as the regarded implications that the literature will address from previous studies concerning the topic. The pamphlet will be focused on providing instructors and administrators the knowledge of various AT products used to assist students with using a computing device. The AT products listed in this pamphlet will be detailed with how they function as well as recommendations on how to use the product based on their student's needs. The pamphlet will also provide a section for strategies on how teachers should teach their students on how to use the AT products appropriately and efficiently. A tri-fold pamphlet will be the template used for this project to convey as much information about AT.

SIGNIFICANCE OF THE PROJECT

This research can be beneficial for students, teachers, families, and their community as giving students with disabilities the tools they need to utilize a computer is essential as a member of the 21st Century. As students progress throughout their academic careers, they will be tasked to complete further complex tasks that require both critical thinking and technological literacy. Educators teaching these skills to their students will be able to understand the limitations of students struggling in keyboarding, adjusting and accommodating them to ensure they achieve

the skills being taught. With the use of AT devices, frustration could be reduced and thereby hopefully motivate students to complete assignments that require the use of computing device, allowing their next teachers to challenge them and advance their skills with more complex writing assignments. With the use of AT, students might increase their confidence in keyboarding, which has become so much of an essential skill that secretarial and certain office jobs require that applicants have typing speed average between 40-60 Words Per Minute (Green, 2017). By giving students with physical disabilities the assistive technology and the knowledge to use it as an aide for computer use, students would become fully integrated in a technological society.

SUMMARY OF CHAPTER

The significance of technology as commonplace in the 21st century is absolute as it has become nearly accessible everywhere. Educators should ensure that all of their students are achieving in their academics, especially if assessments, classwork, and homework require the use of technology to provide proof of achieving content knowledge. Allowing access of AT software and hardware technology that can assist students with motor-impaired disabilities are necessary to provide them with equal opportunities for academic success alongside their peers. This project will focus on providing teachers and administrators a guide of assistive computing hardware and software along with a list of strategies on how to implement them based on the severity of student's motor impairment.

DEFINITION OF TERMS

- **Assistive Technology Computer Hardware:** AT Computer Hardware is any item, product, or device that can be used to maintain, increase, or improve the functional

capabilities of individuals with disabilities when using technological devices. Examples include modified keyboards, keyguards, eye-mouse cameras, etc.

- **Assistive Technology Computer Software:** AT Computer Software is a software or system program designed to maintain, increase, or improve the functional capabilities of individuals with disabilities when using a computer application or program. Examples include screen readers, speech recognition software, communication programs, etc.
- **Typing Speed:** The average amount of words per minute (WPM) an individual can produce during a writing assignment.

CHAPTER TWO: LITERATURE REVIEW

As previously stated, Assistive Technology is broadly defined as technology that is available to be utilized by students with a range of special needs and disabilities that affect their fine motor skills (Flanagan, Bouck, & Richardson; 2013; Connor et al., 2010; Zhou et al., 2011; Lupasc, 2015; Garret, 2007; Mezei, 2009; Obringer et al., 2007; Pouplin et al, 2016; Williams, 2002). When it comes to using computing and/or technological devices, there is often a need for fine motor skills in order to operate a computer. Students with physical disabilities have difficulties with writing efficiently due to decreased motor skills, which in turn can cause handwriting to be an inefficient option and typing an extremely slow process (Garret, 2007). Not only are fine motor skills needed to utilize a computing technological device, there are also other skills students will need to write with minimal errors. These skills include experience in word processing and keyboarding skills (Obringer et al., 2007; Garret, 2007; Mezei, 2009). These abilities are often affected by the student's physical limitations that prevent them from writing efficiently such as: Cerebral palsy, Duchenne muscular dystrophy, and hydrocephalus (Mezei, 2009).

However, there are multiple types of Assistive Technology that are able to remedy and alleviate the stress of using a computing device without their disabilities and/or limitations preventing them from utilizing the device. These technologies range from keyguards (designated holes for keys to prevent typing errors) and improvised keyboards (bigger keys, keys spaced out between each other, etc.) to computer software applications such as speech recognition and word prediction software (Garrett, 2007; Mezei, 2009; Obringer et al., 2007). The technology is only effective when proper strategies in utilizing these AT are implemented (Garrett, 2007; Mezei, 2009; Obringer et al., 2007; Lupasc, 2015; Simpson, Gauthier, & Prochazka, 2010; Simpson et

al., 2010). And in order for these strategies to be useful, the educator must be proficient in learning the different types of AT and use them in accordance to the student's needs. Most general education teachers lack the knowledge and experience in understanding and using AT which would benefit their students in increasing their learning and independence (Flanagan et al., 2013).

ASSISTIVE TECHNOLOGY HARDWARE SOLUTIONS

Some of the few assistive technologies that have helped students with disabilities on producing less errors when using the computer are also the earliest forms of assistive technology for computing devices. AT hardware for computing devices are assistive technologies that involve aiding the student in utilizing the physical aspects of the computer such as keyboard, mouse, and computer screen. While harnessing the internal technological aspect is important fully assist students with special needs to make use of applications and programs of the computer, they will also need aides in compensating for their lack of fine motor skills in order to effectively utilize the applications in the computer.

A. KEYGUARDS

One of the most common uses of assistive technology hardware for the computer that aides users to improve and maintain accuracy in typing are keyguards. Keyguards are raised shields (usually either made of plastic or metal material) that are overlaid onto a keyboard. Holes are in the shield were placed over each key to allow the user to strike only one letter at time to prevent the mistake of having multiple keys pressed at one time (Obringer, 2007) They were also intended to increase typing speed in relation to the increased accuracy that they are intended to provide (McCormack, 1989).

Due to its very basic design, it is often recommended that keyguards should be paired with other assistive technologies to increase its effectiveness. John Obringer and his colleagues conducted a study in which they tested the effectiveness of an individual's writing using a combination of assistive technologies in different test runs. After their first test yielded an accuracy rate of 48% in which they used only a customized keyboard tailored to accommodate their volunteer with cerebral palsy, Obringer, Coffey, McFadden, Etheridge, and Pounder (2007) had noticed “an increased accuracy rate of 84% when the Intellikeys (an AT device that provides personal customization of a keyboard such as larger icons and large spacing between icons) was paired with keyguards during the second trial” (pg. 62).

Despite their effectiveness in this study, these keyguards are still primitive and simplistic by design, which might not produce the desired effect that they are designed provide. McCormack’s (1989) study on keyguards and their effectiveness in improving typing speed and accuracy during typing had encountered sensory limitations in using adaptive equipment such as keyguards. One limitation included the user’s visual access to the keyboard when using the keyguard that made locating the keys difficult. Another limitation was the alteration of kinesthetic and tactile feedback which produced a different sensation when typing through holes to press the keys, decreasing typing speed to adjust to the sensation (McCormack, 1989).

Though these keyguards increase the accuracy of typing, using these keyguards only by themselves sacrifices typing speed. McCormack’s study of an 8 year-old boy with cerebral palsy utilizing these keyguards examined the effectiveness of typing speed and accuracy during typing exercises. As a result, the subject was able to increase their accuracy from 33% to 90% after implementing keyguards, but in return decreased their typing speed from 9 letters per minute to a steady 2 letters per minute (McCormack, 1989). This very distinct deficiency in speed has made

it very apparent that keyguards are only to be used a supplemental tool if both efficiency in speed and accuracy in typing are to be achieved. According to McCormack (1989), "When a computer is used for communication, accuracy is imperative for the proper exchange of information" and that while it is only necessary for a timely exchange of information, "Speed is also very important" (pg. 314). Considering the advancement and complexity of technology in 21st century in both social and professional settings, typing speed and accuracy are both skills that are highly needed to communicate effectively. Thus, while it is determined that keyguards are very effective in increasing accuracy in typing, they should be used in tandem with other assistive technologies that can increase typing speed.

B. Camera Mouses

Not only will students with limitations need assistive technology to be able to type to navigate the internet and utilize computer applications such as word processor, they will also need aides in accessing those applications that require the use of a mouse. One of the few physical assistive technologies that can remedy the difficulty of using a mouse require the motor movements limited only to the head region.

Camera mouses involve the use of a camera attached to the computer and using the movement of their eyes to control a computer mouse. Users with limited control of their hands and dexterity control the computer mouse through the movement of their eyes, often tracked by both the webcam connected to the computer and through the use of five electrodes placed on the user's head (Lupasc, 2015). However, the assistive technology software can only allow the user to click once which prevents certain complex actions such as click-and-drag and double click. It also requires a specific amount of time to create a click by focusing on one certain object or icon in which the amount of time is adjusted based on the user's activity (Lupasc, 2015). Despite

these limitations, camera mouse is considered to be an efficient alternative that can operate almost as well as a normal computer mouse.

Camera mouses are not only a substitute for users that have limited fine motor skills that cannot operate a standard computer mouse, they also improve visual perception and eye-hand coordination. In a study conducted by Reham Alsakhawi and Ragaee Saeed Alsakhawi (2017), they explored the effects of camera mouse assistive technology on children with spastic hemiplegia (a form of cerebral paralysis that hinders visuo-spatial abilities) on their eye-hand coordination, in which their result were recorded via computer games that focused on visual motor integration abilities in tandem with physical therapy treatments.

Based on the data of their three month study, Alsakhawi and Alsakhawi (2017) concluded that their study displayed increases in scores in visual motor integration, attributing the improvement of the integration to "the ability to promote optimal neural integration, organize and use sensory input to interact with the environment through practice and repetition" (pg. 122). Through the assistance of camera mouses, the test subjects of this study were able to improve both hand and eye movements that would in turn increase their proficiency in eye-hand coordination. However, whether these data results can still be achieved without the addition of physical occupational therapy is unknown as the physical treatments were also practiced and repeated along side the camera mouse study.

Another piece of assistive technology hardware that has also produced an effect on how well the user is able to control a computer mouse requires a combination of three different technologies. One of the three technologies that can help users with utilizing a computer mouse is a tooth-click detector. The tooth-click detector is a lightweight device that is worn around the

ear to pick up audible sounds from the user's mouth. Those audible sounds are then acknowledged and translated into clicks. The study in which this device is used integrated a custom software that displayed options for user as to whether they meant to left click, right click, or click and drag (Simpson, Gauthier, & Prochazka; 2010).

The second device that is used in combination with the tooth-click detector is was similar to the previous assistive technology discussed earlier that used a web camera to detect head movements. A head mouse, more specifically a TrackIR, is an infrared camera that tracks a reflective sticker that is worn on the head of the user (Simpson, Gauthier, & Prochazka; 2010). The movements tracked by the infrared camera are translated into movement for the mouse. When used along with tooth-click detector, the user's head is a suitable alternative device than a standard computer mouse.

The third device among the three can be an appropriate replacement for the head mouse, depending on the user's needs and limitations. The gyro mouse, though intended to be used as a powerpoint presentation device, can be attached to the head of the user and allow them to freely control the movement of the mouse by moving their head in any direction they would like.

In a study conducted by Simpson, Gauthier, and Prochazka (2010) in determining the most effective assistive technology combination, they tested the efficiency of two different combinations: A Tooth-Click device with an Optical Head Mouse (TC/OHM) and a Tooth-Click device with a Gyrometer Head Mouse(TC/GHM). The study involved two different types of subjects: individuals that were able-bodied and individuals that had tetraplegia (spinal cord injury). In a series of experiments that involved randomized click-related tasks, though there was no difference between using TC/GHM and TC/OHM for able-bodied subjects, tetraplegic

subjects experienced some difficulty with the TC/GHM compared to the TC/OHM. Based on the data that the researchers gathered from their experiments, there was a minor significance of 14% click performance rate with the TC/GHM while working with the TC/OHM generated a 22% click performance rate (Simpson, Gauthier, & Prochazka, 2010). This difference was due to the fact that the addition of a camera to track the movement from the infrared sticker was more reliable than the technology of the gyrometric mouse which was tracked only through sensitive movement.

ASSISTIVE TECHNOLOGY SOFTWARE PROGRESS TO AID USERS

It is not enough to just provide AT hardware for students with disabilities to ensure they can access computing technology with less strain and difficulty. As technology advances through every period of time, teachers and administrators must be willing to use new and updated assistive technology software that can be used to further aid their students with particular needs. As discussed in the previous studies about combining different pieces of assistive technologies, the practice of using multiple AT's is beneficial for user's as certain combinations increases the efficiency of using a computer (Obringer, 2007; Simpson et al., 2010). While some software are constantly going through updates and revisions to fix problems and bugs encountered by users to ensure they are receiving the best aid, there is some software that users can rely on that can still provide benefits based on their needs.

A. SPEECH RECOGNITION SOFTWARE

Speech Recognition has been one of the few assistive technologies that only work in certain aspects depending on the needs of the user. These aspects include user's ability to pronounce words and sounds clearly, as well as the user's ability to communicate with the software to minimize errors (Garrett, 2007; Simon, Gauthier, & Prochazka, 2010). As explained

by Garrett (2007) during her review of the literature, speech recognition is a program that allows the user to speak instead of type to speak directly to the computer and speak in word processing applications instead of typing to produce text. Not only does it transcribe what the user says into text, it can also be flexible to let the user initiate commands to maneuver the operating system such as opening applications and navigating through the internet. It requires training and practice, however, to let the speech recognition software to create voice files and recognize the user's speech patterns in order to utilize it (Garrett 2007). Sometimes the training involves the user to speak for 5 to 10 minutes sentences generated by the software to create those voice files and adapt to their user's speech patterns, with prolonged training guaranteeing more accuracy in speech commands (Simpson, Gauthier, & Prozchaka; 2010).

The benefits that speech recognition software can provide for students with disabilities are numerous depending on how well they are paired with other assistive technologies and/or the amount of time and practice the user has had with the software. Just as previously mentioned, speech recognition can allow the user to use speech instead of a keyboard to write documents, making the writing experience easier and less stressful than typing. In Garrett's (2007) study of comparing the effectiveness of word processing in contrast to speech recognition software, they were able to provide data that all five of their subjects were able to utilize the speech recognition software to write draft papers. The data was based on five factors that were key essentials to the keyboarding process: writing fluency, accuracy, type of word error, recall of intended meaning, and length of the document (Garrett, 2007).

Based on the data that Garrett (2007) received during the study, the speech recognition software developed mixed results for the factors stated previously. The writing fluency was measured based on the overall Words Correct Per Minute (WCPM) they had scored in each

session. On average, the subjects had steady slow rates ranging between 10-30 WCPM on the word processing application, which contrasts significantly with varying interchangeable rates between 40-80 WCPM on the speech recognition software (Garrett, 2007). The writing fluency for each subject showed increased rates in their WCPM when using the speech recognition software compared to the word processing application. Allowing them to use their voice, the subjects were able to produce more correct words through their vocal skills than their fine motor skills.

Despite the increase in writing fluency and the rate in which they produced correct words over their sessions, the subjects accuracy was affected negatively. All five study participants showed that they were more accurate with the word processing application as opposed to the speech recognition software. Ranges of 80%-100% accuracy were recorded from the sessions involved with using only the word processing application while a staggering 60%-80% accuracy within sessions involving the speech recognition software were reported (Garrett, 2007).

Subjects using the speech recognition software often encountered speech recognition errors which produced incorrect words from the ones they intended. This was due to the possibility of of speech recognition software difficulty in translating/decrypting certain speech patterns and/or accents to produce the word intended. Referencing back to Simpson, Gauthier, and Prochazka (2010) study on effectiveness between tooth-click triggering and speech recognition, the researchers have also noticed a decrease in accuracy in using speech recognition to generate mouse clicks. In their data, while only one instance of a tooth-click to produce a mouse click durated past 11 seconds, fifteen instances occurred in which speech recognition took more than 11 seconds to produce a mouse click (Simpson, Gauthier, & Prochazka; 2010). The

unreliability on the accuracy of speech recognition is due in part to the speech recognition software's ability to process the speech/sounds coming from the user.

Resuming the review of Garrett's (2007) research, another issue involved with the speech recognition software was the ability to recall errors to its intended meaning. Unlike the word processing application in which the students were able to recall and correct the errors they made, subjects trying to recall their errors through speech recognition experienced difficulty in correcting errors through this software. Three out of the five subjects had drafts that had contained about ¼ errors throughout their paper which were mainly due in part to the majority of errors primarily consisting of incorrect words as well as unintentional additional words (Garrett, 2007). These errors were caused through insufficient and inaccurate processing from the software that had picked up on the instances of sound and tone from the user such as having a nasal quality of voice or heavily breathing on the mic. The software in turn processed these noises to that resulted in creating additional unintentional words. In order to make corrections to these mistakes, however, the software needed additional user input in order to recognize the user's correction commands to update its audio files to lessen the frequency of unintentional or incorrect words (Garrett, 2007).

Correcting these errors through the speech recognition software had been costly in time for all subjects in the study, which was exceedingly difficult to accomplish. Though the subjects were able to recall and correct their errors when using a word processing application to write their products, researchers hoped for that ideal ability to recall errors immediately through speech recognition software (Garrett, 2007). However, this ideal was not possible to achieve with the software due to instances in which speech patterns affected the user's ability to recall errors. The researchers had indicated that all of the subjects encountered the same problem of what they

intended to write and how the software interpreted their words to create unintended words and phrases (Garrett, 2007). Despite the ease in which the subjects were able to effectively increase their rate of correct words per minute, variables such as processing delay and mis-processing the speech given by the subjects can still slow the progress of writing a final writing product.

B. Word Prediction Software

While Speech Recognition software is able to allow the user to input words into their document at an increased frequency compared to keyboarding, users also encounter the common problem of the software misinterpreting their speech and create errors that are even more difficult to recall and correct. Another type of AT software that can help fill in the gaps left by misinterpretation and increase accuracy with users in word processing applications, word prediction software is considered a valuable resource to help students with physical disabilities create and accomplish writing products (Pouplin et al., 2016). Word Prediction Software (WPS) provides the user with a selection of correctly spelled words from the few keystrokes made (Mezei, 2009). This function allows the user to immediately finish the word they are currently typing with much ease as a smartphone user encounters after typing a few letters through text messaging.

The accessibility of WPS is very determinant on the user's time constraints and how comfortable they feel when utilizing the software. WPS's function allows individuals with significant physical disabilities to access word processing applications with minimal stress and fatigue, however, at the inconvenience of adding additional work through browsing time for the desired word and the cognitive overhead to make that decision (Mezei, 2009; Williams, 2002; Pouplin et al., 2016; Hu et al., 2013). To minimize the amount of time and cognition it takes to choose a word, the users can change the settings to determine: the number words shown on a list,

the number of letters it takes to prompt the word list, and the layout and location of the word list (Pouplin et al., 2016). Individuals with cerebral palsy, down syndrome, and various afflictions that affect their fine motor skills have had different feelings and preferences when using WPS to create word documents. Certain participants with down syndrome have had difficulty with the use of WPS due to the additional browsing time and cognitive overhead while other participants with spina bifidia and cerebral palsy have found the software beneficial in creating their product (Mezei, 2009; Hu et al., 2013).

Despite the negative effect of time-consuming thought processes required to utilize the WPS, the research gathered from the literature confirms the necessity and validity of the software's function. The use of the WPS and its benefits varies between users and their own disability that hinders fine motor movement, but the software provides a benefit nonetheless compared to the user's own writing ability without the assistance of that technology (Mezei, 2009; Hu et al., 2013; Pouplin et al., 2016). Word prediction, combined with the word processing application can provide ease to users, having them type the number associated with the word of their choice to produce fewer keystrokes (Mezei, 2009; Williams, 2002). The fewer keystrokes made, the greater the text entry rate which improves the number of words generated per minute (Mezei, 2009; Hu et al., 2013). The software itself is very versatile in enhancing the user's writing fluency, self correcting itself with proper grammar implementations and capitalizations (Williams, 2002; Mezei, 2009; Hu et al., 2013). To focus on these benefits and lessen the detriments that follow, research often suggests to a number of solutions to isolate those benefits.

To lessen the time and cognitive process that comes with decision making in choosing the appropriate and desired word of the user, certain solutions have been proposed from the research gathered by the literature. One solution was to pair up the AT of Word Prediction Softwares with

other AT such as Speech Recognition, Mouse Cameras, and Keyguards (Obringer et al., 2007; Garrett, 2007; Mezei, 2009; Simpson, Gauthier, & Prochazka, 2010; Flanagan, Bouck, & Richardson, 2013; Hu et al., 2013; Pouplin et al., 2016). As stated by Obringer, Coffey, MacFadden, Etheridge, and Pounder (2007), "a single piece of assistive technology… may not result in an appreciable difference in functioning" while the use of two or more assistive technology [devices and/or software] may need to combined to "obtain a synergistic effect" (p. 65). Along with the combination of multiple AT's, the modification or adjustment of settings to AT software/hardware can help lessen/eliminate detriments and solely focus on the positive aspects they provide (Williams, 2002; Garrett, 2007; Pouplin et al., 2016). Thus the use of AT, whether it be a software application or a hardware device, can help with certain aspects of the user's ability, if given the right combination. With practice, familiarity, and experimentation to make these adjustments, the AT software can be modified to fit the user's needs.

KNOWLEDGE OF AT SOFTWARE/HARDWARE IN EDUCATORS

The design of new and updated assistive technology appears at a constant rate, some of which are available to schools that need them out of necessity for students with disabilities. Students accessing assistive technology will need proper guidance and instruction from an educator with the knowledge to access and function the AT with minimal to no complications. However, recent studies and research have discovered that AT has been underutilized by students with disabilities due to the lack of AT knowledge and skills of teachers (Connor et al., 2010; Zhou et al., 2011; Flanagan, Bouck, & Richardson, 2013; Knighton, 2013). Without the proper instructions and guidelines to operate AT for students that are required to use them, students will have some difficulties in accessing a general education curriculum. To solve this problem, it is critical to reflect on the factors on the lack of AT knowledge and how to address them.

The lack of AT knowledge and/or skills of educators stems from a variety of factors. These factors include: the lack of training/expertise, how frequently the AT is used in the classroom, the financial cost of AT products, and the level of confidence in the educator's knowledge/skills (Zhou et al., 2011; Flanagan, Bouck, & Richardson, 2013). The lack of training on using assistive technology correlates to the amount of coursework, years of experience, and the amount of support an educator receives regarding the topic of AT (Connor et al., 2010; Zhou et al., 2011; Flanagan, Bouck, & Richardson, 2013).Thus, the more coursework, years of experience, and support received in learning the functions of an AT, the more confidence and readiness an educator will feel in teaching students how to use AT. In order to acquire the coursework and experience, educators must develop technological pedagogical content knowledge.

As defined by Knighton (2013), technological pedagogical content knowledge is "the intersection of content and pedagogy with technological knowledge, technological content knowledge, and technological pedagogical knowledge" (p. 7). Technological knowledge involves the knowledge and skills of using basic technologies, whereas technological content knowledge entails the knowledge of specific content that can demonstrated through the incorporation of technology (Knighton, 2013). Technological pedagogical knowledge requires the educator to alter their way of teaching as a result of using technology (Knighton, 2013). These three components that construct the idea of technological pedagogical content knowledge are essential for educators to effectively instruct students on how to use their AT.

To facilitate the technological pedagogical content knowledge in educators, they will need to practice using AT and integrating the technology into their classroom with frequent usage. Based on the quantitative data research provided, general education teachers were

unfamiliar with most advanced assistive technology software and/or hardware, but were more adept of recent strategies and technologies for classroom teaching (Flanagan, Bouck, & Richardson, 2013; Knighton, 2013). Despite the lack of knowledge of AT software/hardware functionality, educators still show the capacity to learn new teaching strategies and new technologies that would help benefit their classrooms. While the factor of lacking AT knowledge includes educators who have had no prior experience to use AT, some stems from educator's negative experiences with implementing AT into their classroom. As with word prediction software and speech recognition, educators have found it frustrating to implement these software programs as they cause more problems in literacy instruction in which students cannot knowingly choose the appropriate word from WPS and the amount of time it takes to set-up the AT (Mezei, 2009; Williams, 2002; Flanagan, Bouck, & Richardson; 2013; Hu et al., 2013; Pouplin et al., 2016).

SUMMARY OF CHAPTER

AT hardware and software provide sustainable benefits for the user, especially for those that require assistance with fine-motor skills on computing devices. Each singular piece of assistive technology has both its' strengths and weaknesses when used one at a time, but become more effective when paired with other AT hardware/software that can provide for its' user based on their needs. There is a variety of AT products that are readily available and constantly updated to provide better accessibility and functionality for users to complete their task with ease. However, AT software/hardware are not used in the classroom often as educators struggle to implement the technology into their classrooms. Educators have difficulties due to the cost of AT products, their inexperience with using AT, and their lack of expertise, which affects the educator's overall confidence in implementing these AT hardware/software. In order to remedy

this, educators must gain technological pedagogical content knowledge to understand and operate basic functions of AT products.

The next chapter will explore the methodology of this project, detailing the pamphlet created that will provide the basic technological pedagogical content knowledge for educators. The pamphlet was sectioned into five parts to cover functionalities and usage of AT hardware and software products, as well as provide strategies to help implement these technologies into the classroom. Designed with the idea of educators and administrators as the audience for this pamphlet, the instruments used in the creation will be explored and detailed to give a clear indication of how the project came to realization. The steps taken to produce this pamphlet involves research from other insightful, instructional pamphlets regarding AT devices and the programs used to create a clear, professionally-designed instruction pamphlet.

CHAPTER THREE: METHODOLOGY

In order to help implement the use of AT software and hardware for students with specific needs, educators are required to have basic knowledge on the most current assistive technology hardware and software available. After educators have acquired that knowledge, they should implement what they know about assistive technology and its functions, strategies, and procedures to assist students who require to use AT. To answer the question as to what strategies can be implemented by teachers to ensure that students with physical disabilities involving fine motor skills are provided with appropriate and effective assistive technology, a product was designed to provide those strategies.

This product was a pamphlet designed to provide strategies and guidance to help educators provide assistance for their students in using AT appropriately and effectively. The pamphlet's main objective is to educate readers the different types of AT and strategies how to teach students on how to use the AT device. The pamphlet was designed for its intended audience (educators and administrators) in particular for middle school and high school environments. The pamphlet was created through the combination of two computer softwares: Microsoft Word and Microsoft Publisher; for their familiarity and common use in office and schools. There were a total of five phases to the procedure of creating the pamphlet to ensure that not only did the pamphlet provide informative strategies, but it was created to be organized, thorough, and clear for educators and administrators to read with little to no confusion.

DESIGN

As it was mentioned earlier, a pamphlet was created for educators and administrators to ensure students that require the use of an AT are using them appropriately and effectively by

providing them clear informative strategies for different types of AT software and hardware devices.

A pamphlet was considered the best way to provide information and knowledge in a manner that is both convenient and effective. Educators and administrators, besides working five days a week, have dedicated hours after school for student's extracurricular activities, tutoring, and lesson plan preparation. The pamphlet was created to help educators and administrators maintain access to a resource that they can refer to when a situation dealing with AT software/hardware occurs.

As a suited resource on hand, the pamphlet was intended to be an educator and administrator's personal pamphlet that would be considered their own personal property. The pamphlet was broken down into four sections: 1) An introduction, 2) Detail about AT software applications and their strategies, 3) Detail about AT hardware devices and their strategies, 4) A list of strategies and ideas to ensure appropriate and effective use of AT through the relationships of the student in need of AT, parents/guardians of the student and their IEP team.

AUDIENCE AND SETTING

The audience that this pamphlet was intended for were educators and school administrators in middle school and high school work environments. Whether the same strategies and policies listed and described in the pamphlet would have the same effect and desired outcomes in an elementary school environment is not determined due to certain AT's requiring complex actions as well as interactions with student's utilizing AT may differ between elementary and middle/high school grades. The pamphlet was designed with the intention of

maintaining and developing meaningful interactions with students with physical disabilities, their parents, and their IEP team.

PROCEDURES FOR DEVELOPING THE PROJECT

Resourceful tools have been used to help create this pamphlet as a combination of computer software applications were needed to help make the pamphlet organized, clear, and visually aesthetic. One of the two software applications used in the making of the pamphlet was Microsoft Word. Commonly and frequently used in both office, school, and home, this was a vital tool to use in creating the pamphlet as I was able to draft, organize, write, revise, and finalize the project. The editing and formatting functions of the application, though updated every so often, are easily operated, feasible and allow me to access complex tasks through the toolbar. The outline and draft will be created through Microsoft Word, which will be transferred to a second software application. It is a software application I am most familiar with and can access all of its functions with ease.

The second software application used in tandem to create the pamphlet was Lucidpress. While Microsoft Word may lack in certain areas of layouts and formatting options, Lucidpress can make the document follow the same general guidelines in producing a pamphlet that would be structured to make finding information within the tri-fold book convenient. The application was used after the drafts for the pamphlet's sections were finalized. The text that was typed on the Microsoft Word application was then typed on Lucidpress, where final formatting and layout adjustments were made.

After careful consideration and research in viewing multiple pamphlet templates, the most viable option that was used in developing the project was creating a tri-fold pamphlet

covering the necessary AT software and hardware, its functions, and how to appropriately and effectively use them in a learning environment. It will be organized with each section of the tri-fold pamphlet to show brief information about the different types of AT software and hardware respectively, with another section providing strategies for teaching students how to use the AT device appropriately and effectively.

To ensure that the pamphlet was created to fulfill inquiries and solve situations in which an AT software/hardware was needed for use by a student with physical disabilities, an extensive process of procedures took place to achieve the final product. The first step taken was to do extensive research on recent and updated pamphlets relating AT Software/Hardware functionalities and/or strategies on making AT effective and appropriate. More than eight pamphlets were researched that fit the criteria along with research conducted on texts that covered Assistive Technologies in the classroom. After research had taken place, it was then decided to create the pamphlet in sections, writing drafts and revisions on Microsoft Word then after finalization, the text from Microsoft Word was transferred to a Microsoft Publisher document to make adjustments and layout options. The sections of the pamphlet were created first while minor components of the pamphlet, such as the pamphlets design and format were added after the main sections of the pamphlet were completed.

SUMMARY OF CHAPTER

A pamphlet was created for educators and administrators to teach them the basic functions and operations of AT software/hardware to ensure that students will be effectively using AT appropriately. The pamphlet was designed and created for educators and administrators in a middle/high school environment. It was constructed through Microsoft Word and Microsoft Publisher and backed with research based on similar pamphlets on AT software/hardware.

Divided into four sections, its informative content covered strategies for both software and hardware for educators to refer to if they encounter a situation in which their student is ineffectively/inappropriately using the AT device. What follows in the next chapter is the finished product of the project a fully revised AT software/hardware pamphlet for educators and administrators.

CHAPTER FOUR: PROJECT PRESENTATION

Below is the content of the pamphlet that I have created for this project:

Assistive Technology

Applying Methods to Use A.T. Devices Appropriately and Effectively

What is A.T.?

Assistive Technology (A.T.) refers to any item, piece of equipment or device that is used to maintain, increase, or improve the functional capabilities of individuals with disabilities.

The Need for A.T. Devices

In order to produce autonomy and seamless integration, many students with disabilities will need to make use of A.T. devices. Through the use of A.T. devices, students with disabilities will be able to build on their individual strengths, accomplish higher achievement, gain motivation, and complete academic tasks independently.

Teaching A.T. Strategies

When A.T. is appropriately integrated into the general education classroom, students can be able to accomplish academic tasks through multiple means of A.T. devices. Here are a few strategies to help educators to implement A.T. use:

1. Consult with IEP Team
    a. The IEP team determines whether the a student's needs can be fulfilled through A.T. or other means. It is important to have a team member with a vast knowledge of A.T. devices and services.

2. A.T. Implementation Plan
    a. A sub-group of the initial IEP team will develop implementation plans that will determine what A.T. services and devices are used, as well as individuals designated to assist in implementation.
3. A.T. Training with Students
    a. In order for a student to feel comfortable with the A.T. they are paired up with, the student undergoes training to understand all the functions of the device and how the device will help them.
4. Encourage A.T. Use
    a. Educators that learn how to use a student's A.T. device, incorporate A.T. into the classroom daily, and gather support from knowledgeable individuals can help maximize student success.

Determining Needs Based on Tasks

Observe the student's classroom and analyze the tasks the student is required to complete in the classroom. Determine what tasks the student cannot achieve without the use of an A.T. device and start looking at possible A.T. device options.

Understand the Student's Needs

Know your student's strengths and weaknesses, participate in A.T. training to learn about the student's A.T., and understand how the A.T. helps support the student's IEP goals and objectives. Make sure to regularly monitor the student's progress.

List of A.T. Device Suggestions:

- Intellikeys: A modified and expanded keyboard for children and adults with visual, physical, or cognitive disabilities
- Eye Camera Mouse: A mouse that can be controlled by eye movements, allowing people with total paralysis the ability to use a computer
- Soothesayer: A word prediction software program designed for use by individuals with upper extremity or cognitive disabilities.
- Soundwriter: A speech recognition software add-on for Google docs that allows the user to voice type documents through a microphone.

(Left Picture) A student using an eye-tracking camera to navigate through a learning application. (Right Picture) A keyguard, a low-tech A.T. device, designed to minimize typing errors.

Resources to Extend Your Learning

There are A.T. devices constantly produced, manufactured, and updated every year to continue providing assistance to students with physical needs. To find out more about the other types of A.T. available and discover more strategies to implement, check out the resources down below for more information.

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http://www.orin.com/access/at_fund_sources.htm

https://www.atia.org

https://www.edutopia.org/article/ assistive-technology-resources

https://www.abledata.acl.go

CHAPTER FIVE: PROJECT RECOMMENDATIONS

Educators need access to a resource of strategies on how to apply methods to ensure students with disabilities are effectively and appropriately using AT devices. In order for effective and appropriate AT device use to take place, they need a guide of what AT devices are available as well as coordination with an IEP team to determine whether the student should need an AT device and how the AT device should be implemented. Though limited in terms of information, a resource pamphlet that provides a handful of viable strategies can help educators with exploring the options available with their students with disabilities.

In this chapter, I will review the lessons that I have learned from the conception and development of this project, along with the educational implications that have stemmed from the project creation, the limitations of the project, and the future of the project.

LESSONS LEARNED

I have learned two lessons after creating and developing the pamphlet. The lessons I have learned are stemmed from the creation of the pamphlet itself.

During the creation process of the pamphlet, there were issues concerning the design of the pamphlet and the amount of information the pamphlet can provide. Considering that it was a tri-fold pamphlet, I had learned that it was difficult to decide which important strategies to list in the small amount of spaces provided. All the strategies that I had gathered from my research were important for guiding educators to implement appropriate and effective AT use, but considering there was only a limited amount of space for pamphlet without making it seem cluttered, I could only determine the more effective strategies for educators to apply to add to the pamphlet. Despite the small amount of information that can be provided, I had learned how to

properly organize the information into a coherent presentable guide. It required 1-2 days to learn the tools of designing a pamphlet and create a professional graphic design for the pamphlet that was clear and clean enough to allow the information to be read without being obscured from any jarring graphics. This was important to note in order to attract attention from educators that are browsing for resources in the resource center of the faculty office.

EDUCATIONAL IMPLICATIONS/RECOMMENDATIONS

From the research that I have gathered and the lessons learned from the project, the creation of a pamphlet needs to have purpose and enough space to support that purpose. To create a pamphlet with a purpose, you need enough information that is organized and presents different themes that make up that purpose. In order to convey these ideas, the best way to create a pamphlet is to work backwards by design (Wiggins & McTighe, 2011). Not only by text, but also by pamphlet design, especially for tri-fold pamphlets. The way a tri-fold pamphlet is folded should reflect the organization of the text based on the columns of the pamphlet what the readers expects to read when going through the pamphlet. When the design of the pamphlet has been realized, then the organization of the text follows which can organized into the different columns. If one theme is too large for one column to contain, then it can either share or take up two columns to provide the space needed.

Another recommendation for those attempting to create a similar project, a pamphlet (whether bi-fold or tri-fold) will not hold a great amount of information compared to a guide or resource manual. These pamphlets are designed to intrigue and educate readers to an extent while urging them to view other resources related to the topic of the pamphlet. The pamphlet should contain educational information that readers can gather and analyze with ease that can interest them to research the information for themselves. It is important to sift through and

determine which information readers will gain knowledge from while providing enough of that information to convey the main ideas of the pamphlet.

This pamphlet was created in mind for educators and parents of students who have been assigned an AT device/service or are in consideration to assigned an AT device/service. The purpose of this pamphlet was to educate readers on the topic of AT and steps that they can take to ensure that their student with disabilities. I hope that with this pamphlet both educators and parents will be more involved with their student's training on AT, discussing with their IEP team on consideration and planning to implement an AT device/service for their student to access. Educators and parents can participate in the process of determining the most effective AT to assign their student through the resources provided on the pamphlet.

PROJECT IMPLEMENTATION PLANS

The plan for this project is to make multiple copies to place in resource centers for faculty at different school sites, as well for the Lake Elsinore Unified School District office. As a substitute teacher, I travel to different school sites for various jobs, which leaves me with the perfect opportunity to ask principals and supervisors to allow me to provide these pamphlets to other faculty members in the lounge area or the resource center. I hope in the future that other educators will see this resource will consider these AT strategies if they feel that their students would benefit from the use of AT devices and services.

LIMITATIONS

There are a few limitations of the project. Considering there was only limited space on the tri-fold pamphlet, there was not much information that can be placed on the pamphlet to ensure there was enough resources and knowledge for the reader. What I should consider next

time is to create a guide/manual that can allow me to convey as much information as I can to provide enough resources on AT teaching strategies. With the amount of pages I could have put into the manual, there would be enough

Also there was a limitation on the success of the pamphlet. There is a need for trial and error to see if it would work with educators, especially for those that have students with physical disabilities that may be considered as AT candidates. It is not known if the pamphlet is the appropriate model for conveying the ideas of effective AT usage. There is a possibility in which the pamphlet will not be able to generate enough interest for educators to consider teaching appropriate AT usage.

There is also a limitation on the time frame of the validity of the pamphlet. There will always be new and updated AT being released between the conception of this project to the near future. And with that AT being constantly developed, so will new strategies on how we should teach appropriate and effective use of AT devices and services.

FUTURE RESEARCH/PROJECT SUGGESTIONS

Assistive Technology is always advancing. It is an idea that will always continue to progress and be a part of education. There are only a few school sites in the Lake Elsinore school district that practice inclusion in which students still need the use of AT to help them achieve their academic goals. For those school sites that do practice inclusion, I hope that the resource pamphlets I made inspire involvement between a student and their teacher into learning how to use an AT device/service. I hope to continue this project into other school districts where teachers experience the problem of making sure that their student is using their AT effectively and appropriately.

CONCLUSION

Assistive technology can be that bridge between students with physical/mental disabilities and their own academic goals. When implemented properly and used effectively, AT can be a very powerful tool for students to use. As educators, it is within our own self-interests and student's interest that we help accommodate the students we are teaching, to provide assistance to them in using their AT device/service appropriately and effectively so that they can complete their academic tasks. There is a variety of AT devices (both software and hardware) that teachers should be aware of that can help a student with completing tasks that require the use of a computer. There is also benefits to be had from educators who invest their time in learning their students AT device/service to increase their motivation and usage. A resource pamphlet is only a small step in taking that extra mile and going beyond what we can do for student with physical/mental disabilities. Despite the strategies, resources, and knowledge it can provide, there is more that needs to be done for an educator to be involved in their student's academic career.

Teachers and educators should be able to support their students with physical/mental disabilities by understanding their strengths and weaknesses when using AT devices. Discussing with either the student, their IEP team, their parents/guardians, or all three will help generate an understanding of the student's struggle with achieving their academic goals. In addition, adjusting and implementing lessons that can allow the student optimally use the AT device will help increase motivation and prolonged usage.

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