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PREDICTING ASSISTIVE TECHNOLOGY SELF-EFFICACY IN
TEACHERS OF STUDENTS WITH VISUAL IMPAIRMENTS

by

Allen Huang

A Dissertation

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Doctor of Education

Major: Instruction and Curriculum Leadership

The University of Memphis

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Dedication

This dissertation is dedicated to my three children, Theo, Owen, and Iris. When I began this doctoral journey there was just one of you, and as I complete this journey, I have all of you. I have been on an emotional roller coaster this entire time, and yet your love and exuberance each day grounded me in remembering what matters most in life. Thank you for this blessing. I love each of you so much.

You are all too young to remember this period of our lives, but I will never forget the evenings spent putting you all to bed with books and songs and then working as late as I could to keep making progress with my writing. I look forward to the day I can explain the work of this dissertation to you, and I hope you will learn from this endeavor that even the greatest of accomplishments are reached a little bit at a time.

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This dissertation is not just the product of my own efforts, but it is truly the culmination of all the love and support I have received leading up to this point.

First, I must thank my dear wife Catie for being at my side through this entire journey. You encouraged me to pursue this dream of an advanced degree, you patiently helped me navigate my toughest of moments, and you provided tough love when I needed to hear it most; all of this done with grace and understanding. Thank you for getting me across the finish line.

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To my dissertation committee members, Dr. Craig Shepherd, Dr. Rachel Schles, and Dr. Luann Ley Davis, thank you for helping me develop and refine this manuscript. Dr. Shepherd, your nuanced feedback engaged my thinking so that I was sure of why I wrote what I did. Dr. Schles, I am grateful for your friendship and that we are colleagues in the field. This research has greater validity thanks to your specific insights. Dr. Ley Davis, I am humbled by your words of encouragement that this dissertation's findings are meaningful and worthy of publication.

Abstract

Students who are blind and visually impaired can use assistive technology (AT) improve their access to the educational environment. Mastering the use of AT is a crucial part of developing long-term independence and productivity in academic, vocational, and leisure settings. However, teachers of students with visual impairments (TVIs) report poor self-efficacy for teaching and supporting the use of AT. TVIs with low assistive technology self-efficacy (ATSE) may be less likely to use AT with their students, teach and support AT effectively, and persist through difficult experiences with students' AT. Subsequently, students are at risk of not being exposed to AT that is useful and appropriate to them, and their AT skills may not reach mastery levels necessary for achieving desired outcomes. To date, the literature has not identified or examined any specific factors associated with TVIs' ATSE. This study conducted such an investigation, using a quantitative, predictive correlational research design to examine the associations between 12 TVI experience factors and TVIs' ATSE. A survey was distributed to TVIs across the United States, requesting input regarding their experiences, and a novel TVIs' Assistive Technology Self-Efficacy Scale was developed to measure TVIs' beliefs regarding their ATSE. The data were analyzed using a hierarchical multiple regression. Four TVI experience factors were found to be predictive of TVIs' ATSE, and the variable categories of training experience and work experience factors were also found to be predictive of ATSE. These data, along with a variety of descriptive statistics, provide an updated examination of the state of AT in the field of visual impairments; researchers and practitioners now have specific aspects of TVIs' experiences to design interventions around and further investigate in future research.

Keywords: Visual Impairments, Assistive Technology, Self-Efficacy, Predictive Correlation, Hierarchical Multiple Regression

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CHAPTER 1: INTRODUCTION

Students who are visually impaired, including those who are blind, often depend on the use of assistive technology (AT) to access learning materials (Jones et al., 2019; Morash & Siu, 2016; Wong, 2018). Teachers of students with visual impairments (TVI) are the professionals qualified and responsible for providing vision-specific instruction to students with visual impairments (Herzberg, Rosenblum, & Robbins, 2017; Siu & Emerson, 2017), including dedicated instruction in the area of AT skills and concepts (Hatlen, 1996; Presley & D'Andrea, 2009; Sapp & Hatlen, 2010). However, in-service TVIs have reported low assistive technology self-efficacy (ATSE) (Abner & Lahm, 2002; Ajuwon et al., 2016; Edwards & Lewis, 1998; Zhou et al., 2011; Zhou et al., 2012). Zhou et al. (2011) found 57.5% of TVI participants ($n = 165$) lacked adequate confidence in their knowledge of and skills in teaching and supporting the use of AT, and Zhou et al. (2012) found 59.3% of TVI participants ($n = 840$) reported no confidence, limited confidence, or some confidence in teaching and supporting AT with students with visual impairments. Unfortunately, a consequence of low ATSE is TVIs' poor integration of AT to enable learning (Morash & Siu, 2016; Wong & Cohen, 2015). Therefore, students learning and mastering AT skills critical to achieving successful educational and vocational outcomes may suffer (Ripat & Woodgate, 2017). In order to ensure that as many students with visual impairments as possible are receiving high-quality AT instruction and supports, TVIs must be supported to develop their self-efficacy for teaching AT skills and concepts.

Unfortunately, very little empirical literature has examined factors predictive of ATSE. This proposed study will examine the predictive relationship between the ATSE of TVIs and a variety of factors associated with it, using self-efficacy theory to guide the study (Bandura, 1977). Bandura, in his self-efficacy theory, purported that there are 4 sources of self-efficacy that

contribute to its development: Mastery experiences, vicarious experiences, verbal persuasion, and physiological states. In the study, 11 predictor variables relevant to the TVI experience and aligned with the 4 sources of self-efficacy were identified from the literature. The predictor variable categories include TVIs' demographics, training experiences, and work-related experiences. The TVI experience factors will be tested through the examination of their predictive associations, if any, with TVIs' ATSE.

Problem of Practice

TVIs face several challenges as they seek to provide high-quality AT instruction. First, students who are blind and visually impaired possess a vast and infinitely diverse range of visual experiences. TVIs, responsible for meeting the needs of any student in their caseload, must be prepared to meet students' varied needs with their corresponding appropriate AT. Commenting on AT skills, a TVI in Ajuwon et al.'s (2016) study of teachers' perceptions said, "Instructing VI students from birth to age 22 with a wide range of abilities in the expanded core curriculum is a challenge in itself!" (p. 131). Furthermore, AT for individuals with visual impairments is frequently changing, and keeping track of new developments in the field is not an easy task (Morash & Siu, 2016; Wong, 2018). Lastly, adding to these challenges is TVIs' poor ATSE (Abner & Lahm, 2002; Ajuwon et al., 2016; Edwards & Lewis, 1998; Jones et al., 2019; Zhou et al., 2011; Zhou et al., 2012), which suggests that many TVIs are not effectively exposing their students to AT and providing rigorous AT instruction and support (Thornton et al., 2020; Wong & Cohen, 2015; Zhou et al., 2012). As a result, students with visual impairments may not master the AT skills necessary to access learning information independently and efficiently in school or productivity tasks in the workplace (Abner & Lahm, 2002); they would be poorly prepared for success as independent members of society (Ripat & Woodgate, 2017).

Seeking to address the issue of TVIs' low ATSE, the literature has recommended that: (a) pre-service university TVI personnel preparation programs improve how they address AT in their coursework and practicum experiences, and (b) professional development (PD) opportunities focusing on AT be provided to TVIs (Ajuwon et al., 2016; Kamei-Hannan et al., 2012; Morash & Siu, 2016; Smith et al., 2009; Wong & Law, 2016; Zhou et al., 2011; Zhou et al., 2012). However, before effective coursework and PD can be developed to address low ATSE, instructional designers need to understand what specific factors influence TVIs' ATSE. For example, Zhou et al. (2012) wondered "Simply providing information about competencies in preservice programs may not be sufficient...But how can faculty improve the [pre-service] students' level of competence in the foundations domain? Would providing students with practical scenarios of case studies make them more confident...?" (p. 663). The authors have ideas but lack concrete data useful for making informed decisions. However, equipped with more information about the factors associated with ATSE, researchers will be able to conduct more targeted investigations on the topic, further contributing to the literature on the topic. University faculty will also be more informed regarding methods for teaching AT to TVI candidates, and practitioners will be able to design more effective professional development experiences for their peers.

Purpose Statement

The purpose of this quantitative, predictive correlational research study is to examine the predictive relationships, if any, between the criterion variable of TVIs' ATSE and the predictor variables of demographic factors (age, TVI experience), training experience factors (form of university training, path to TVI licensure, university AT training, pre-pandemic AT PD availability, and current AT PD availability), and work experience factors (method of attending

AT PD, service delivery model, number of additional TVIs in the district, percent of weekly service time teaching AT, and ability to purchase new AT). These variables are defined both narratively and operationally in Appendix A.

For the purposes of this study, ATSE is defined as TVIs' belief that they can perform the AT-specific duties necessary to support their students' successful use of AT (Abner & Lahm, 2002). In order to measure TVIs' ATSE, an original instrument, the TVIs' Assistive Technology Self-Efficacy Scale, was developed in alignment with Siu and Morash's (2014) four dimensions of AT proficiency and drew item design inspiration from the Teachers' Sense of Efficacy Scale by Tschannen-Moran and Hoy (2001). Additional survey questions were developed to measure the study's predictor variables. This study collected data through the administration of a survey with participants from a convenience sample of TVIs in the United States.

Theoretical Framework

This study uses self-efficacy theory (Bandura, 1977) as its theoretical framework, through which TVIs' demographic, training experience, and work experience factors were selected as relevant for use from existing literature (Morash & Siu, 2016; Siu & Morash, 2014; Wong & Cohen, 2015; Zhou et al., 2011; Zhou et al., 2012).

Self-efficacy theory was developed by Albert Bandura around the same time as social learning theory (Bandura, 1977), later termed social cognitive theory (Bandura, 2005). In his seminal paper on self-efficacy theory, Bandura (1977) defined efficacy expectations as "the conviction that one can successfully execute the behavior required to produce [certain] outcomes" (p. 193). Self-efficacy theory was thus proposed under the assumption that certain psychological procedures can serve as means for creating and strengthening one's expectations of personal efficacy (Bandura, 1977, 1994; Tschannen-Moran et al., 1998).

Bandura (1977) notably identified that one's perceived self-efficacy can affect coping efforts on chosen activities. That is, self-efficacy was described as determining how hard and how long a person will attempt to perform a given task. Individuals with high self-efficacy will persist at a task through difficult situations, whereas individuals with low self-efficacy will give up at the challenging task sooner (Tschannen-Moran et al., 1998). Given this description, self-efficacy theory is relevant to the challenges faced by TVIs regarding their low ATSE. TVIs with higher ATSE will likely make greater efforts to master new learning of a given AT solution to teach its use with a student (Schunk, 1995), and they may also proactively look for new opportunities to integrate AT in their students' daily routines (Kent & Giles, 2017). TVIs with lower ATSE may become discouraged regarding the task of learning to use an AT solution, or they may decline to introduce certain AT to their students (Edwards & Lewis, 1998). What can be done, then, to improve and achieve a strong ATSE? Bandura (1977, 1994, 1997) stated that there are four sources of self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, and physiological states. He theorized that these sources had varying levels of influence on individuals' perceived self-efficacy, from mastery experiences having the greatest influence to physiological states having the least influence. Perhaps it is possible, then, to identify factors from TVIs' background, training, and work experiences that are aligned with self-efficacy theory's sources of self-efficacy. If identified, then these factors could be investigated to determine their correlations with TVIs' ATSE. Should self-efficacy theory (Bandura, 1977) hold true as hypothesized, then at least some identified factors are expected to be positively associated with TVIs' ATSE.

The specific variables for each factor category are related to one of the four sources of self-efficacy: mastery experiences, vicarious experiences, social persuasion, and physiological

state (Bandura, 1977, 1994). Mastery experiences are direct moments of successful performances in which individuals' successes raise their personal efficacy beliefs. For example, a TVI who has a successful lesson introducing computer accessibility features to a student will develop confidence in his or her ability to conduct such lessons in the future. Mastery experiences are considered the strongest source of self-efficacy, and repeated mastery experiences are thought to develop resiliency in one's self-efficacy to persist through adversity (Bandura, 1994).

Vicarious experiences are those in which individuals observe others performing tasks successfully, thus improving one's beliefs that they too can perform the task. A comprehensive video demonstration of an electronic braille device's unique features may serve to assuage a TVI's doubts regarding being able to teach those specific features with a student and rather bolster their personal efficacy for doing just that. Vicarious experiences are considered the next strongest source of self-efficacy, especially influential if the model is perceived to be similar to the individual (Bandura, 1994).

Social persuasion involves the encouragement, verbal or otherwise, given to individuals that they are indeed able to perform a given task. If one is persuaded by this external motivation, they may put forth and sustain greater efforts toward an activity than if they previously held self-doubts (Bandura, 1994). Social persuasion would likely be effective if a TVI's experienced colleague encouraged them that they would have a successful lesson, as opposed to a situation in which the TVI had no peers in the school district or was being encouraged by someone unfamiliar with the field of visual impairments.

Lastly, physiological states refers to the influence an individual's awareness and interpretations of their state of being can have on their efficacy beliefs for performing a task (Klassen & Usher, 2010). For example, a TVI feeling stress and anxiety during a difficult lesson

may interpret those sensations as evidence that they are poorly qualified to teach their student. However, this source is considered the weakest, as most individuals are thought to be able to reduce the effects of such interpretations through overall positive states of self-efficacy and relatively weak overall self-doubts (Bandura, 1977).

The alignment between the 4 sources of self-efficacy and the 12 TVI experience predictor variables are displayed in Table 1. Self-efficacy theory suggests activities that exemplify a given source of self-efficacy will support improved judgments of one's self-efficacy. As such, the predictor variables being investigated are hypothesized to be predictive of ATSE.

Table 1

Definitions of Sources of Self-Efficacy and Alignment with TVI Variables of Interest

Source of Self-Efficacy	Definition of Source	Aligned Variables of Interest
Mastery experiences	Direct experiences of successful performances; Most powerful source	TVI experience Form of university training Path to TVI licensure University AT training Pre-pandemic AT PD availability Current AT PD availability Service delivery model % of weekly service time teaching AT Ability to purchase new AT
Vicarious experiences	Observations of others performing tasks successfully; Second most powerful source	TVI experience Form of university training Path to TVI licensure University AT training Pre-pandemic AT PD availability Current AT PD availability Method of attending AT PD Service delivery model Number of additional TVIs
Social persuasion	Persuasion by influential people that one can master an activity; Next most powerful source	Service delivery model Number of additional TVIs
Physiological states	One's physiological state influences belief in oneself; Least powerful source	Age

Research Questions

The research questions for this study are:

Research Question 1. What are the associations, if any, between any of TVIs' demographic factors (age, years of TVI experience), training experience factors (form of university training, path to TVI licensure, university AT training, pre-pandemic AT professional development

availability, current AT professional development availability), work experience factors (method of attending AT professional development, service delivery model, number of additional TVIs, percent of weekly service time teaching AT, ability to purchase new AT), and assistive technology self-efficacy (ATSE)?

Research Question 1A. To what extent, if at all, is the linear combination of TVIs' demographic factors (age, TVI experience) predictive of TVIs' ATSE?

Research Question 1B. To what extent, if at all, is the linear combination of TVIs' training experience factors (form of university training, path to TVI licensure, university AT training, pre-pandemic AT professional development availability, current AT professional development availability) predictive of TVIs' ATSE?

Research Question 1C. To what extent, if at all, is the linear combination of TVIs' work experience factors (method of attending AT professional development opportunities, service delivery model, number of additional TVIs, percent of weekly service time teaching AT, ability to purchase new AT) predictive of TVIs' ATSE?

Null Hypotheses

The research hypotheses for this study are the following:

Research Hypothesis 1. There will be statistically significant associations between in-service TVIs' demographic factors (age, TVI experience), training experience factors (form of university training, path to TVI licensure, university AT training, pre-pandemic AT professional development availability, current AT professional development availability), work experience factors (method of attending AT professional development opportunities, service delivery model, number of TVIs in work setting, time available to provide AT instruction, availability of AT resources), and ATSE.

Research Hypothesis 2. There will be a statistically significant association between the linear combination of TVIs' demographic factors (age, years of experience as a TVI) and ATSE.

Research Hypothesis 3. There will be a statistically significant association between the linear combination of TVIs' training experience factors (form of university training, path to TVI licensure, university AT training, pre-pandemic AT professional development availability, current AT professional development availability) and ATSE.

Research Hypothesis 4. There will be a statistically significant association between the linear combination of TVIs' work experience factors (method of attending AT professional development opportunities, service delivery model, number of additional TVIs, percent of weekly service time teaching AT, ability to purchase new AT) and ATSE.

The null hypotheses for this study are the following:

Null Hypothesis 1. There are no statistically significant associations between in-service TVIs' demographic factors (age, TVI experience), training experience factors (form of university training, path to TVI licensure, university AT training, pre-pandemic AT professional development availability, current AT professional development availability), work experience factors (method of attending AT professional development opportunities, service delivery model, number of TVIs in work setting, time available to provide AT instruction, availability of AT resources), and ATSE.

Null Hypothesis 2. There is no statistically significant association between the linear combination of TVIs' demographic factors (age, TVI experience) and ATSE.

Null Hypothesis 3. There is no statistically significant association between the linear combination of TVIs' training experience factors (form of university training, path to TVI

licensure, university AT training, pre-pandemic AT professional development availability, current AT professional development availability) and ATSE.

Null Hypothesis 4. There is no statistically significant association between the linear combination of TVIs' work experience factors (method of attending AT professional development opportunities, service delivery model, number of additional TVIs, percent of weekly service time teaching AT, ability to purchase new AT) and ATSE.

Definitions

Visual impairments. All eye and neurological conditions that result in an individual's visual experience, even after correction, being reduced in some form compared with individuals without the same conditions (IDEA, 2004). In this study, visual impairment includes blindness, which is the total lack of sight.

Teacher of students with visual impairments (TVI). Educators trained and certified to provide specialized instruction and supports to students who are blind or visually impaired. (Siu & Emerson, 2017)

TVI licensure. The license, certification, or endorsement required and managed by a state that legally allows an individual to provide vision services to students with visual impairments. Requirements for becoming a licensed TVI vary from state to state which can result in TVIs varying widely in their skill levels (Pogrund & Wibbenmeyer, 2008).

Provisional TVI licensure. In some states, an individual may work as a TVI even though they have not met the requirements for full TVI licensure. Usually, these individuals are actively seeking a degree, credential, or other formal training in order to eventually meet their state's full TVI licensure requirements. This could mean satisfying a coursework requirement or having the content knowledge to pass a certification test (Pogrund & Wibbenmeyer, 2008).

Itinerant TVI. Itinerant TVIs work in a service delivery model in which they provide vision services to students in their local schools. Itinerant TVIs are usually responsible for more than one student in the school district and thus travel between their students' schools to provide vision services (Siu & Morash, 2014).

Resource room TVI. Some TVIs work at a single school within their district and provide vision services and supports to students in a resource room context (Siu & Morash, 2014).

Specialized schools for the blind. Specialized schools for the blind are residential schools in which all students have a visual impairment and where more frequent, disability-specific instruction and supports are provided than in local schools. Typically, most teachers at specialized schools for the blind are TVIs (McMahon, 2014).

University training program. This refers to the university-based personnel preparation programs in which teacher candidates are taught specific knowledge and skills relevant to their area of study. University training programs vary in how they are set up, but teacher candidates usually earn a degree or certificate when they complete their programs and then seek licensure in their area of study.

In-service. This refers to the time after a teacher has completed his or her educational training. In-service teachers are actively working, and in-service professional development is specialized training provided for teachers who are currently working.

Professional development (PD). Specialized training designed to improve the knowledge, skills, and competence of an individual in a certain topic.

Assistive technology (AT). Any form of technology that assists individuals in achieving an augmented level of access to some form of information. This includes low-tech to high-tech devices and software, as well as common and dedicated solutions (Presley & D'Andrea, 2009).

Self-efficacy. Self-efficacy is the conviction an individual holds regarding whether they can successfully execute a task or demonstrate a skill required to produce certain outcomes (Bandura, 1977).

Teacher self-efficacy. Teacher self-efficacy is a teacher's judgment of his or her capabilities to perform the various elements of their job responsibilities such that desired outcomes for student engagement and learning occur (Tschannen-Moran & Hoy, 2001).

Assistive technology self-efficacy (ATSE). ATSE is defined as TVIs' belief that they can perform the AT-specific duties necessary to support their students' successful use of AT.

CHAPTER 2: LITERATURE REVIEW

This literature review is structured around Bandura's self-efficacy theory (1977). Self-efficacy theory's key principles are first defined and discussed. Then, the field of teaching students with visual impairments is introduced, and literature describing the role and responsibilities of teachers of students with visual impairments (TVIs) are reviewed. In addition, assistive technology (AT) used by students with visual impairments is defined and discussed. Research on teacher self-efficacy is reviewed, followed by research specifically involving the assistive technology self-efficacy (ATSE) of TVIs. Finally, specific traits and experiences that vary among TVIs are presented and categorized as either demographic, training experience, or work experience factors; theorized links to ATSE are identified.

Self-Efficacy Theory

Self-efficacy theory was initially proposed by Alfred Bandura in 1977, part of his career efforts to promote a cognitive interactional model of human behavior change that contrasted with earlier beliefs of behavior change as rooted solely in responses to external stimuli (Klassen & Usher, 2010). In his seminal work, Bandura (1977) presented self-efficacy theory as a theory in which psychological changes achieved by different forms of treatment could be explained and predicted. Specifically, self-efficacy theory assumes that psychological procedures, whatever they might involve, serve as means of creating and strengthening one's beliefs about their personal efficacy (Bandura, 1977). For example, when different individuals begin an activity, they may differ in their self-efficacy for learning or performing relevant actions due to differences in their prior experiences, skill levels, and attitudes (Schunk, 1995). Taking such factors into account, one's efficacy beliefs can be defined as "the conviction that one can successfully execute the behavior required to produce the outcomes" (Bandura, 1977, p. 193).

An important clarification to make is that efficacy beliefs differ from outcome expectancies. Bandura (1977) defined outcome expectancy as an individual's estimate, after a behavior has initiated, that the behavior will result in certain outcomes. Efficacy belief, the principal focus of self-efficacy theory, is conceptually positioned as involving psychological processes that affect and lead to the initiation and persistence of behavior; self-efficacy is deeply concerned with individuals' decisions to engage in behavior, as well as to persevere in behaviors once initiated (Bandura, 1977; Schunk, 1995).

Self-efficacy is described as influential toward the tasks people will undertake, the level of effort expended toward tasks, the amount of time they will persevere in the midst of challenges, and the ways they view setbacks in their efforts (Bandura, 1994; Maddux, 2009). Judgments of self-efficacy are less about how skilled one is and more about what an individual can do with the skills they have (Maddux, 1995). So, an individual with a strong sense of efficacy might either accomplish more or have a greater impact than someone who technically has more skills but does not believe strongly in their ability to perform those skills successfully. Bandura (1977) stated that "Not only can perceived self-efficacy have directive influence on choice of activities and settings, but, through expectations of eventual success, it can affect coping efforts once they are initiated" (p. 194). Given these influences, Bandura (1994) described some specific consequences of strong and poor senses of efficacy, which can be viewed in Table 2.

Table 2

Consequences of High and Low Self-Efficacy

Behaviors	High Self-Efficacy	Low Self-Efficacy
Approach to difficult tasks	Difficult tasks seen as challenges to be mastered Focus on how to perform tasks successfully	Difficult tasks seen as threats to be avoided Focus on personal deficiencies, obstacles, other adverse outcomes
View of new challenges	Develop intrinsic interest and deep engrossment in activities	Low aspirations to take on new challenges
Goal setting	Set challenging goals and maintain commitment to goals	Weak commitment toward goals being pursued
Response to failures	Heighten and sustain efforts Failure attributed to insufficient effort or knowledge which can be acquired Quickly recover sense of efficacy	Quick to lose faith in capabilities Failure seen as proof of insufficient aptitude Slow to recover sense of efficacy

Sources of Self-Efficacy

Given that the development of high self-efficacy is desirable, Bandura described four fundamental sources by which self-efficacy can be influenced (Bandura, 1994; Klassen & Usher, 2010). These sources of self-efficacy are: mastery experiences, vicarious experiences, social persuasion, and physiological states (Bandura, 1977, 1994; Klassen & Usher, 2010). It is individuals' interactions with these sources that underpin self-efficacy theory, cognitively processing and constructing meaning from those experiences. The sources of self-efficacy vary in the strength of their influence on self-efficacy.

Mastery experiences. Mastery experiences, originally termed performance accomplishments, are previous successful experiences. When individuals perform tasks successfully, they develop a sense of accomplishment that raises their self-efficacy for future tasks. Conversely, if repeated failures are experienced, then self-efficacy will be lowered.

Mastery experiences is the strongest source of self-efficacy because it alone involves considering how one's own self has succeeded in a task. Its positive effects are thought to be amplified particularly when individuals persevere through occasional failures. This is because individuals develop the notion that they are capable of mastering even highly difficult challenges through determined efforts (Bandura, 1977, 1994). Bandura (1977) describes mastery experiences as increasing self-efficacy through the following modes: direct experience with a task, desensitization or becoming less averse to a task, exposure and understanding of a task, and teaching oneself to perform a task.

Vicarious experiences. Vicarious experiences are social observations of others performing tasks successfully. When an individual can observe someone similar to themselves succeed through sustained effort, they develop the sense that they too can perform the task (Bandura, 1994). Witnessing others experience failure despite high effort can discourage individuals of their own chances of success, lowering their self-efficacy. Vicarious experiences are considered the second strongest source of self-efficacy, as the potential influence on individuals from social models they perceive to be similar to them is very high. The more similar a model is perceived to be, from the model's characteristics to the task being conducted, the more influential the successful completion of a task can be (Bandura, 1977, 1994).

Social persuasion. Social persuasion is the verbal suggestion to individuals to believe that they can successfully perform a task. When an individual is successfully persuaded by another person that they can be successful, they are likely to put forth a greater, sustained effort toward a task (Bandura, 1994). Social persuasion might involve encouragement, exhortation, and self-instruction (Bandura, 1977). Social persuasion is considered weaker than mastery experiences and vicarious experiences for developing self-efficacy, as it lacks the "authentic

experiential base” of an individual’s own direct accomplishments (Bandura, 1977, p. 198). That is, individuals will not have much actual experience to base their self-efficacy beliefs on when confronted with challenging situations.

Physiological states. The final source of self-efficacy is physiological states, in which individuals consider their state of being, including stress, fatigue, and mood, and make subsequent judgments of their capabilities (Bandura, 1994). Should an individual judge themselves to be in a positive mood, they may find their self-efficacy to be boosted, and having a poor mood may have a limiting effect on self-efficacy. Similarly, feeling stressed about a situation may lead to negative impressions of one’s readiness to complete a task; reducing one’s stress can prove to assuage such concerns (Bandura, 1994). Physiological states is considered to have the weakest influence on self-efficacy.

This study aligned TVI experience factors with these sources of self-efficacy, and it hypothesized that self-efficacy theory would be confirmed, explaining significant relationships between the TVI experience factors and TVIs’ ATSE.

Education for Students with Visual Impairments

People with visual impairments (defined as those who are blind or have low vision) are a group of individuals whose visual access to their environment, to some degree, is diminished in comparison to those who do not have a visual impairment. For example, an individual with low vision may not be able to see the text in a book clearly unless holding the book very closely, and someone who is blind cannot see the visual content of a television. Given these challenges, various professionals work to advance the independence and capabilities of people with visual impairments (Siu & Emerson, 2017).

Teachers of students with visual impairments (TVI) play a critical role in the education of students with visual impairments. This is because TVIs are the only professionals specifically trained to address the unique, disability-specific learning needs of these children (Sapp & Hatlen, 2010; Siu & Emerson, 2017). They are responsible for determining students' individual visual experience and addressing their corresponding barriers of access to the general education core curriculum through appropriate instruction and supports (Correa-Torres & Howell, 2004; Herzberg et al., 2017; Siu & Emerson, 2017). For example, TVIs teach students how to enlarge small print with a magnifying device, and they also teach students the braille code as a means of literacy in lieu of reading print.

In a broader sense, TVIs are responsible for teaching skills and concepts that are part of the Expanded Core Curriculum (ECC; Hatlen, 1996; Sapp & Hatlen, 2010; Siu & Emerson, 2017; Siu & Morash, 2014; Wolffe & Kelly, 2011). The ECC is a conceptual framework that consists of nine skill and concept areas that students with visual impairments may need to learn explicitly because they cannot be learned incidentally through visual observation (Hatlen, 1996; Sapp & Hatlen, 2010). The nine areas of the ECC include: compensatory or access skills, career education, independent living skills, orientation and mobility skills and concepts, recreational and leisure skills, self-determination skills, social interaction skills, sensory efficiency skills, and use of assistive technology (AT; Hatlen, 1996; Sapp & Hatlen, 2010).

For example, as children grow up, they typically observe the social interactions of their family members and peers, noticing various details including how those interactions played out. However, one concept a student with visual impairment might not learn is how closely individuals stand to each other when carrying out conversations; they might not realize that it is not socially appropriate to stand very close to the person they are talking to. Here, a TVI would

identify the concept gap and explicitly teach their student about appropriate speaking distances. An example of the need for AT instruction is if a student with visual impairment needed to use a smartphone. The student might be aware of smartphones' features but not actually know how to use the phone; they have not been able to see others use the phone or be taught how to use its built-in accessibility features. In this example, a TVI might teach the student how to use specialized swipe and tap gestures to navigate the device.

Assistive Technology for Students with Visual Impairments

The literature has established that teaching students with visual impairments how to use AT is one of TVIs' primary instructional responsibilities (Abner & Lahm, 2002; Ajuwon et al., 2016; Siu & Morash, 2014; Smith et al., 2009). Not only are traditional roles like supporting students' access to visual content in the classroom using tools like magnifiers still commonplace and relevant, but in the present climate of increasing technological integration in education, TVIs must also provide explicit instruction in the access of classroom educational technologies through AT (Siu & Emerson, 2017). To this end, Kelly and Smith (2011) stated, "in this era of accountability, professionals need to demonstrate effectiveness, regardless of any extenuating circumstances related to the rapid advancement of products" (p. 75). No matter the state of educational practices and technologies, TVIs need to make every effort to establish and maintain functional proficiency with AT. Otherwise, they will find themselves unable to provide the necessary instruction and supports their students need.

Definition of Assistive Technology

The *Individuals with Disabilities Education Improvement Act* (IDEA, 2004) defines AT devices 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” (Sec. 602, 20 USC 1401, § 300.5). IDEA (2004) also identifies AT service as “any service that directly assists an individual with a disability in the selection, acquisition, or use of an assistive technology device” (§ 300.6). This broad definition encompasses both low-tech and high-tech solutions. Low-tech AT is usually affordable and non-electronic in nature. For example, a binder turned on its side to serve as a slant board for an improved viewing angle is an example of low-tech AT. High-tech AT is usually more expensive, is powered electronically, and requires more direct instruction to learn how to use. Screen reading software is a high-tech AT solution, and a new learner would likely need specific instruction to learn various keystrokes involved in using the software functionally and efficiently for hearing the contents of a computer screen. Given these examples, for the purposes of this study, AT refers to high-tech electronic devices or software solutions used by individuals with visual impairments, including both specialized and common technology. These kinds of AT are not easily mastered by TVIs without dedicated training, and it is important that they understand the nuances and specific use cases of various AT to know which solutions will best support a student’s learning access needs.

In the field of education for students with visual impairments, AT often refers to specialized devices or software solutions that provide individuals with unique methods of improving access to instructional materials (Kelly & Smith, 2011; Sapp & Hatlen, 2010; Smith & Kelly, 2014). This could be in the form of improved visual access, and it can also include alternative forms of access in lieu of or in addition to visual access. For example, tools like magnification devices provide improved visual access to print materials, and screen reading software provides auditory access to digital content on a computer or smartphone (Smith et al., 2009). AT can also include common technology found in educational environments, like

computers, tablets, and smartphones. This is because, as part of the ECC, TVIs cannot assume that students with visual impairments will understand basic skills and concepts related to the use of such devices (Sapp & Hatlen, 2010). Therefore, instruction may be necessary to ensure that fundamental access skills for ubiquitous technologies are mastered.

TVI Role in Teaching Assistive Technology

TVIs alone are responsible for teaching critical vision-specific AT skills and concepts to students with visual impairments. They are the only professionals with expertise regarding the intersection of visual impairment and education, including the provision of instruction in AT (Pogrund & Wibbenmeyer, 2008; Siu & Emerson, 2017). Siu and Morash (2014) stated that TVIs teach according to the ECC, and as a result, “these teachers are primarily responsible for AT instruction with students with visual impairments” (p. 385).

Teaching and supporting AT is of critical importance for TVIs because of the benefits AT can play in the educational, vocational, and life experiences of students with visual impairments. For example, AT can be used by individuals with visual impairments to meaningfully access and express themselves on social media platforms (Della Líbera & Jurberg, 2017). In many ways, AT has the potential to be a “great equalizer” for individuals with disabilities because it “can be used to address many of the challenges that individuals with visual impairments face” (Kelly & Smith, 2011, p. 73).

TVIs are responsible for introducing their students to a variety of AT options. D’Andrea (2012) conducted a study investigating the use of AT in high school aged students, as well as their attitudes towards AT. Participants had differing opinions regarding the AT they preferred depending on cost, how common it was, and perceived usefulness for certain tasks. As such, the author cautioned against one-size-fits-all approaches to introducing AT and emphasized

providing students with as many tools as possible. This approach would allow students with visual impairments to be exposed to sufficient options to make appropriate choices for themselves. In contrast, if students with visual impairments have little or no exposure to AT, they become at risk of falling behind their sighted peers (Kelly, 2009).

Beyond the basic matter of access, students with visual impairments also develop independence when they master AT skills (Kelly & Kapperman, 2018). Indeed, Bouck, et al. (2011) tested a computer-based voice input, speech output calculator with high school students with visual impairments and found that participants received the calculator positively because of the independence the tool provided them in completing math problems.

Positive Outcomes of Using Assistive Technology.

The ultimate goal for independent students with visual impairments is positive postsecondary outcomes, as current national data show only 44% of adults with visual impairments are employed (McDonnall & Sui, 2019). Similarly, McDonnall and Tatch (2021) found that employment rates for people with visual impairments vary substantially by education level, from an average of 62.5% for those with a college degree to 26.2% for those with less than a high school degree; all these employment rates fell well below that of individuals with no disabilities, but the gap in employment rates was reduced as individuals achieved higher levels of education. AT can be of tremendous use to individuals with visual impairments in accessing job materials and performing responsibilities effectively, and research has shown that AT use by individuals with visual impairments significantly predicts the likelihood of having paid employment or attending a postsecondary institution (Kelly, 2011; Wolffe & Kelly, 2011).

The literature bears out the responsibility TVIs have in being the professionals with the knowledge and skills to introduce AT to students with visual impairments. That is, TVIs' ability

to teach and support AT has the potential to dramatically alter their students' life trajectories. Furthermore, TVIs' ATSE beliefs are closely tied to the quality of AT instruction and support they provide, and these beliefs can be significantly influenced by a variety of factors (Siu & Morash, 2014).

Teacher Self-Efficacy

Literature about self-efficacy and the education of students with visual impairments has so far been discussed, and this section considers how self-efficacy is tied to the field of education. Research regarding teacher self-efficacy serves as the foundation of this study, which seeks to investigate the application of this knowledge base to the field of visual impairments.

Teacher self-efficacy is concerned with the application of the concept of self-efficacy to the field of education, specifically teachers (Tschannen-Moran et al., 1998). Tschannen-Moran and Hoy (2001) describe teacher self-efficacy as “a judgment of his or her capabilities to bring about desired outcomes of student engagement and learning... This judgment has powerful effects” (p. 783). That is, teachers' beliefs about their ability to do their jobs educating students with positive results can have significant impacts on a variety of outcomes.

A large body of research has investigated the relationship between teacher self-efficacy and such outcomes, which can be student-related like achievement, motivation, and student self-efficacy (Klassen & Tze, 2014; Mohamadi & Asadzadeh, 2012; Mojavezi & Poodineh Tamiz, 2012; Tschannen-Moran & Hoy, 2001; Zee & Koomen, 2016), as well as teacher-related like effort put toward teaching, planning and goal setting, openness to new ideas and instructional methods, and resilience when faced with setbacks (Bandura, 1997; Klassen & Tze, 2014; Thornton et al., 2020; Tschannen-Moran et al., 1998; Tschannen-Moran & Hoy, 2001). The general consensus is that teacher self-efficacy is positively associated with student outcomes, but

the relationship is more likely a result of teachers' behaviors than the efficacy beliefs themselves (Kim & Seo, 2018; Kim, 2012). This is because teacher self-efficacy more conclusively affects teacher behaviors, and it is behaviors like more rigorous lesson planning, dedicating greater effort toward teaching, and willingness to persist through challenging situations in the classroom that more directly influential toward student outcomes (Klassen et al., 2011; Thornton et al., 2020; Zee & Koomen, 2016).

Notably, general teacher self-efficacy has been found to be influential toward teachers' technology integration (Barton & Dexter, 2020; Henson, 2002; Kent & Giles, 2017; Martin et al., 2014). That is, teachers with higher levels of self-efficacy generally demonstrate higher levels of technology use in their classrooms (Henson, 2002; Kent & Giles, 2017). Teachers' beliefs about technology and perceived readiness to use technology have also been found to be significant influences on whether or not they integrate technology in their teaching practices (Barton & Dexter, 2020; Gil-Flores et al., 2017; Inan & Lowther, 2010; Tondeur et al., 2017).

Assistive Technology Self-Efficacy of TVIs

In this study, ATSE is defined as TVIs' belief that they can perform the AT-specific duties necessary to support their students' successful use of AT (Abner & Lahm, 2002), and AT refers to high-tech electronic devices or software solutions used by individuals with visual impairments, including both specialized and common, non-specialized technology. ATSE can be considered a TVI's overall confidence level in performing the comprehensive duties involved with supporting AT. TVIs may differ in their efficacy beliefs for supporting different students or specific AT solutions, but ATSE as referred to in this study is intended to capture the whole notion held by TVIs regarding their ability to support their students' AT use.

Applying Teacher Self-Efficacy to TVIs

The application of teacher self-efficacy to the field of visual impairments is natural, given the specific forms of instruction TVIs are responsible for, including AT (Siu & Morash, 2014). Earlier discussion highlighted how teacher self-efficacy is often an indicator for teacher behaviors like effort, planning, and resilience, as well as teachers' willingness to try new instructional methods (Bandura, 1997; Klassen & Tze, 2014; Thornton et al., 2020; Tschannen-Moran et al., 1998; Tschannen-Moran & Hoy, 2001) which then contribute toward students' educational outcomes. Similar dynamics may exist for TVIs and their students, and TVIs' ATSE may be correlated with even more unique TVI and student outcomes. Specifically, if TVIs believe in their ability to support AT with their students, they will put forth greater effort, planning, and resilience, likely leading to positive AT-related student outcomes.

For example, general educators with high self-efficacy for using AT are more willing to integrate AT into their practices (Marino et al., 2009). If TVIs were supported in developing their ATSE, a similar willingness to integrate AT could result in a greater number of students using AT themselves. Next, teachers with high self-efficacy put more effort into teaching and persist in teaching challenging material (Tschannan-Moran et al., 1998; Tschannen-Moran & Hoy, 2001). It could be inferred that TVIs with high ATSE will likewise make efforts to provide comprehensive instruction in AT (as opposed to cursory or incomplete instruction) and persist when complicated situations arise no matter their level of AT knowledge and familiarity. That is, they might be more willing to learn about AT, work longer with a student, troubleshoot an issue, or seek out solutions to issues being experienced.

Implications of Poor ATSE in TVIs

TVIs face numerous challenges in supporting their students' AT needs, including a wide range of AT options to potentially need to learn to use (Ajuwon, 2016), poor university training in AT (Smith & Kelly, 2007), only being familiar with the AT their specific students use (Siu & Morash, 2014), high cost of purchasing appropriate AT (Al-Zboon, 2020; Kamei-Hannan et al., 2012), difficulty accessing development in AT (Ajuwon, 2016), lack of a structured curriculum to help guide pacing and decision making (Wong & Law, 2016), and lack of frequent use and opportunities to practice (Kamei-Hannan et al., 2012). Any number of such challenges might negatively influence a TVI's opportunities for mastery and vicarious experiences, ultimately manifesting in poor or less-developed ATSE beliefs

If ATSE was significantly diminished in a TVI, there would be potential for negative TVI and student outcomes. First, the amount of AT use and integration might be low, resulting in students having insufficient exposure to, as well as opportunities to master, relevant AT. Next, the TVI's quality of AT instruction and supports might be lackluster, and students would be at risk for learning incorrect AT skills and strategies. A TVI lacking confidence in his or her AT abilities may not be willing to struggle through a complex device's user manual or seek out expert support; certain AT challenges might be perceived as insurmountable.

Poor State of AT Competency in TVIs

Unfortunately, research conducted to this point shows a poor overall state of TVIs' AT competency, including AT content and pedagogical knowledge, AT integration and ATSE. Many TVIs report that they are unfamiliar with the AT used by students with visual impairments (Abner & Lahm, 2002; Edwards & Lewis, 1998; Kapperman et al., 2002; Wong & Cohen, 2015; Zhou et al., 2011). The literature also shows a majority of TVIs do not believe they are

competent in teaching their students to use AT (Abner & Lahm, 2002), nor do they have confidence in their ability to teaching and supporting AT (Zhou et al., 2011; Zhou et al., 2012).

Specifically, Abner and Lahm (2002) surveyed 72 TVIs in Kentucky and found that 49% of the respondents lacked confidence in teaching AT to their students. Most of the respondents felt that they were at an apprentice level (51%), the lowest of 3 levels, or novice level (33%), of ability for teaching students with visual impairments to use AT; only 16% believed they were proficient. Zhou et al. (2011) surveyed 165 TVIs in Texas for their perceptions of their AT knowledge, and the authors found 57.5% of participants lacked adequate confidence in teaching assistive technology. Zhou et al. (2012) conducted a similar study with a national sample of 840 TVIs, and 59.3% of participants reported no to some confidence in teaching and supporting AT with their students. Ajuwon et al. (2016) provided insights into TVIs' perceptions of their AT knowledge and skills, presenting qualitative data from the studies conducted by Zhou et al. (2011) and Zhou et al. (2012). Ajuwon et al. (2016) found that in both studies, the top two comment categories were perceptions of the need for more education in AT and perceptions of inadequate proficiency with AT. For example, one participant commented, "I don't know where to get 'beginner' training" (p. 130). Another said, "We are asked to teach AT, but are NEVER given any textbooks or systematic methodology to do so. We have to look up tutorials online and try to adapt them to our students' needs" (p. 131).

Supporting TVIs' Assistive Technology Self-Efficacy

The need for TVIs to be adequately prepared to for teaching and supporting AT is abundantly clear (Smith et al., 2009; Smith & Kelley, 2007). TVI competency in this domain is necessary because AT use by students with visual impairments has been associated with several positive outcomes like functional improvements in the quality of academic work, independence

in completion of tasks, enrollment in postsecondary institutions, and employment (Bouck et al., 2011; Kelly, 2009, 2011; Kamei-Hannan & Lawson, 2012; Wolffe & Kelly, 2011).

What, then, is to be done about such a poor state of ATSE in TVIs? Recommendations made by researchers typically mention addressing university pre-service training programs' methods of teaching AT, as well as providing professional development training on AT topics for in-service TVIs (Abner & Lahm, 2002; Ajuwon et al., 2016; Zhou et al., 2011, 2012). Notably, the literature recommends that pre-service training programs make AT a fundamental part of their curricula, including dedicated courses on the subject (Abner & Lahm, 2002; Smith et al., 2009; Zhou et al., 2011). In-service trainings in AT are recommended to provide opportunities for hands-on experiences with AT solutions, and an AT support system is recommended so that TVIs can receive timely and adequate assistance (Morash & Siu, 2016; Zhou et al., 2011). However, though the underuse of AT by TVIs is often attributed to lack of knowledge, increased AT funding and training during pre-service university programs have not led to an increase in AT integration by TVIs (Kapperman et al., 2002; Kelly, 2009, 2011). Even as the literature has identified some of TVIs' issues with AT and recommended solutions, it has not yet conclusively validated those recommendations and identified evidence-based solutions.

Assistive Technology Proficiency

Researchers have also recognized that there is a need for universally adopted standards of practice or competencies for TVIs related to AT. Smith et al. (2009) conducted a Delphi study developed such a list of competencies using, identifying 111 AT competencies that were concluded by expert panelists to be highly reliable and valid. The authors recommended that the AT competencies be used to develop curriculum units that could be used in both pre-service and

in-service contexts, by both university training programs and professional organizations developing professional development materials.

Siu and Morash (2014) examined the 111 AT competencies developed by Smith et al. (2009) and reconceptualized them into four validated dimensions of a new construct called AT proficiency. The four dimensions of AT proficiency are choosing, funding, ability, and integration. Choosing is defined as the willingness and resources to choose AT to overcome an accessibility issue. Funding is the willingness and resources to find funding for the chosen AT. Ability is the willingness and ability in learning, using, and troubleshooting AT. Integration is the willingness to integrate AT into student lessons. High proficiency levels are characterized as being willing and knowledgeable, while low proficiency levels are characterized as being averse to AT. Morash and Siu (2016) found that a TVI's identification with a community of practice, or social network, was predictive of AT proficiency.

Predictors of Assistive Technology Self-Efficacy

Self-efficacy theory suggests that individuals' self-efficacy (SE) can be developed through the four sources of SE (Bandura, 1977). That is, when opportunities for mastery experiences, vicarious experiences, or verbal persuasion are provided for a given activity, individuals have been shown to have improved SE. However, research involving SET and its sources has not been conducted in the field of visual impairments or applied to the population of TVIs. Addressing this gap would bolster the field's understanding of factors that may be influential to TVIs' ATSE. SET and existing literature from the field suggest 11 factors, or predictor variables, that vary among TVIs. Given their alignment with Bandura's (1977) sources of SE, this study hypothesizes that they may be predictive of improved ATSE in TVIs.

Demographic Factors

Age. TVIs of different ages may possess different levels of ATSE. It is hypothesized that age plays a role in the opportunities one has for mastery experiences, as well as that it has differing effects on individuals' physiological states (Bandura, 1977). Zhou et al. (2012) found a small negative relationship ($r = -0.11$) between age and TVIs' confidence in teaching and supporting AT; the authors believed this result could be explained as a matter of younger TVIs growing up with technology much more prevalent in their lives than older TVIs. Furthermore, older TVIs may have learned to use AT in their university training programs that are now obsolete, and they may be less familiar with current AT solutions (Zhou et al., 2012).

Years of experience as a TVI. Increased years of experience as a TVI likely presents more opportunities for an individual to be exposed to different AT solutions and to have used them with students. Zhou et al. 2011 found a small positive relationship ($r = 0.23$) between years of experience as a TVI and TVIs' confidence level for teaching and supporting AT. This factor was hypothesized to align with Bandura's (1977) vicarious experiences and mastery experiences, respectively.

Training Experience Factors

Form of university training and path to TVI licensure. TVI licensure is defined in this study as any license, certification, or endorsement required and managed by a state that allows an individual to work as a TVI. The traditional path to full TVI licensure involves individuals taking university coursework, in which the specific skills involved in teaching students with visual impairments are taught to prospective teachers. University training programs vary in the specific formats of their course loads and scheduling, but students' options generally consist of attending full-time or part-time to earn either a degree or certificate (Pogrund & Wibbenmeyer, 2008).

Following the completion of their university programs, students will take various steps with their state to become licensed as a TVI.

However, alternative paths to TVI licensure exist in some states, some of which involve taking reduced credit hours or merely passing a test, or working as a TVI through a provisional or emergency license while taking university coursework (Pogrund & Wibbenmeyer, 2008). For example, in this researcher's home state of Tennessee, the requirement for becoming licensed as a TVI is simply to pass a vision-specific Praxis® test; no formal university training coursework is required, much less a degree or certificate from a training program. Indeed, Pogrund and Wibbenmeyer (2008) conducted a survey to determine the accepted paths to TVI licensure in states across the United States. The authors found that these routes were not uniform and concluded that the meaning of the term *certified teacher of students with visual impairments* varies widely.

As such, the quality and quantity of TVI training an individual receives prior to becoming a licensed TVI, may vary widely between TVIs trained in university training programs and those who had cursory training experiences or passed a test without any formal coursework involving visual impairments. TVIs, all licensed by their states, likely have very different proficiency levels, background knowledge, and experience with skills like AT due to variations in the quantity and quality of training experiences they received. The factors of Form of University Training and Path to TVI Licensure were both thus hypothesized to be aligned with Bandura's (1977) mastery experiences and vicarious experiences.

University AT training. The manner in which AT skills and concepts are taught to TVIs varies among university training programs, and these differences may be influential toward TVIs' ATSE. Smith and Kelley (2007) surveyed 30 university training programs and found that

15 programs had dedicated courses for teaching vision-specific AT content to prospective TVIs. 12 programs embedded AT content within other program courses, and 3 had AT courses that were not specific to visual impairments. Formal AT courses can contribute to TVIs' initiative in seeking additional training in AT (Kamei-Hannan et al., 2012). However, the quality of AT instruction in training programs can vary, as Smith et al. (2009) stated that there was not a set of AT competencies universally adopted by TVI training programs; programs also likely varied in resources available for maintaining current AT, instructors themselves able to stay current, and limitations with time and programming. This factor was hypothesized to align with Bandura's (1977) mastery experiences and vicarious experiences.

AT professional development availability. AT-specific professional development (PD) is extremely valuable to in-service TVIs, as these trainings are a means for augmenting AT skillsets and keeping abreast of new developments in the field (Siu & Morash, 2014; Zhou et al., 2011). Formal trainings can be characterized as a form of "hand-holding" (Wong, 2018, p. 438), which minimize how overwhelming learning objectives might appear to TVIs; they have the potential for being influential toward TVIs' ATSE. Unfortunately, TVIs do not always have such PD opportunities available to them (Edwards & Lewis, 1998; Gilson, 2014; Wong & Cohen, 2015). This factor was thus hypothesized to be aligned with Bandura's (1977) mastery experiences and vicarious experiences. In this study, the availability of AT PD was broken down into two variables. The first consisted of AT PD availability prior to the COVID-19 pandemic, and the second measured AT PD availability during the current school year.

Method of attending AT professional development opportunities. TVIs may be aware of AT-specific PD opportunities available to them, but such trainings will be of no use to them if they are unable to attend. Wong and Law (2016) found that TVIs knew of sources for AT support

and learning but only had limited formal consultations with those sources. Also, itinerant teachers with unique schedules might need to adjust their schedule or take leave to attend a PD opportunity (Gilson, 2014), whereas teachers working in schools for the blind might have AT-specific PD more accessible to them within the school's fixed routines (Siu & Morash, 2014). The nature of how a TVI is able to attend available PDs may impact the quality of the PD experience, and this factor was hypothesized to be aligned with Bandura's (1977) vicarious experiences.

Work Experience Factors

Service delivery model. Most TVIs work as itinerant teachers who travel between schools that their students attend (Correa-Torres & Howell, 2004; Siu & Morash, 2014). Itinerant TVIs have been found to spend less time directly working with students with visual impairments than other school-based teachers, which can mean less time available to work on AT with students (Correa-Torres & Howell, 2004). Furthermore, they typically do not work alongside other TVIs and thus can experience feelings of isolation and lack of opportunity for PD (Correa-Torres & Howell, 2004; Kapperman et al., 2002; Siu & Morash, 2014). In contrast, TVIs working in schools for the blind are able to collaborate with TVI colleagues on a regular basis and have more time available to provide AT instruction and supports (Kelly, 2009; McMahon, 2014). These differences are likely to influence one's ATSE, particularly through Bandura's (1977) mastery experiences, vicarious experiences, and social persuasion.

Number of other TVIs in the district. The number of TVI colleagues an individual has impacts how often they are able to collaborate or seek out support for topics like AT (Pogrund & Cowan, 2013; Siu & Morash, 2014). Itinerant TVIs may be the only such professional employed by their school district or region and thus have no peers to collaborate with (Wong & Law, 2016).

When working in a team of TVIs, however, researchers have found that some individuals become identified as go-to resources for the others when seeking ideas and support (Wong & Cohen, 2015). Having more colleagues may increase one's opportunities to collaborate, and identity with a community of practice has been found to be related to AT proficiency (Morash & Siu, 2016). As such, this factor was hypothesized to be supportive of ATSE through alignment with Bandura's (1977) vicarious experiences and social persuasion.

Percent of weekly service time teaching AT. The time a TVI spends providing AT instruction can vary depending on their specific circumstances. In examining the experiences of itinerant TVIs, Wolffe et al. (2002) stated that TVIs' levels of instructional time involving AT was not as intense as one might anticipate; TVIs were not found to have large blocks of time set aside for teaching AT. Similarly, Wong and Law (2016) reported that TVIs they observed only provided 2 hours of AT specific instruction with their students per week. In contrast, Kelly (2009, 2011) found that students attending schools for the blind were more likely to be using AT; it can be inferred these students had more time available with their school-based TVIs to develop their skills for using AT. This factor was aligned with Bandura's (1977) mastery experiences, as the direct provision of AT instruction and support would likely develop a TVI's ATSE.

Ability to purchase new AT. A TVI's access to AT resources available for use with their students may influence their ATSE, as a lack of resources might mean the inability to practice using a given AT solution (Wong & Cohen, 2015). Their ability to purchase new AT is often related to their school district's funds available for purchasing expensive AT, or it could also be a product of TVIs and administrators' awareness of available resources for funding or procuring AT (Morash & Siu, 2016). Ajuwon et al. (2016) advocated for the funding of AT so that students with visual impairments would have the tools and skills needed to be independent. Similarly,

Wong and Law (2016) recommended the provision of AT devices for trial purposes, as making AT available to TVIs could alleviate their uncertainty over its appropriateness and promote confidence. That is something an organization or state agency might be able to do for TVIs, but such resources would not be helpful if TVIs were not aware of them. For example, all states have some form of an instructional resource center that is able to order certain AT solutions from the American Printing House for the Blind. However, some TVIs may not be aware of these programs, and if no other options for acquiring new AT existed, they might have fewer opportunities to use and master the AT their students need to be successful. This factor was aligned with Bandura's (1977) mastery experiences.

Summary

This chapter has reviewed the literature related to self-efficacy and its relevance to TVIs' responsibility to teach and support AT with their students. The literature reveals poor ATSE in TVIs, which may subsequently hamper students' mastery of AT. Students with poor AT skills may be delayed or prevented from developing independence in educational and vocational settings. This review found limited research involving the influences on poor ATSE in TVIs. Bandura's (1977) Self-Efficacy Theory was used as a theoretical framework for examining how ATSE can be influenced, specifically through its four sources of self-efficacy: mastery experiences, vicarious experiences, social persuasion, and physiological states. This chapter identified 12 factors common to TVIs' experiences and proposed that each of them was aligned with at least one of those sources. The literature suggested that variations among TVIs' experiences for each of the factors may be influential toward TVIs' ATSE. As such, this study sought to provide insights regarding the possible predictive relationships between these TVI

experience factors and TVIs' ATSE, and its results proved to better inform TVIs and instructional designers regarding methods of supporting the development of ATSE in TVIs.

The next chapter explains how this study tested its hypothesized relationships between the 12 TVI experience factors, or predictor variables, and TVIs' ATSE, the criterion variable. It will describe how the data were collected and analyzed to answer each research question.

CHAPTER 3: METHODOLOGY

Introduction

Teachers of students with visual impairments (TVI) report low self-efficacy for teaching and supporting assistive technology (AT)-enabled student learning (Abner & Lahm, 2002; Ajuwon et al., 2016; Edwards & Lewis, 1998; Jones et al., 2019; Zhou et al., 2011; Zhou et al., 2012). Researchers recommend that university training programs more rigorously address AT, as well as that more AT-specific professional development (PD) be provided to in-service TVIs (Ajuwon et al., 2016; Kamei-Hannan et al., 2012; Morash & Siu, 2016; Smith et al., 2009; Wong & Law, 2016; Zhou et al., 2011; Zhou et al., 2012). However, instructional designers cannot effectively carry out these recommendations due to a lack of research that identifies factors that are predictive of TVIs' assistive technology self-efficacy (ATSE). Addressing this gap in the literature will help focus the efforts of researchers and instructional designers by identifying factors that do or do not predict ATSE. That is, knowing these influential TVI experience factors will inform researchers and instructional designers to examine and address them specifically in more focused research and PD trainings. This study presented a variety of TVI experience factors and explored whether or not they were predictive of TVIs' ATSE.

The Investigation Plan

Study Design

This study used a quantitative, survey (non-experimental), cross-sectional, predictive correlational research design. In correlational research design “investigators use the correlational statistic to describe and measure the degree of association (or relationship) between two or more variables or sets of scores” (Creswell & Creswell, 2018, p. 12). Researchers using correlational research design examine the relationship and strength of the relationships between and among

variables, not test them in an experimental fashion (Creswell & Guetterman, 2019). Correlational research design was best suited for this study because it involved research questions about the predictive strength of associations among 12 TVI experience factors and TVIs' ATSE. This study did not include an experimental intervention, and it did not seek to establish a causal relationship between them. The study's goal was to reveal topics around which interventions and future research could be designed (Campbell & Stanley, 1963).

The decision to use the predictive form of correlational research instead of the explanatory type was made because this study did not simply seek to explore and explain the state of a situation. Instead, this study's purpose was to potentially identify whether any TVI experience factors (predictor variables) could meaningfully be used to forecast TVIs' ATSE (criterion variable; Creswell & Guetterman, 2019). Gall et al., (2015) state that predictive correlational research can use data collected at one time (cross-sectional) to predict future outcomes. As such, this study collected information regarding TVIs' demographic information, training experiences, and work experiences through responses to survey questions. The data collected were analyzed and used to investigate the predictive strength of associations those experience factors had with TVIs' ATSE.

Design Limitations

This study's design has some limitations that should be noted. Efforts to limit their impact on the study are discussed. Notably, the results of this predictive correlational research study only identified the degrees of association between the predictor variables and criterion variable. So, these associations may not be used to make definitive judgments regarding causal relationships between TVIs' experience factors and ATSE (Gall et al., 2015).

Next, this study used a convenience sample of TVIs in the United States, recruited in a variety of manners including snowball sampling in which participants who received the recruitment message were asked to share the message with peers from their professional networks. Only TVIs who were reached through the recruitment procedures and eligible to participate were included, and thus the study's participants cannot be guaranteed to be representative of the entire population of TVIs in the United States. Due to this nonignorable nonresponse, the study's data regarding correlations among variables may not be generalizable to all TVIs in the United States (Gall et al., 2015).

Furthermore, this study lacks internal validity due to the absence of controls as part of correlational research design. For example, this study's predictor variables may suffer from errors in measurement, and the study's nonrandom convenience sample may have inadvertently skewed the data. More specifically, correlational studies experience threats to internal validity including omitted variables, incorrectly measured variables, sample selection bias, and simultaneous causality bias (Leighton, 2010; Sheppard, 2020). It is possible that variables of interest that are correlated with ATSE were not identified, and these variables would provide a "plausible rival hypothesis" (Campbell & Stanley, 1963, p. 64) to those stated in this investigation plan. This study took steps to avoid such concerns, as variables were rigorously selected from existing literature, and alignment with the theoretical framework of Self-Efficacy Theory (SET) was ensured (Mertens, 2015).

Participant Characteristics

The population of interest for this study was practicing, in-service, TVIs working in the United States. Participants were identified using a non-random, convenience and voluntary response sample of TVIs working in the United States. The sample of willing participants was

recruited using a standard message describing the study and desired participant characteristics (Creswell & Guetterman, 2019). To participate in the study, potential participants were required to meet the following selection parameters: at least 18 years of age, licensed as a TVI in at least one state the United States of America, actively employed and working as a TVI. There were no minimum or maximum levels of experience required, and no specific grades or grade bands taught were required for participation in the study. These criteria were explained in the recruitment email and verified through a mandatory screening question prompt prior to the beginning of the survey. Prospective participants who responded that they did not meet the inclusion criteria (e.g., a retired TVI not currently working with students) were thanked for their interest and directed to close the survey window. Those who affirmed their eligibility and consented to participate then proceeded to begin the survey.

The number of responses received, or cases, was crucial to being able to answer this study's research questions. Cohen (1992) stated that in order to detect a large effect size ($f^2 = .35$) at Power = .80 when conducting a multiple or partial multiple correlation ($\alpha = .05$), the minimum sample size required is 30. Furthermore, 68 cases would allow for the detection of a medium effect size ($f^2 = .15$) at Power = .80 and $\alpha = .05$. According to Creswell and Guetterman (2019), researchers conducting correlational studies require about 70 responses to adequately perform necessary statistical procedures. Mertens (2015) advised that while correlational research is advantageous because it can include several variables, including more variables requires a larger sample size to ensure confidence in the statistical analyses conducted. The author recommended that the sample should consist at least 15 responses per variable when using correlational research design, and in this study such a minimum desired sample size was 180 responses. Given these various parameters, a minimum of 180 participants with useable data was sought to take

part in the study. This study anticipated that at least 400 qualified participants would respond to survey requests, as the number of TVIs that responded to a nationwide survey conducted by Zhou et al. (2012) was 840. Morash and Siu (2016) received 494 qualified American participants after using participant recruitment procedures that this study modeled in part.

Participant demographic information included variables of interest from each of the study's TVI experience factor categories, not just variables from the Demographic Factors category. The demographic variables were: gender, state, age, years of experience as a TVI, form of university training, path to TVI licensure, university AT training, service delivery model, and number of additional TVIs in the district. Descriptive statistics for the demographic information were calculated to provide insights regarding the study's participant characteristics and experiences. Descriptive statistics were also determined for the remaining TVI experience factors and items from the TVIs' Assistive Technology Self-Efficacy Scale (TATSES) instrument developed to measure the criterion variable.

Setting

This study used a predictive correlational research design and did not involve a physical setting in which an intervention was implemented with participants (Creswell & Guetterman, 2019). However, TVIs work in a variety of settings depending on their service delivery model, from numerous schools in one day (itinerant teaching) to a school resource room or classroom in a specialized school for the blind. The exact location and device used to complete the survey varied across participants. The setting of this study was thus defined as the electronic and physical media and digital platforms through which the participants' surveys were completed. For example, the setting included the computers and smartphones used by participants to access

the survey, as well as the Internet web browsers used to select the survey link and complete the survey online.

Instrumentation/Data Collection Methods

The survey used to gather the study's data was created in the Qualtrics online survey platform. The survey began with two demographic items (gender and state that participants worked in) that were analyzed using descriptive statistics only. Two primary sections followed: items developed to measure the study's 12 TVI experience factors (predictor variables) of interest and items from the TVIs' Assistive Technology Self-Efficacy Scale instrument (TATSES) measuring TVIs' ATSE. The survey concluded with an invitation to provide contact information for the purposes of the gift card incentive. The complete survey is displayed in Appendix B.

TVI Experience Survey Questions

The first section included 12 items that measured the following TVI experience factors of interest: age, years of experience as a TVI, form of university training, path to TVI licensure, university AT training, pre-pandemic AT PD availability, current AT PD availability, method of attending AT PD, service delivery model, number of additional TVIs, percent of weekly service time teaching AT, and ability to purchase new AT. These items were listed in the survey according to their demographic, training experience, or work experience category. The first section of the survey included nominal, ordinal, and ratio type multiple choice questions with four to seven response options. The 12 TVI experience factors, corresponding survey questions, and variable types are displayed in Appendix A.

Age was measured as a ratio-type variable by having participants provide their ages in terms of years. Years of experience as a TVI was measured in terms of the number of school years the participant has completed working as a TVI. This was measured as a ratio-type variable

in which participants identified the specific number of years they had worked as a TVI. Form of university training was measured by asking participants the format and outcome of the university training program they attended. Response options were the following nominal options: yes – attended as full-time student and earned a degree, yes – attended as full-time student and earned a certificate, yes – attended as part-time student and earned a degree, yes – attended as part-time student and earned a certificate, currently enrolled in a university training program to earn a degree, currently enrolled in a university training program to earn a certificate, and no, I did not receive university training to become a TVI. Path to TVI licensure was measured by asking participants how they met their state’s requirement to work as a TVI. Response options were the following nominal choices: I completed a university training program and then met my state’s licensure requirements (I did not work as a TVI under a provisional license during my university training), I worked as a TVI under a provisional license while enrolled in a university training program (I completed the program and then met my state’s licensure requirements), I am working as a TVI under a provisional license and am enrolled in a university training program (I will complete my program and then meet my state’s licensure requirements), I met my state’s licensure requirements without participation in a university training program (e.g., took a Praxis® or similar test only), and other. University AT training was measured by asking participants how AT content was presented during their university TVI training programs. Response options include the following nominal choices: in a VI course dedicated to vision-specific AT content, in a VI course that was not dedicated to vision-specific AT content, across several courses throughout the program that were not dedicated solely to vision-specific AT content, in a non-VI course (e.g. general AT course that included vision-specific AT), not addressed in any coursework throughout the program, and other. Pre-pandemic AT PD

availability was measured by asking participants to rate how many AT PD opportunities they had, in-person or online, prior to the COVID-19 pandemic (defined as prior to March 2020). Response options were ordinal: many, some, very few, and no opportunities. Not Applicable was an option for participants who were not yet working as TVIs at the time. Current AT PD availability was similarly measured by asking participants to rate how many AT PD opportunities they had, in-person or online, in the current school year (2021-2022). Response options were ordinal: many, some, very few, and no opportunities. Method of attending AT PD was measured by asking participants the method by which they attended an AT PD during the current school year (2021-2022). Response options were nominal and included adjusting their schedule, taking PD leave time, taking personal leave time, not attending any AT PD opportunities, and other. Service delivery model was measured as a nominal variable by asking participants whether they worked as itinerant teachers, as resource room teachers, at schools for the blind, or in other settings. The number of additional TVIs working in the participant's district was measured as a ratio-type variable in which participants provided the number of TVI peers they worked with in their school district. Percentage of weekly service time teaching AT was measured by asking TVIs to select the range that best represented how much of their weekly service time was spent teaching and supporting AT. The ordinal response options were 81-100%, 61-80%, 41-60%, 21-40%, and 0-20%, and the variable was treated as a continuous variable. Ability to purchase new AT was measured by asking participants how readily they believed they could have new AT solutions purchased to use with students. A 5-item ordinal scale was used to measure the variable, with response options ranging from always to never.

ATSE Instrument

TVIs' Assistive Technology Self-Efficacy Scale. The second section of the survey instrument included the study's instrument for measuring ATSE. There is no validated instrument that specifically measures the assistive technology self-efficacy of TVIs, so this study developed and a novel instrument: the TVIs' Assistive Technology Self-Efficacy Scale (TATSES). More specifically, the TATSES was developed to determine TVIs' self-efficacy beliefs regarding their AT skills, including being able to choose appropriate AT, find funding for AT, use certain types of AT, and integrate AT into student lessons (Morash & Siu, 2016). The instrument development began with the development of candidate items. Once the initial TATSES instrument was developed, a panel of three subject matter experts (SME) in the field of visual impairments and AT was identified to provide expert review of the instrument for face and content validity (Worthington & Whittaker, 2006), following procedures utilized by Herring and Rockinson-Szapkiw (2021). Each SME possessed a terminal degree in the field of visual impairments and had published research involving AT.

Face validity was defined as whether or not the items appeared appropriate for the study's broader goals. Content validity was defined as whether or not the items accurately measured the constructs they aimed to measure. Feedback from the SMEs was considered and used to revise TATSES items as needed; decisions regarding how, if necessary, to revise items were made through a final consultation with a dissertation committee member who works in the field of visual impairments.

A valid and reliable set of 111 AT competencies have been established in the literature (Smith et al., 2009) and used by researchers (Morash & Siu, 2016; Siu & Morash, 2014; Zhou et al., 2011, 2012) for investigating AT-specific topics in TVIs. Siu and Morash (2014) notably

considered the 111 AT competencies and reconceptualized them into four dimensions of AT proficiency for TVIs. The dimensions' validity was supported by expert review and TVI input; Chronbach's alpha for the researchers' test instrument measuring AT proficiency was 0.8, indicating reliability.

The set of candidate items for measuring TVIs' AT self-efficacy was developed to be in alignment with Siu and Morash's (2014) validated dimensions of AT proficiency, which themselves were developed from validated AT competencies for TVIs (Smith et al., 2009). This approach was taken to ensure that the TATSES instrument's items would cover the full scope of expectations for TVIs' knowledge and abilities involving AT, establishing content validity. The instrument's items were aligned with the four dimensions of AT proficiency (i.e., choosing, funding, using, and integrating) based upon narrative definitions for each dimension and its respective highest proficiency level, as described by Siu and Morash (2014) and Morash and Siu (2016).

Candidate items for the TATSES were also initially developed to model the item format used in Tschannen-Moran and Hoy's (2001) Teachers' Sense of Efficacy Scale (TSES). The TSES is an established instrument, valid and reliable, that measures individuals' judgments of his or her capabilities to conduct key tasks from teachers' typical work responsibilities. Items in the TSES were determined to be too focused on the role of a general classroom teacher for adaptation into an instrument used with TVIs. Furthermore, adapting TSES items to sufficiently include AT subject matter was determined to likely compromise the original scale's validity and reliability. As such, initial item development only loosely followed the TSES by following its specific item format and wording. For example, all items began with the phrases "How well can

you...,” or “To what extent...” (Tschannen-Moran and Hoy, 2001) and ended with language involving TVIs’ AT knowledge and abilities.

The initial TVIs’ Assistive Technology Self-Efficacy Scale instrument consisting of 16 items was developed to measure TVIs’ self-efficacy beliefs regarding AT-related skills covering all four domains of AT proficiency as identified earlier and defined in Table 3. Items asked participants a question beginning with either “How well can you...,” or “To what extent...,” and ended with an AT-specific skill. Modeling after the TSES’s 9-point scale, TATSES items used a 5-point Likert-style scale measuring responses to the question of the level or extent to which the participant believed they could perform the item’s AT-related task (Tschannen-Moran & Hoy, 2001). Scale responses included 1 (Not at All), 2 (Very Little), 3 (Somewhat), 4 (A Good Bit), and 5 (A Great Deal).

Each SME was emailed a copy of the TATSES. The email described the instrument’s intended use and functional benefit to the field, as well as its intended alignment with existing AT literature (Fink, 2010; Morash & Siu, 2016; Siu & Morash, 2014; Smith et al., 2009). SMEs were given guidelines for rating each item for content validity and face validity using a five-point scale (1 = very poor; 5 = very good). Space was provided for additional feedback (e.g., comments regarding clarity, conciseness, reading level, as well as suggested item changes, additions, or deletions). SMEs emailed their completed item ratings back to this researcher.

When all SME ratings were returned, each item’s mean rating for content and face validity was calculated. The procedure for flagging potentially problematic items for review was to determine if any items possessed average scores under four for both content and face validity. Ultimately, no items met these criteria for necessitating a review, and the expert review confirmed good face and content validity for the TATSES’s items. SMEs’ additional feedback for

all items were also examined for improvement themes. Three prevailing suggestions were identified. First was the suggestion to reword the instrument's items from being responses indicating a magnitude of one's ability to become items worded in an "I can" statement format that participants would agree or disagree to at some level. A key comment stated that such an approach would make the scale's items easier to comprehend and respond to. The second suggestion was to change the number of response options from five to six so as to avoid the possibility of respondent tendencies for selecting the middle, most neutral option. Furthermore, the third suggestion was for the response options to adopt the terminology of agreeing or disagreeing. These suggestions were discussed with a dissertation committee member, and all the suggestions were adopted. The four dimensions of AT proficiency, their definitions from the literature, and aligned items from the finalized TATSES instrument are displayed in Table 3. Response options were revised to consist of the following: 1 (Strongly Disagree), 2 (Moderately Disagree), 3 (Disagree Slightly), 4 (Agree Slightly), 5 (Moderately Agree), and 6 (Strongly Agree).

Table 3

Dimensions of AT Proficiency and Aligned TATSES Instrument Items

AT Proficiency Dimension	Definition	TATSES Instrument Items
Choosing	A TVI's willingness and knowledge of resources for choosing AT for students. (Morash & Siu, 2016; Siu & Morash, 2014)	<ol style="list-style-type: none"> 1. I can identify a broad spectrum of AT in the field of visual impairments. 2. I can use a variety of AT assessment strategies for determining my students' needs. 3. I can identify AT that is appropriate for my students. 4. I can search for alternative AT if the set of AT I am familiar with does not meet my student's needs? 5. I am able to access AT experts to support my AT decision making. 6. I am able to access AT professional development opportunities to support my AT decision making.
Funding	A TVI's willingness and resources for funding AT for students. (Morash & Siu, 2016; Siu & Morash, 2014)	<ol style="list-style-type: none"> 7. I know how to procure AT that I have determined appropriate for my students. 8. I can advocate to my supervisors for the purchasing of AT appropriate for my students.
Ability	A TVI's willingness and ability to use AT and troubleshoot problems. (Morash & Siu, 2016; Siu & Morash, 2014)	<ol style="list-style-type: none"> 9. I can use my students' AT. 10. I can teach new AT skills to my students. 11. I can gauge student mastery of AT I have taught. 12. I can troubleshoot AT issues my students experience. 13. I can quickly learn about a specific type of AT.
Integration	A TVI's willingness and ability to integrate AT into lessons with students. (Morash & Siu, 2016; Siu & Morash, 2014)	<ol style="list-style-type: none"> 14. I can generalize the use of AT for a variety of tasks and applications. 15. I can implement AT in my students' classes. 16. I can help other teachers understand proper applications of AT.

Following the first two sections of the survey in which data were collected, a final section alerted participants that they had completed the survey and could now proceed to close it out or provide their contact information to participate in the gift card giveaway. To prevent participants' contact information from being associated with their study responses, participants interested in the giveaway were directed to select a link that would take them to a Microsoft Form external to the survey's Qualtrics platform. This Microsoft Form was used to collect names, emails, and phone numbers that were used to contact participants and award gift cards.

Data Collection/Procedures

Approval to conduct this study was requested from the University of Memphis Institutional Review Board (IRB). Materials provided for consideration were a description of the study and participant informed consent form that included the message used for participant recruitment. Upon receiving approval from the University of Memphis IRB, the researcher began recruiting participants. The IRB approval letter is displayed in Appendix C

The study's participants were reached through an adaptation of methods used by Zhou et al. (2012) and Morash and Siu (2016) to follow procedures outlined by Dillman et al. (2014), with additional measures thereafter. First, a standard recruitment message was shared with potential participants. This message briefly described the purpose of the study and provided a link to the online survey which was hosted on the Qualtrics platform. The recruitment message stated that this study was seeking practicing, in-service TVIs working in the United States, and it also requested that TVIs share the recruitment message with any peers they knew who might be eligible to participate. The recruitment message incentivized participation in the study by stating that five participants would be randomly selected to each receive a \$20 gift card.

First, the Association for the Education and Rehabilitation of the Visually Impaired (AER) was contacted requesting that the recruitment message be sent out to all AER members through a monthly newsletter; AER is the preeminent professional organization for professionals serving individuals with visual impairments and blindness in the United States. Additionally, email addresses for AER state chapter presidents were requested from the national AER office. These individuals were emailed with the same request to share the recruitment message with their states' members.

Next, a similar process was conducted with Ex-Officio trustees (EOT) of the American Printing House for the Blind (APH). APH is an organization that uniquely produces a wide variety of instructional resources for individuals who are blind and visually impaired, and EOTs are designated individuals in each state who help maintain and administer Federal Quota funds allocated to their state for the purposes of purchasing materials from APH (<https://www.aph.org/federal-quota/>). All states' EOTs and contact information are listed on APH's website, and all EOTs were emailed requesting that they share the study's recruitment message with their networks of TVIs.

State schools for the blind were contacted with a similar request as that made with AER and APH EOTs. The Council of Schools and Services for the Blind (COSB) is a consortium of specialized schools and agencies in Canada and the United States, and its member schools and agencies are listed on the consortium's website. Every member school for the blind or agency in the United States was researched through its website to determine an ideal school contact or contacts to reach out to by email. Preferred contact individuals were school superintendents and principals, but other relevant supervisors or departmental staff members were contacted requesting that they share the study's recruitment message with their school or agency's' TVIs.

AER state chapter presidents, APH EOTs, and state schools for the blind were asked to forward the study's recruitment message to their membership, local school districts, and school TVIs, respectively. Following snowball sampling methodology (Creswell & Guetterman, 2019), the recruitment message asked participants to share the study's information with peers who were eligible to participate but might not know about the study yet. According to Dillman et al.'s (2014) process for conducting internet, phone, and mail surveys, reminder emails were sent to AER state chapter presidents, APH EOTs, and schools for the blind one week and two weeks following the initial recruitment email if no response acknowledging receipt was received.

Finally, in addition to the above steps, the recruitment message was posted to two prominent professional TVI Facebook groups named *Teachers of the Blind and Visually Impaired/O&M Specialists* and *Teachers of the Blind and Visually Impaired*. A reminder regarding the study's availability was posted weekly for three weeks after the initial post to each group.

The researcher monitored the collection of survey responses for 30 days to ensure that the pace of completed responses reached the minimum desired number of 180 responses necessary for confidence in data analysis. Upon completion of the survey window, 192 responses usable for statistical analyses had been received, and the survey was closed. The data were exported from the Qualtrics platform in an SPSS data file format for analysis using the SPSS statistical analysis software.

This researcher firmly believes in the ethical solicitation of participation and study information from participants, as well as the ethical storage, use, and interpretation of gathered data. The design of survey questions was intended to be objective and avoid the perception of favoritism or judgement toward available response options. The methods of solicitation were

selected to utilize trusted distribution channels. Data from this study were anonymous, with no personally identifiable information collected aside from that which was collected by voluntary participation for the purpose of entering the gift card giveaway; this was done in through the Microsoft Forms platform apart from the Qualtrics survey platform. Regardless, the anonymized response data were stored in a non-cloud connected folder on this researcher's computer, accessible only by using this researcher's personal account credentials. Contact information collected for the gift card giveaway was stored in Microsoft Forms which is a cloud-connected service, but this information was only accessible through this researcher's unique account credentials. Upon the survey's closure, five participants were randomly selected and contacted to receive a gift card. If no response was received within three days of being notified, a new participant was contacted. Once all of the gift cards were distributed, the researcher deleted the Microsoft Form and all personally identifiable data within; at no point was the data housed in the Microsoft Form exported from the platform.

Analysis

This predictive correlational research study conducted analyses of the data using descriptive statistics and hierarchical multiple regression. Descriptive statistics were examined for all 12 of the survey instrument's TVI experience predictor variables of interest, with specific emphasis placed on the following designated demographic participant variables: gender, age, years of experience as a TVI, form of university training, path to TVI licensure, university AT training, service delivery model, and number of other TVIs in the district. These analyses were used to gain general insights regarding potential trends in the participants' most discussed characteristics and experience data. This study's research questions and corresponding null hypotheses were tested by analyzing the results of two different hierarchical multiple regressions.

Hierarchical Multiple Regression

Hierarchical multiple regression (HMR) is a specific method for conducting a multiple regression that allows researchers to compare the effects of different models, that is predictor variables or sets of predictor variables, on a criterion variable (Kim, 2016). HMR determines whether a predictor variable or variables explains variance in a criterion variable beyond that already explained by other predictor variables (Hajovsky & Reynolds, 2018). This means that the grouping of variables, as well as the order in which variables are entered in the regression is important, and researchers should have an empirical or theoretical base for making such decisions (Mertens, 2015). Researchers can then develop a framework for a hierarchical series of regression models in which more variables are added to the regression in each successive step. A HMR was the most appropriate statistical analysis for this study because it could be used to evaluate each of the study's research questions.

This study's research questions consisted of a primary Research Question 1, followed by secondary Research Questions 1A, 1B, and 1C. Research Question 1 asked whether there were associations between any of the proposed TVI experience factors (predictor variables) and TVIs' ATSE (criterion variable). A HMR containing 12 models was used to evaluate Research Question 1, in which each of the 12 predictor variables were added one-by-one in successive models.

Research Questions 1A, 1B, and 1C involved the potential associations between specific linear combinations of predictor variables, that is categorical groupings of variables, and TVIs' ATSE, the criterion variable. A second HMR was used to analyze the specific categories of predictor variables as established in Chapter 2. Demographic factors comprised the first regression model, training experience factors were added for the second regression model, and

work experience factors were added for the third regression model. These models were used to evaluate Research Questions 1A, 1B, and 1C, respectively.

SPSS was used to run each of the HMRs and generate regression tables containing the R^2 statistic. R^2 was used to determine the amount of variance in TVIs' ATSE, the criterion, that could be explained by the specific set of TVI experience predictor variables used in each regression model (Creswell & Guetterman, 2019). ΔR^2 was calculated for each of the HMRs' models to evaluate the additional amount of variance that could be attributed to the addition of an individual or category grouping of predictor variables (Hajovsky & Reynolds, 2018). The F statistic was used to determine the statistical significance of the ΔR^2 results, and these data were evaluated for statistical significance at the $p = .05$ level. Statistical significance would suggest that a given model is predictive of the criterion variable. Adjusted R^2 was reported as well, as the statistic controls for the effects of having multiple predictor variables in a regression. Specifically, adjusted R^2 only improves when a new variable added improves the model, and it decreases when the new variable does not affect the model.

Assumptions

Independence of observations. The assumption of independence means that any errors in the model are not related to each other (Field, 2018). The Durbin-Watson statistic is a test statistic that can measure the correlations between errors from a regression analysis, and it will be examined to ensure independence of errors. The Durbin-Watson statistic varies from 0 to 4, with a value of 2 meaning that errors are not correlated. Values greater than 2 indicate negative correlations between adjacent errors, and values less than 2 indicate positive correlations between adjacent errors. Field (2018) stated that values less than 1 and greater than 3 would be problematic for the assumption of independence.

Linearity and Homoscedasticity. Linearity is the assumption that the criterion variable's scores are linearly related to the predictor variables (Field, 2018). Without linearity, there can be no confidence in the proposed linear regression analyses. Homoscedasticity is referred to as the homogeneity of variance, and it assumes that the variance of the criterion variable is stable at all levels of a predictor variable (Field, 2018). If variance is not stable, then confidence intervals and significance tests may be considered biased and inconsistent, impacting the ability to determine whether the results of a regression were significant. Both linearity and homoscedasticity are tested using a residual scatterplot. If the assumptions have been met, the scatterplot should not resemble any noticeable funnel or curved shapes (Field, 2018).

Multicollinearity. Multicollinearity is a situation that can exist when there is a strong correlation between two or more predictor variables. The risk that high collinearity between predictor variables poses to a correlational research study is that it becomes difficult for the data to differentiate between the individual effects and importance of each predictor variable on the criterion variable (Field, 2018). This study's eight nominal predictor variables (form of university training, path to TVI licensure, university AT training, pre-pandemic AT PD availability, current AT PD availability, method of attending AT PD, service delivery model, and ability to purchase new AT) contained more than two response options and thus were dummy coded in SPSS in order to be accurately used for correlational and regression analysis. Multicollinearity was tested through the examination of the generated correlation matrices for highly correlated predictor variables (are any values of r greater than 0.8), computing the variance inflation factor (VIF; are any VIF greater than 10), and examining the tolerance statistic (is tolerance below 0.2; Field, 2018).

Normality and Outliers. The assumption of normality is important for making parameter estimates and procedures like confidence intervals and significance tests, as these all assume normally distributed statistics to ensure accuracy (Field, 2018). Outliers in the data can have noticeable impacts on various measures and statistics, so it is important to identify any such issues before conducting critical analyses. Normality and outliers will be tested by generating and evaluating both a histogram of distributions and probability-probability chart of the standardized residuals and examining them for a bell curve shape and linear relationship, respectively. Cook's distance, a measure of the overall influence of a case on the model, will also be used to evaluate outliers (Field, 2018). Any values of Cook's distance greater than one indicate that a case that might be influencing the model.

CHAPTER 4: RESULTS

Introduction

The purpose of this quantitative, predictive correlational study was to quantify the ATSE of TVIs in the United States and investigate potential associations with TVI experience factors (predictor variables) that were aligned with Bandura's Self-Efficacy Theory (1977). This study also sought to fill a gap in the literature by determining TVIs' beliefs regarding their ability to perform the AT-specific duties necessary to support their students' successful use of AT.

The initial set of survey responses ($n = 485$) contained a significant number of bot-related identical survey responses, as well as those with no or virtually no data. An initial filtering step removed 288 such responses and yielded 197 cases with usable data from which descriptive statistics were generated. A second filtering step removed five cases with missing data for all items from the TVIs' Assistive Technology Self-Efficacy Scale (TATSES) used to calculate the criterion variable. This step resulted in a final 192 cases used for the regression analysis. Some cases still contained missing data, and these were addressed through pairwise exclusion; when statistical analyses are conducted on a variety of variables, cases are only excluded if a specific variable is missing data (Newman, 2014). Listwise exclusion of missing data was considered, but its complete exclusion of cases containing missing data resulted in a significant decrease in cases ($n = 154$) below the 180 minimum responses sought for statistical confidence.

Descriptive Statistics

Demographics

Descriptive statistics were conducted for both the study's demographic TVI experience factors (predictor variables), as well as the TVI experience factors not considered demographic in nature. Frequency counts are displayed for the categorical demographic factors (gender, form

of university training, path to TVI licensure, university AT training, and service delivery model), and minimums, maximums, and means are presented for the continuous demographic factors (age, TVI experience, and number of additional TVIs). Frequency counts are also displayed for the other categorical TVI experience factors (pre-pandemic AT PD availability, current AT PD availability, method of attending AT PD, percent of weekly service time teaching AT, and ability to purchase new AT).

Most of the participants were female ($n = 172$, 87.8%), compared to male ($n = 18$, 9.2%). The average age of survey participants was 46.8 years old (see Figure 1). The average years of experience as a TVI for survey participants was 11.8 years. However, the histogram of those results (see Figure 2) shows a strong right skew, as the mode was 4 years of experience ($n = 20$, 10.2%); the data suggest that this study's participants were mostly relatively early in their TVI careers. Most participants attended a university training program full-time to earn a degree ($n = 82$, 41.6%), followed by those who attended a university training program part-time to earn either a degree ($n = 49$, 24.9%) or certificate ($n = 34$, 17.3%). More than half of participants ($n = 108$, 54.8%) completed their university training programs and became certified as TVIs before beginning work as TVIs. Sixty participants (30.5%) began their TVI careers working under provisional licenses while enrolled in a university training program. Most participants learned about vision-specific AT content in a TVI program course dedicated to vision-specific AT content ($n = 85$, 43.1%), but 12.1% ($n = 22$) responded that AT content was not taught in any of their TVI program coursework. The majority of participants were itinerant TVIs ($n = 136$, 69%), followed by TVIs in a school for the blind setting ($n = 41$, 20.8%). Notably, 55 participants (30.2%) stated that they were the only TVIs in their districts, and participants stating they had

from 0 to 10 additional TVIs in their district comprised 80% of responses (see Figure 3). All demographic information can be found in Table 4 and Table 5.

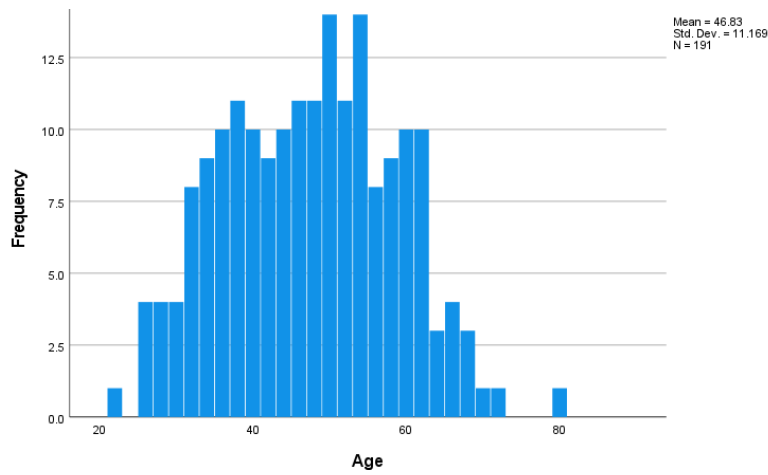


Figure 1. Distribution of Participant Ages

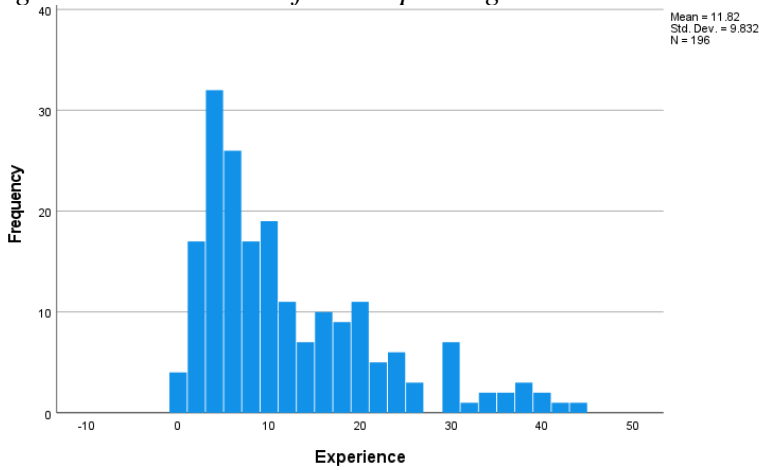


Figure 2. Distribution of Participant Years of Experience as TVI

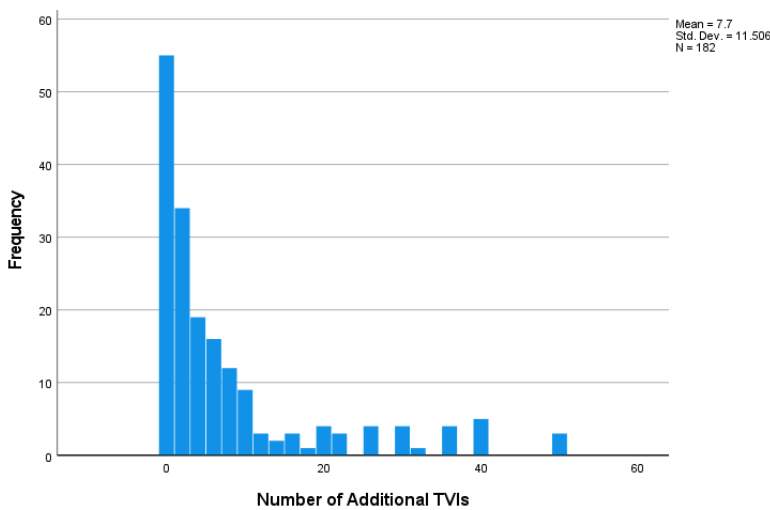


Figure 3. Distribution of Participant Numbers of Additional TVIs in District

Table 4

Frequency Counts for Categorical Participant Demographic Factors

Factor	Responses	Category	Frequency	%
Gender	196	Male	18	9.2
		Female	172	87.8
		Non-binary/third gender	1	0.5
		Prefer not to say	5	2.5
Form of University Training	197	Full time + Degree	82	41.6
		Full time + Certificate	14	7.1
		Part time + Degree	49	24.9
		Part time + Certificate	34	17.3
		Enrolled now + Degree	4	2
		Enrolled now + Cert.	1	.5
		No university training	13	6.6
Path to TVI Licensure	197	University training, did not work as TVI during program, then became licensed	108	54.8
		University training, worked as TVI during program under provisional license, then became licensed	60	30.5
		Currently in university program, working under provisional license, then will meet license requirement	4	2
		Met state license requirement without university training	9	4.6
		Other path to TVI licensure	16	8.1
University AT Training	182	VI course dedicated to vision-specific AT content	85	46.7
		VI course not dedicated to vision-specific AT content	31	17
		Across several VI courses not dedicated to vision-specific AT content	34	18.7
		In a non-VI course that included vision-specific AT content	10	5.5
		Not addressed in any coursework throughout program	22	12.1
Service Delivery Model	197	Itinerant TVI	136	69
		Resource room TVI	6	3
		TVI in school for the blind	41	20.8
		Other	14	7.1

Table 5

Minimums, Maximums, and Means for Continuous Participant Demographic Factors

Factor	Responses	Minimum	Maximum	Mean	SD
Age	191	22	79	46.8	11.169
Years of Experience as TVI	196	0	43	11.8	9.832
# of Additional TVIs in district	182	0	50	7.7	11.506

Other TVI Experiences

Frequency counts for the non-demographic TVI experience factors are displayed in Table 6 to provide general insights to participant responses. Participants rated the availability of AT PD both prior to the COVID-19 pandemic (before March 2020; $n = 180$), as well as at the time of the research survey (Spring 2022; $n = 197$). Notably, ratings of “Many opportunities” increased from 14.4% ($n = 26$) to 24.4% ($n = 48$), and ratings of “Very few opportunities” decreased from 35% ($n = 63$) to 24.4% ($n = 48$). This result suggests that during the COVID-19 pandemic more AT PD may have become available to TVIs, likely in the form of virtual PD opportunities; this would align with the education-wide shift toward more online learning that occurred at that time. Most participants adjusted their schedules to attend AT PD opportunities in the current school year ($n = 92$, 46.9%), but over a quarter of participants did not attend any AT-specific PD opportunities ($n = 55$, 28.1%). For the current school year, over half of participants spent either 0-20% ($n = 62$, 31.5%) or 21-40% ($n = 57$, 28.9%) of their weekly service time teaching AT-specific content with students. This result raises questions regarding the breakdown of specific topics (including ECC skills) that TVIs are teaching, as well as the circumstances that result in that breakdown. Finally, a majority of participants responded that they could either always ($n = 13$, 6.6%) or usually ($n = 78$, 39.6%) have new AT solutions purchased to trial and use with students; 39.1% of participants ($n = 77$) responded “occasionally.”

Table 6

Frequency Counts for Other Categorical TVI Experience Factors

Factor	Responses	Category	Frequency	%
Pre-pandemic AT PD Availability	180	Many opportunities	26	14.4
		Some opportunities	88	48.9
		Very few opportunities	63	35
		No opportunities	3	1.7
Current AT PD Availability	197	Many opportunities	48	24.4
		Some opportunities	99	50.3
		Very few opportunities	48	24.4
		No opportunities	2	1
Method of Attending AT PD	196	Adjusted schedule (no leave taken)	92	46.9
		Professional development time taken	28	14.3
		Personal leave time taken	5	2.6
		No AT PD attended	55	28.1
		Other	16	8.2
% of Weekly Service Time Teaching AT	197	81-100%	18	9.1
		61-80%	21	10.7
		41-60%	39	19.8
		21-40%	57	28.9
		0-20%	62	31.5
Ability to Purchase New AT	197	Always	13	6.6
		Usually	78	39.6
		Occasionally	77	39.1
		Rarely	25	12.7
		Never	4	2

Criterion Variable

Descriptive statistics for the criterion variable, TVIs' ATSE, and the 16 individual items of the TVIs' Assistive Technology Self-Efficacy Scale (TATSES) are displayed in Table 7. The TATSES has a minimum score of 1 (strongly disagree) and a high score of 6 (strongly agree). Participants' TVI ATSE scores were generated by computing the average of their scores for the 16 individual scale items. There was an overall mean TVI ATSE of 4.704 (SD = .772), between the labels of "4 - Agree Slightly" and "5 - Moderately Agree." Of the individual TATSES items' average scores, there was an overall minimum of 4.21 (Item 2 – "I can use a variety of AT assessment strategies for determining my students' needs"). This was closely followed by Item 6 with a mean of 4.29. Its ATSE statement is, "I am able to access AT professional development opportunities to support my AT decision making." The overall maximum score among the items was Item 8 with a mean of 5.16. Its ATSE statement is, "I can advocate to my supervisors for the purchasing of AT appropriate for my students." The TATSES instrument was found to be very reliable in this study sample, with a Chronbach's Alpha of .926 (Gall, Gall, & Borg, 2015).

Table 7

Psychometric Characteristics and Descriptive Statistics for TVIs' ATSE and TATSES Scale Items

Variable	Minimum	Maximum	Mean	SD	α
TVIs' ATSE	2.13	6	4.70	.772	.926
TATSES Item 1	1	6	4.75	1.081	
TATSES Item 2	1	6	4.21	1.205	
TATSES Item 3	1	6	4.66	1.069	
TATSES Item 4	1	6	4.67	1.100	
TATSES Item 5	1	6	4.69	1.259	
TATSES Item 6	1	6	4.29	1.146	
TATSES Item 7	1	6	4.91	1.085	
TATSES Item 8	1	6	5.16	1.067	
TATSES Item 9	1	6	4.80	1.110	
TATSES Item 10	1	6	4.82	1.144	
TATSES Item 11	2	6	5.04	0.883	
TATSES Item 12	1	6	4.42	1.280	
TATSES Item 13	1	6	4.57	1.186	
TATSES Item 14	2	6	4.80	0.924	
TATSES Item 15	1	6	4.84	1.085	
TATSES Item 16	1	6	4.63	1.076	

Statistical Analyses**Assumption Testing**

Prior to conducting the hierarchical multiple regression, six assumptions were tested to establish confidence in the regression analysis. These assumptions were: the independence of observations, linearity of the relationship between the criterion variable and predictor variables, presence of homoscedasticity, absence of multicollinearity, normality of regression residuals, and absence of outliers.

The independence of observations was tested using the Durbin-Watson statistic. The final hierarchical multiple regression model had a Durbin-Watson statistic of 2.078, which is within the acceptable range. The assumption of independence of observations was confirmed.

Linearity and homoscedasticity were both tested by examining a scatterplot of residuals (see Figure 4). The scatterplot does not appear to show any egregious funnel-like patterns (indicative of heteroscedasticity) or curvature to the dots (indicating a lack of linearity). The assumptions of linearity and homoscedasticity were confirmed.

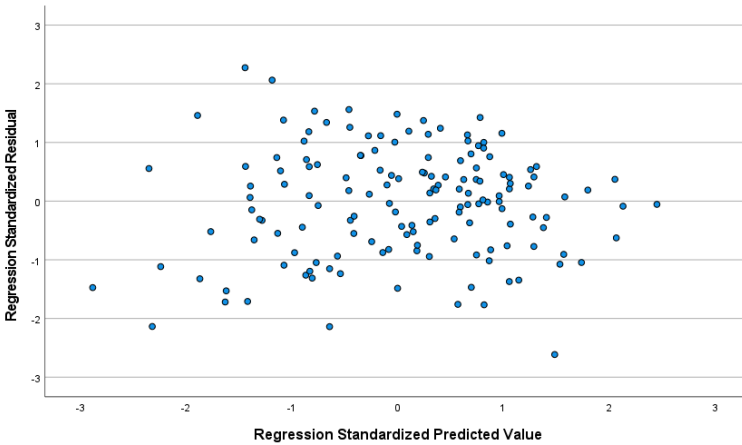


Figure 4. Residual Scatterplot

Multicollinearity among predictor variables was tested through examination of variance influence factor (VIF), tolerance statistic values, and the correlation matrix. There were no variables identified as having VIF values above 10. The three highest VIF values were 5.852, 5.285, and 5.183, and these values had corresponding tolerance values of .171, .189, and .193 below the general threshold of 0.2 that would suggest the possibility of multicollinearity. All three of these variables were dummy variables for a nominal predictor variable. When nominal variables with three or more categories are represented by dummy variables and the reference category contains relatively low cases, the remaining dummy variables may have higher VIFs and lower tolerances even if the nominal variable itself is not associated with other predictor variables (Allison, 2012). Furthermore, examination of the correlation matrix revealed no extremely high correlations among variables (r greater than 0.8). As such, the potential concern

raised by low tolerance values was ignored, and the assumption of the absence of multicollinearity was confirmed.

Normality was tested by examining a histogram of residuals, as well a probability-probability plot of residuals. The histogram (see Figure 5) displayed a good fit of the normal curve, and the probability-probability plot (see Figure 6) displayed a linear relationship. The assumption of normality was confirmed.

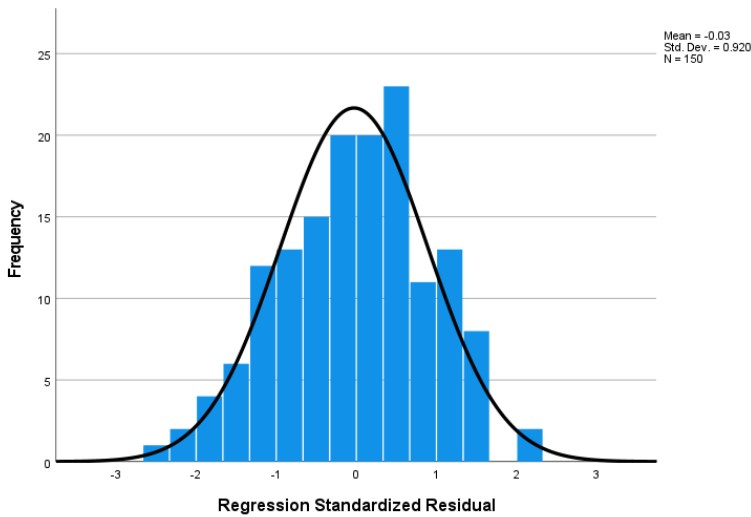


Figure 5. Distribution of Residuals

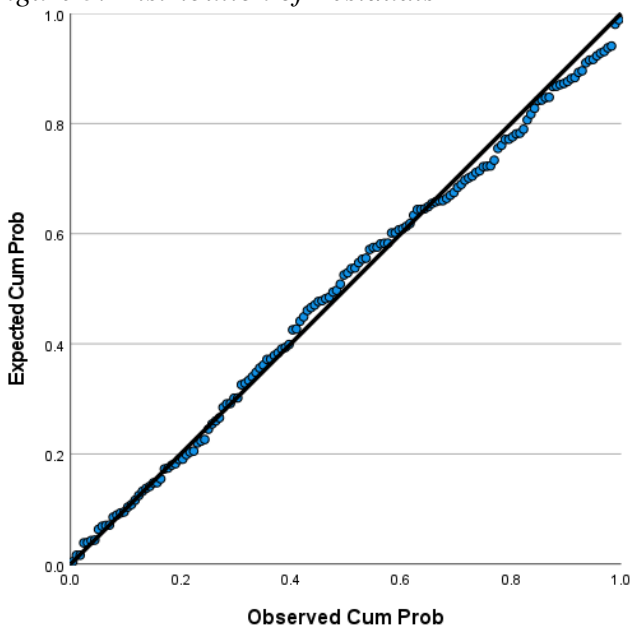


Figure 6. Probability-Probability Plot of Residuals

Outliers were tested through examination of the probability-probability plot of residuals, distribution of residuals, and Cook's Distance. Neither the distribution of residuals nor probability-probability plot of residuals appear to show any significant outliers. When Cook's Distance was generated for each response case, the highest value was .118, well below the threshold of a value of 1 that would raise concern. The assumption of the lack of outliers was confirmed.

Hierarchical Multiple Regression

Hierarchical multiple regression (HMR) was used to analyze the data and test this study's null hypotheses. The first null hypothesis (H_01) stated that there would not be any statistically significant associations between in-service TVIs' demographic factors (age, TVI experience), training experience factors (form of university training, path to TVI licensure, university AT training, pre-pandemic AT professional development availability, current AT professional development availability), work experience factors (method of attending AT professional development opportunities, service delivery model, number of TVIs in work setting, time available to provide AT instruction, availability of AT resources), and ATSE.

The second null hypothesis (H_02) stated that there would not be any statistically significant association between the linear combination of TVIs' demographic factors (age, TVI experience) and ATSE.

The third null hypothesis (H_03) stated that there would not be any statistically significant association between the linear combination of TVIs' training experience factors (form of university training, path to TVI licensure, university AT training, pre-pandemic AT professional development availability, current AT professional development availability) and ATSE.

The fourth null hypothesis (H₀₄) stated that there would not be any statistically significant association between the linear combination of TVIs' work experience factors (method of attending AT professional development opportunities, service delivery model, number of additional TVIs, percent of weekly service time teaching AT, ability to purchase new AT) and ATSE.

First Hierarchical Multiple Regression

The first null hypothesis (H₀₁) was tested using a HMR with 12 models. The first model contained the first predictor variable (age), and successive models added the next individual predictor variable until all predictor variables had been entered into the regression. The predictor variables were added one-by-one in order according to their TVI experience factor categories. These categories (demographic factors, training experience factors, work experience factors) consisted of predictor variables that were conceptually aligned. The approach of adding predictor variables individually in their own models allowed the significance (*F* Change) of each predictor variable's ΔR^2 to be tested and provide insights regarding its predictive relationship with TVIs' ATSE; the 12-model HMR also allowed nominal predictor variables' corresponding dummy-codes to be input in blocks together.

The HMR used to test null hypothesis H₀₁ found that four of the 12 models had statistically significant values of ΔR^2 (see Table 8), and the predictor variables corresponding with those models thus may be considered predictive of TVIs' ATSE. The first null hypothesis (H₀₁) was rejected. Model 5 found that adding the variable *University AT Training* resulted in a statistically significant ΔR^2 improvement in the model's ability to predict TVIs' ATSE, $F(4, 150) = 4.877, p = .001, \Delta R^2 = .108$. Model 6 found that adding the variable *Pre-pandemic AT PD Availability* resulted in a statistically significant ΔR^2 improvement in the model's ability to

predict TVIs' ATSE, $F(3, 147) = 5.075, p = .002, \Delta R^2 = .078$. Model 7 found that adding the variable *Current AT PD Availability* resulted in a statistically significant ΔR^2 improvement in the model's ability to predict TVIs' ATSE, $F(3, 144) = 3.046, p = .031, \Delta R^2 = .045$. Model 11 found that adding the variable *Percent of Weekly Service Time Teaching AT* resulted in a statistically significant ΔR^2 improvement in the model's ability to predict TVIs' ATSE, $F(1, 135) = 17.449, p = <.001, \Delta R^2 = .075$. Two models resulted in values of ΔR^2 that were relatively close to the $p = .05$ threshold for statistical significance but failed to meet the criteria. These were Model 2, which added the variable *TVI Experience*, $F(1, 161) = 3.863, p = .051, \Delta R^2 = .023$, and Model 12, which added the variable *Ability to Purchase New AT*, $F(4, 131) = 2.385, \Delta R^2 = .055$. Adjusted R^2 for both Model 2 and Model 12 improved, suggesting *TVI Experience* and *Ability to Purchase New AT* did, to some extent, improve the models' prediction of ATSE.

Table 8

HMR Examining TVI Experience Factors' Prediction of TVIs' ATSE

Model	Variable Added	R^2	ΔR^2	Adjusted R^2	F Change	p
1	Age	.004	.004	-.002	$F(1, 162) = .631$	.428
2	TVI Experience	.027	.023	.015	$F(1, 161) = 3.863$	.051
3	Form of University Training	.051	.023	.014	$F(4, 157) = .969$	.426
4	Path to TVI Licensure	.059	.009	.004	$F(3, 154) = .465$	.707
5	University AT Training	.167	.108	.095	$F(4, 150) = 4.877$	.001
6	Pre-pandemic AT PD Availability	.246	.078	.163	$F(3, 147) = 5.075$	.002
7	Current AT PD Availability	.291	.045	.197	$F(3, 144) = 3.046$	.031
8	Method of Attending AT PD	.328	.037	.217	$F(4, 140) = 1.937$	.108
9	Service Delivery Model	.339	.011	.213	$F(3, 137) = .761$	.518
10	Number of Additional TVIs	.345	.006	.215	$F(1, 136) = 1.350$	.247
11	% of Weekly Service Time Teaching AT	.420	.075	.300	$F(1, 135) = 17.449$	<.001
12	Ability to Purchase New AT	.460	.039	.328	$F(4, 131) = 2.385$	.055

Second Hierarchical Multiple Regression

The second (H₀₂), third (H₀₃), and fourth (H₀₄) null hypotheses were tested using a HMR with 3 models, each adding predictor variables that were conceptually aligned with each other. The first model included the TVI demographic factors of age and TVI experience. The second model added the TVI training experience factors of form of university training, path to TVI licensure, university AT training, pre-pandemic AT PD availability, and current AT PD availability. The third model added the TVI work experience factors of method of attending AT PD, service delivery model, number of additional TVIs, percent of weekly service time teaching AT, and ability to purchase new AT. The significance (*F* change) of each model's ΔR^2 was used to test the null hypotheses (see Table 9).

Model 1, testing the second null hypothesis (H₀₂), accounted for 2.7% ($R^2 = .027$) of variance in TVIs' ATSE. The ΔR^2 value was not statistically significant, $F(2, 161) = 2.253, p = .108, \Delta R^2 = .027$. This result does not support the suggestion that TVIs' demographic factors are predictive of TVIs' ATSE. The second null hypothesis (H₀₂) failed to be rejected. Model 2, testing the third null hypothesis (H₀₃), accounted for 29.1% ($R^2 = .291$) of variance in TVIs' ATSE. The ΔR^2 value of .263 was statistically significant, $F(17, 144) = 3.145, p = <.001$. This result supports the suggestion that TVIs' training experience factors are predictive of TVIs' ATSE. The third null hypothesis (H₀₃) was rejected. Model 3, testing the fourth null hypothesis (H₀₄), accounted for 46% ($R^2 = .460$) of variance in TVIs' ATSE. The ΔR^2 value of .169 was statistically significant, $F(13, 131) = 3.151, p = <.001$. This result supports the suggestion that TVIs' work experience factors are predictive of TVIs' ATSE. The fourth null hypothesis (H₀₄) was rejected.

Table 9

HMR Examining TVI Experience Factor Categories' Prediction of TVIs' ATSE

Model	TVI Experience Category	Variables Added	R^2	ΔR^2	Adj. R^2	F Change	p
1	Demographic Factors	Age TVI Experience	.027	.027	.015	$F(2, 161) = 2.253$	.108
2	Training Experience Factors	Form of University Training Path to TVI Licensure University AT Training Pre-pandemic AT PD Availability Current AT PD Availability	.291	.263	.197	$F(17, 144) = 3.145$	<.001
3	Work Experience Factors	Method of Attending AT PD Service Delivery Model Number of Additional TVIs % of Weekly Service Time Teaching AT Ability to Purchase New AT	.460	.169	.328	$F(13, 131) = 3.151$	<.001

Summary

In summary, 192 TVIs from the United States participated in this predictive correlational study that examined possible associations between TVIs' experience factors (predictor variables) and their ATSE. Descriptive statistics were conducted on each variable, including those designated descriptive in nature and those that were not. Depending on missing data in various cases, the number of cases used to report the descriptive statistics varied between $n = 180$ and $n = 197$. Assumptions for multiple regression analyses were tested, and all assumptions were confirmed. The hierarchical multiple regression was conducted using 192 cases containing both predictor variable data and ATSE data. Four individual predictor variables (university AT training, pre-pandemic AT PD availability, current AT PD availability, percent of weekly service

time teaching AT) were found to have statistically significant contributions to the HMR's prediction of TVIs' ATSE. Furthermore, HMR models testing the significance of TVIs' experience categories found that TVIs' training experience factors and work experience factors significantly contributed to the HMR's prediction of TVIs' ATSE.

In the next chapter, these findings will be discussed and situated in the existing literature. Implications of this study and recommendations for future research will be shared.

CHAPTER 5: DISCUSSION

Introduction

The purpose of this predictive correlational study was to propose TVI experience factors that are aligned with Bandura's (1977) Self-Efficacy Theory (SET) and investigate them as potential sources of assistive technology self-efficacy (ATSE). Data were collected using a survey that contained items involving TVI experience factors (predictor variables), as well as items involving TVIs' ATSE which comprised a newly created TVIs' Assistive Technology Self-Efficacy Scale. Following the distribution of the survey to TVIs across the United States, the data were analyzed using two hierarchical multiple regressions of different variable groupings. This chapter will discuss the study's findings in light of existing literature and whether or not the results validate expectations suggested through alignment with SET (Bandura, 1977). The implications of this study will be discussed, limitations of this study will be noted, and recommendations for future research will be proposed.

Discussion

This study proposed 12 TVI experience factors as potential predictors of TVIs' ATSE. The experience factors were all theoretically aligned with one of the four sources of self-efficacy, as defined in Alfred Bandura's (1977) Self-Efficacy Theory. The theoretical alignment between SET and the TVI experience factors was intended to provide a basis through which the TVI experience factors could plausibly be hypothesized to be predictive of TVIs' ATSE. Following this study's use of a 12-model hierarchical multiple regression to analyze the data, four of the 12 TVI experience factors were found to have statistically significant effects on the proportion of variance in TVIs' ATSE. These factors were: university AT training, pre-pandemic AT PD availability, current AT PD availability, and percent of weekly service time teaching AT.

Factors Predictive of ATSE

The TVI experience factor of university AT training was intended to capture the variation in how participants were taught AT in their university training programs. Researchers have found that university training programs do not teach AT in the same ways, both in terms of their course structures and the set of AT competencies that are covered with students (Smith & Kelley, 2007; Smith et al., 2009). More specifically, Kamei-Hannan et al., (2012) found that a university course focused on AT improved students' perceived proficiency levels with AT. Indeed, the data from this study supported these earlier findings, revealing that participants' university AT training experiences were varied. The university training experience is a unique time during which one might expect to experience a fair amount of hands-on and observational learning opportunities, and this was the basis for this factor's alignment with the self-efficacy sources of mastery and vicarious experiences. However, if university training programs do vary in the ways they teach AT content, as confirmed for this study's sample of TVIs, it stands to reason that a student's quality and quantity of AT learning opportunities will vary. For example, factors such as fewer direct, hands-on experiences with AT or opportunities to learn from expert, experienced TVIs and AT trainers could correspond with fewer opportunities for mastery and vicarious experiences compared with programming that emphasized such activities. This disparity could in turn result in differing levels of ATSE in TVIs; the statistically significant *F* change statistic for university AT training supported this hypothesis. Further examination through continued research regarding the current approaches university training programs are taking in providing AT instruction is warranted, especially so that researchers and university training program administrators can better understand what specific experiences and salient features of experiences provide the most meaningful AT learning opportunities.

AT PD availability was measured by having participants rate their perception of the availability of AT learning opportunities, both prior to the onset of the COVID-19 pandemic and during the current school year. Similar to university AT training, AT PD opportunities are learning experiences in which a TVI should expect to learn from AT experts (vicarious experiences) and also practice using AT themselves (mastery experiences). However, when TVIs recognize their learning needs and seek out AT-specific PD opportunities, the actual availability of these opportunities can determine whether or not meaningful learning experiences occur (Ajuwon et al., 2016; Wong & Cohen, 2015). The regression analysis found that both pre-pandemic AT PD availability and current AT PD availability were significant predictors of TVIs' ATSE, supporting the notion that varying availability of AT PD for TVIs can impact their beliefs about being able to teach and support AT with their students. More research is needed to examine the nuance to this experience factor, like contrasting existing AT PD availability with TVIs' awareness of such trainings (Ajuwon et al., 2016). However, based on the predictive nature of these factors, practitioners and PD providers should examine the quantity and frequency of their AT trainings; the methods of communicating about trainings should be evaluated as well. In addition, factors such as whether or not AT PD is offered in-person or virtually, as well as the availability of trainings on specific AT topics, should also be examined to build on existing distance education literature (Ajuwon & Craig, 2007; Gilson, 2014; Griffin-Shirley et al., 2002; McLinden et al., 2006). The question of in-person and virtual trainings is of specific relevance in the field given the COVID-19 pandemic beginning in March of 2020. In this study, participants responded that there was a greater availability of AT training during the current school year (two school years after the onset of the pandemic) than prior to the pandemic. This finding may have been due to an increase in online AT PD opportunities, and additional research should seek to

seek to confirm if this was the case. If found to be accurate, this change would be consistent with the trend across K-12 education since the beginning of the pandemic that has seen more educational experiences conducted virtually in the interest of personal health and flexibility of instruction (Nowicki, 2020). Anecdotally, this researcher contributed to such an effort during the 2020-2021 school year. When the annual Unity Conference held by the Tennessee School for the Blind was canceled due to COVID-19 precautions, this researcher helped develop a partnership between the Tennessee School for the Blind, Vanderbilt University Visual Disabilities Program, and the Tennessee Chapter of the Association for the Education and Rehabilitation of the Blind and Visually Impaired, forming the Unity Virtual Academy of online, virtual professional development opportunities. Instead of a single conference, the Unity Virtual Academy held more than 12 virtual sessions across its first school year.

The percent of weekly service time spent teaching AT was proposed as a way to gather data about how much AT instruction TVIs were providing. This factor is of great importance, as a TVIs' direct AT instruction and support activities with students are opportunities to gain constructive mastery experiences that develop ATSE (Ajuwon et al., 2016; Tschannen-Moran & Chen, 2014). Greater frequency of AT instruction would therefore mean more opportunities for mastery experiences and development of ATSE (Tschannen-Moran & Chen, 2014). This study hypothesized that, by alignment of this service time predictor variable with mastery experiences, the amount of time spent teaching and supporting AT would be associated with ATSE. The significance of this work experience's contribution to the regression model confirmed this hypothesis. That is, the more a TVI teaches AT with students, the greater their ATSE is predicted to be. TVIs, then, will benefit from asking themselves why they teach AT at their current rate. This study defines AT as high-tech electronic devices or software solutions used by individuals

with visual impairments, including both specialized and common technology. The literature has found that some TVIs only teach the AT that they are familiar with (Ajuwon et al, 2016; Wong & Cohen, 2015). It is possible that much of a teacher's caseload or class responsibility in a school for the blind is comprised of younger students who generally would not be taught to use certain high-tech AT solutions. In this example, a TVI might delay introducing an appropriate high-tech AT solution because they have not used it frequently. Repeated delays of this fashion would result in the lack of or low number of experiences involving AT, potentially corresponding with a lack of ATSE development. Additional factors influencing a teacher's frequency of AT instruction also include TVIs with split duties (i.e., working half of the day as TVI and the other half as a speech-language pathologist), in which fewer students with visual impairments seen could result in fewer opportunities for direct instruction. TVIs may also not be aware of their students' needs for AT or what AT to use with them (Al-Zboon, 2020; Wong & Law, 2016), and this ignorance could result in a lack of AT instruction. If this is the case, determining the AT evaluation skillsets of TVIs could be beneficial. Increased use of effective AT evaluations could lead to an increase in the overall awareness of how relevant and useful AT can be to all students with visual impairments. TVIs may then increasingly incorporate AT instruction into their service visits, or they may seek out PD opportunities to better prepare themselves for teaching specific AT skills.

Factors Close to Statistical Significance

The TVI experience factors of *TVI Experience* and *Ability to Purchase New AT* were almost statistically significant in their prediction of TVIs' ATSE, and both were determined through the adjusted R^2 statistic to improve the prediction model. Researchers should consider including both factors in future investigations involving their relationships with TVIs' ATSE, as

it is possible that relationships of value exist but were not confirmed through this study's method of statistical analysis.

Other Factors

The following TVI experience factors were not found to have statistically significant predictive association with TVIs' ATSE: age, TVI experience, form of university training, path to TVI licensure, method of attending AT PD, service delivery model, number of additional TVIs, and ability to purchase new AT. These factors will be discussed in relation to the literature and their alignment with Self-Efficacy Theory.

Age was aligned with the physiological states source of self-efficacy. Specifically, it was thought to potentially be impactful in the case of older TVIs who may have different motivations or self-efficacy beliefs than younger TVIs. Of course, the definition of old and young is a subjective notion, yet the question of age's influence on teachers, including their self-efficacy, has continued to be examined in the literature (Rezaeian & Abdollahzadeh, 2020; Torenbook & Peters, 2017). Šabić et al. (2022) found that younger teachers were more proficient with teaching information and communication technology than older teachers, but Rezaeian and Abdollahzadeh (2020) concluded that age did not significantly affect one's teacher self-efficacy. Investigating TVIs and their ATSE, this study did not support the hypothesis that older TVIs might possess poorer ATSE than younger TVIs who have more so grown up around technology. Perhaps this is because older TVIs are usually more experienced with more time spent teaching AT. As such, a TVI's age alone should not be thought of as a predictor of their ATSE, and it likely should only be considered alongside a variety of additional contextual and cultural factors (Rezaeian & Abdollahzadeh, 2020).

The number of years in which a participant has worked as a TVI was aligned with both mastery experiences and vicarious experiences. The hypothesis was that more years of experience might consist of a TVI having had more instances of ATSE-developing mastery and vicarious experiences working with students and observing peers or participating in PD. Conversely, less experienced TVIs would possess fewer such experiences. The data analysis for this experience factor was close to statistical significance, but it ultimately did not meet the necessary threshold to support this hypothesis. There may be some reasons for this. For example, some TVIs will work for long periods of time without encountering a student who needs to learn braille and thus not need to teach the use of a high-tech refreshable braille display or braille notetaker (Ajuwon et al., 2016). Furthermore, there are so many instructional responsibilities given to TVIs that it is nearly impossible to maintain a ready state of knowledge and skills that they do not use regularly (Ajuwon et al., 2016; Siu & Emerson, 2017).

A TVI's form of university training and path to TVI licensure were experience variables intended to measure some of the variation in participants' experiences as they were beginning their careers. In both predictors, differing experiences presumably would result in different forms, frequencies, and quality of training experiences (Pogrud & Wibbenmeyer, 2008). For example, participants who were university students that earned degrees might be expected to have more opportunities for both mastery and vicarious experiences with AT than university students earning certificates due to the greater number of courses taken. Furthermore, participants who did not have any university training at all prior to becoming TVIs might lack familiarity with AT and report poor ATSE (Pogrud & Wibbenmeyer, 2008). The results ultimately did not determine that the variation in ATSE accounted for by these two variables was significant. One reason for this could be that there are many additional factors contributing to the

different kinds of university training options available to TVI-candidates, as well as the paths they take towards becoming licensed to work as TVIs. Specifically, there are numerous structural and programmatic differences between university training programs that this study's item response options likely did not adequately capture (Pogrund, 2017). Similarly, states also have been found to differ in the requirements TVIs must satisfy in order to become licensed as TVIs (Pogrund & Wibbenmeyer, 2008). The field will benefit from a current analysis of how university training programs are structured and what states' licensure requirements are.

The method of attending AT PD TVI experience factor was hypothesized to align with vicarious experiences, as the circumstances under which a TVI was able to attend an AT PD opportunity might impact the frequency and quality of the learning experiences attended. For example, itinerant TVIs adjusting their schedules to fit in a virtual PD might be distracted and have a less fruitful PD experience than TVIs at school for the blind who have regularly scheduled PD build into the school calendar and do not have the obligation of other services to work around (Gilson, 2014). Notably, more than a quarter of participants responded that they did not attend any AT PD. However, the data did not determine this experience factor to be predictive of ATSE. Perhaps this is because the types of AT PD TVIs attend are more influential toward ATSE than merely how they are making the time to attend the PD; if they are attending the PD, it is because they want to be there. Future research should investigate the variety of AT PD being made available to TVIs across the country, both in-person and virtually, and among the questions to explore are what specific kinds of experiences and formats these PD use?

Service delivery model was aligned with mastery experiences, vicarious experiences, and social persuasion. The literature has documented a number of differences in TVIs' experiences depending on the service delivery models they work in (Gilson, 2014; McMahon, 2014; Pogrund

& Cowan, 2013; Pogrud et al., 2013), and these variations were hypothesized to be influential in their opportunities for and exposure to PD and additional peers with whom they might learn from and be supported by. TVIs working as itinerant teachers might have access to mastery experiences, but working alone would likely mean they would lack opportunities for vicarious experiences and social persuasion from colleagues. Conversely, TVIs working in a school for the blind might have a greater likelihood of having mastery experiences, vicarious experiences, and social persuasion. The data did not find this TVI experience factor to be statistically significant in predicting ATSE. Perhaps the experiences of TVIs working as itinerant teachers, resource room TVIs, teachers in schools for the blind, and other placements vary among individuals such that these broad, basic categories cannot be relied upon to suggest a TVI's ATSE. Further research on the variety of lived experiences of TVIs working in different service delivery models would better shed light on this experience factor.

The number of additional TVIs in a participant's school district was aligned with vicarious experiences and social persuasion. The more additional TVIs one might have working with them, the greater their chances of having interactions that led to vicarious experiences or social persuasion (Pogrud & Cowan, 2013). However, this experience factor was not statistically significant. Itinerant TVIs nearly always work alone, driving from school to school seeing students on their own caseloads (Correa-Torres & Howell, 2004; Siu & Morash, 2014). Even with multiple colleagues in the district, there might not be regular opportunities to gather as a team and collaborate, much less shadow each other during the instructional day. Similarly, TVIs working in schools for the blind might have many peers who are also licensed TVIs, but during the school day they are likely the only teachers for their classes. As such, their opportunities for collaboration might not be as great as might be expected. Researchers should

investigate and contrast the lived experiences of TVIs working in different settings to better understand their opportunities for vicarious experiences and social persuasion. They should also focus on TVIs' social contexts, furthering Morash and Siu's (2016) research on the relationship between a supportive community of practice and TVIs' AT proficiency.

The ability to purchase new AT was a TVI experience factor aligned with mastery experiences. TVIs who could frequently or more easily order new AT would likely have a number of opportunities to use AT and develop their ATSE through successful experiences. This experience factor did not meet the criteria for statistical significance of impact on the variance of ATSE, but it missed out by a small margin. Future research should further explore this variable, especially as part of a broader examination of TVIs' experiences working in districts with different socioeconomic levels. Researchers should also investigate the relationship between TVIs' beliefs about their ability to procure AT and their awareness of funding sources and other options for having AT purchased (Siu & Morash, 2014).

TVIs' Assistive Technology Self-Efficacy

Existing research involving TVIs and AT has found TVIs lacking in AT competency and confidence (Abner & Lahm, 2002; Edwards & Lewis, 1998; Kapperman et al., 2002; Wong & Cohen, 2015; Zhou et al., 2011; Zhou et al., 2012). The ATSE data collected from this study's TVI participants cannot be directly compared with these findings due to the lack of a standard measure of AT competency or confidence. However, in this study, the theoretically underpinned construct of TVIs' ATSE has been proposed for the first time, alongside the novel TVIs' Assistive Technology Self-Efficacy Scale (TATSES) that measures the construct. The TATSES was found to be a valid and reliable instrument through SME review and statistical analysis, instilling confidence in the ATSE data gathered. The field now possesses a promising new instrument

through which researchers can gauge TVIs' ATSE beliefs. Armed with this knowledge, researchers can examine the relationships between this measure and crucial student outcomes like AT implementation and AT proficiency. Ultimately, there is potential for links between AT-specific interventions for TVIs and student outcomes to be established.

In this study's first use of the TATSES, TVIs reported an average ATSE score of 4.704 on a scale ranging from 1 to 6. This average score was situated between the labels of "4 - Agree Slightly" and "5 - Moderately Agree" but short of the high mark of "6 - Strongly Agree." To be sure, this average score is on the affirmative side of the TATSES' 6-point scale and appears to be an improvement upon several existing studies that found over half of participants lacking adequate confidence to teach and support AT (Abner & Lahm, 2002; Zhou et al., 2011; Zhou et al., 2012). Still, this average score also indicates there is much room for TVIs to grow in their ATSE, and the field thus has much still to investigate in exploring what constitutes a quality intervention or form of PD that can effectively develop TVIs' ATSE.

Implications

This study filled a gap in the literature by providing a current examination involving TVIs' ATSE, and it serves the field providing direction for much needed additional research involving AT use by both TVIs and students with visual impairments. While this study identified TVI experience factors with statistically significant predictive associations with TVIs' ATSE, the study's design does not allow for causal relationships between predictor variables and the criterion to be drawn. Rather, the results suggest that the factors of university AT training, AT PD availability, and percentage of weekly service time are topics that hold additional research potential.

This study identified four TVI experience factors that were statistically significant in their prediction of ATSE in TVIs. These results confirm Bandura's (1977) Self-Efficacy Theory through very direct alignment with the mastery experiences and vicarious experiences sources of self-efficacy. However, eight other TVI experience factors were not found to be statistically significant predictors of ATSE. As discussed, their alignment with Self-Efficacy Theory was less direct and more theoretical in nature; none of the statistically significant TVI experience factors were aligned with the self-efficacy sources of social persuasion and physiological states. Given this knowledge, Self-Efficacy Theory may be a useful theoretical framework for future research in the field of visual impairments and the TVIs' self-efficacy for specific skills like teaching and supporting AT. When designing such studies, researchers should make sure that their predictor variables are closely aligned with the sources of self-efficacy.

As part of this study, a novel instrument, the TVIs' Assistive Technology Self-Efficacy Scale (TATSES) was developed. The TATSES is underpinned by Siu and Morash's (2014) four domains of AT proficiency, a validated and reliable conceptualization of 111 AT competencies outlined by Smith et al. (2009). These fundamental bases for the TATSES help ensure that the scale has AT content validity, and additionally the TATSES has faced expert review for additional face and content validity prior to its use in this study. The study data gathered from the TATSES were analyzed and yielded a Chronbach's Alpha value of .926. This strong measure of internal consistency suggests that the TATSES holds promise as an instrument that may be used by the field for future examinations of TVIs' ATSE. Moving forward, additional research confirming this study's results, as well as analyses like exploratory factor analysis, are recommended.

Limitations

This study has resulted in promising results that will add to the literature on topic of AT for individuals with visual impairments. It is important, however to note some limitations that may have had effects on these conclusions. These limitations involve the study design, predictor variables used and potentially omitted from use, and the sample size of participants that was used to conduct analyses.

This study utilized a predictive correlational design and identified significant predictive associations between TVIs' ATSE and four TVI experience factors. However, the use of this research design does not allow researchers to make conclusions regarding the causality of the relationships between the criterion and predictor variables. Conducting additional research using experimental designs would allow researchers to definitively declare that cause and effect relationships exist. At this time, the conclusions drawn from this study are best utilized as direction-setting recommendations for future research involving TVIs and AT.

The predictor variables used in this study warrant discussion, including those that were not included in the study. Specifically, the final model in the hierarchical multiple regression analysis, with all 12 predictors included, found that 46% ($R^2 = .460$) of the variance in TVIs' ATSE was accounted for. Therefore, it is likely that there are TVI experience factors not included in this study that are influential toward ATSE. They may not have been discovered during the literature review, like whether or not a TVI is an AT user themselves, or there may not have been reasonable ways to align them with Self-Efficacy Theory. For example, there may be details to a TVI's work circumstances that are impactful on their ATSE but are not factors that could be characterized as influential by way of one of the four sources of self-efficacy. In addition to the predictors potentially omitted from the study, this study found that many of the variables deemed

statistically insignificant may have lacked item responses that adequately accounted for the full extent of TVIs' experiences in a certain area. For example, 8.1% ($n = 16$) of participants selected the "Other path to TVI licensure" response option for the Path to TVI Licensure item. 7.1% of participants selected "Other" for the Service Delivery Model item, and 8.2% ($n = 16$) of participants selected "Other" for the Method of Attending AT PD. Future research should seek to better account for and measure these other-type responses, as well as seek to capture complementary detail to TVI experience factors like how often TVIs are able to meet with colleagues.

Finally, this study sought to reach TVIs working all across the United States, and it used the convenience sample of participants who received the invitation to participate and chose to do so. Unfortunately, efforts to reach TVI networks and schools for the blind across the country were not always fruitful. Not all institutions investigated has easily accessible contact information, and requests to share the research invitation were not always replied to; at the time of the study's recruitment, some school districts had already begun wrapping up for the year. The sample data more likely reflects the population of TVIs who are active on social media or frequently check their email. As such, though the study ultimately collected an adequate number of useable responses for reliable statistical analyses, fewer responses were collected than initially anticipated. This suggests that there were likely to be TVIs who would have been willing to participate in the study but never knew of the opportunity. Future research using similar recruitment methodology should utilize more robust methods of reaching TVIs, including placing phone calls to follow up on email requests to share the study, as well as soliciting participants in-person at professional conferences.

Recommendations

This study proposed 12 promising or logical TVI experience factors as predictor variables to investigate for their association with TVIs' ATSE. Given the major conclusion that four TVI experience factors were predictive of TVIs' ATSE, researchers have been given more definitive direction regarding the experience factors they should focus their TVI and AT-related research efforts on. In contrast, other key TVI experience factors such as TVIs' form of university training, paths to licensure, and service delivery model that one might imagine as impactful toward the overall skillset and competence of a TVI, were insignificant in predicting TVIs' ATSE. The field of visual impairments is a small community of scholars with many important topics of interest, so researchers must prioritize their research on topics that have shown promise. Specific to this study, researchers should follow up on the significant predictors of ATSE and investigate the features of those experience factors that lend them to be so promising.

Researchers should specifically investigate the intricacies of how universities are teaching AT to TVI candidates. This research could seek to determine whether the distribution of how AT was taught to participants matches the approaches university programs currently employ? Has a more set of AT competencies or standards been more widely adopted by university programs? What are the kinds of AT experiences TVI candidates are being offered?

Regarding the availability of AT PD, the field of education has emerged from the early days of the pandemic as more dynamic and flexible in how it approaches PD. Researchers should investigate how practitioners, institutions, and instructional designers are currently designing and structuring their PD opportunities for TVIs. What is the distribution of in-person PD vs virtual PD? What kinds of learning experiences are being offered in each type of PD format?

Lastly, researchers should focus on the factors that are resulting in TVIs with varying percentages of their service time being spent teaching AT. Who are the teachers who spend a significant amount of their time teaching AT? What are their student caseloads like, or what are their class assignments in a school for the blind? Similarly, who are the teachers who reported a lower rate of AT instruction throughout the week? Are they not teaching AT due to their specific caseload students? Do they not have knowledge of useful AT to introduce to their students? Do they not have access to necessary AT resources and solutions to feel competent in teaching AT?

Conclusion

This study has contributed to the field by specifically investigating TVIs' ATSE and experience factors that may contribute to it. This is important for the field, as the existing literature has only alluded to TVIs having low confidence in their AT competencies or ability to teach and support AT with students; until now, no studies have sought to verify these reports or pursued the question of why they are the case. This study has found that TVIs certainly still need support to develop their ATSE, and additional research on the topic of TVIs' ATSE is necessary. AT is widely recognized as a great equalizer for students with visual impairments, as it provides access to nearly all aspects of their school day and beyond, both in a physical and digital sense. It is critical for the field to understand how to best support TVIs in their efficacy beliefs involving the teaching and supporting of AT with students. ATSE is the bridge between competency and pedagogy, the implementation of quality AT instruction. Increased, high-quality AT instruction will only serve to improve the use of AT by students with visual impairments, leading to positive educational, vocational, and leisure outcomes.

The conclusions from this study have provided the field with specific topics for future research. These TVI experience factors of university AT training, AT PD availability, and

percentage of weekly service time teaching AT must be investigated in detail. In addition, this study has resulted in the introduction of a new research instrument, the TVIs' Assistive Technology Self-Efficacy Scale, that holds promise as a specialized tool that the field can reliably and meaningfully employ in future research.

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Appendix A

Definitions of predictor variables, corresponding survey questions, and variable types

Predictor Variable	Narrative Definition and Survey Item	Type of Variable and Response Options
Age	<p>Definition: Refers to the participant’s stated age.</p> <p>Survey item: What is your age?</p>	<p>Ratio: (Participant-specified response)</p>
Years of experience as TVI	<p>Definition: Refers to the number of years the participant has served in their current role as a TVI.</p> <p>Survey item: How many years of experience do you have as a TVI?</p>	<p>Ratio (Participant-specified response)</p>
Form of university training	<p>Definition: Refers to the format and outcome of the university training program the participant attended to become trained as a TVI.</p> <p>Survey item: Did you receive university training to become a TVI?</p>	<p>Nominal:</p> <ul style="list-style-type: none"> • Yes – attended as full-time student and earned a degree • Yes – attended as full-time student and earned a certificate • Yes – attended as part-time student and earned a degree • Yes – attended as part-time student and earned a certificate • Currently enrolled in a university training program to earn a degree • Currently enrolled in a university training program to earn a certificate • No, I did not receive university training to become a TVI
Path to TVI licensure	<p>Definition: Refers to the manner in which a participant met their state’s requirements to work as a TVI.</p> <p>Survey item: What was your path to full TVI licensure?</p>	<p>Nominal:</p> <ul style="list-style-type: none"> • I completed a university training program and then met my state’s licensure requirements (I did not work as a TVI under a provisional license during my university training) • I worked as a TVI under a provisional license while enrolled in a university training program (I completed the program and then met my state’s licensure requirements) • I am working as a TVI under a provisional license and am enrolled in a university training program (I will complete my program and then meet my state’s licensure requirements) • I met my state’s licensure requirements without participation in a university training program (e.g., took a Praxis® or similar test only) • Other

Predictor Variable	Narrative Definition and Survey Item	Type of Variable and Response Options
University AT training	<p>Definition: Refers to the format in which the participant was exposed to AT concepts and instructional skills and strategies during their university TVI training.</p> <p>Survey item: How was vision-specific assistive technology content like specific devices, concepts, skills, and instructional strategies presented during your university training program?</p>	<p>Nominal:</p> <ul style="list-style-type: none"> • In a VI course dedicated to vision-specific AT content • In a VI course that was not dedicated to vision-specific AT content • Across several courses throughout the program that were not dedicated solely to vision-specific AT content • In a non-VI course (e.g. general AT course that included vision-specific AT) • Not addressed in any coursework throughout the program • Other
Pre-pandemic AT PD availability	<p>Definition: Refers to the availability of AT PD that the participant believes they had, in-person or online, prior to the COVID-19 pandemic (defined as before March 2020).</p> <p>Survey item: Prior to the COVID-19 pandemic (before March 2020), how would you rate the availability of AT-specific professional development opportunities for you to attend, in-person or online?</p>	<p>Ordinal:</p> <ul style="list-style-type: none"> • Many opportunities • Some opportunities • Very few opportunities • No opportunities • Not applicable – I was not a TVI at that time
Current AT PD availability	<p>Definition: Refers to the availability of AT PD that the participant believes they had, in-person or online, during the current school year.</p> <p>Survey item: During the 2021-2022 school year, how would you rate the availability of AT-specific professional development opportunities for you to attend, in-person or online?</p>	<p>Ordinal:</p> <ul style="list-style-type: none"> • Many opportunities • Some opportunities • Very few opportunities • No opportunities
Method of attending AT PD	<p>Definition: Refers to the method the TVI used to attend an AT PD during the current school year (2021-2022).</p> <p>Survey item: If you attended an AT-specific professional development opportunity (in-person or online) during the 2021-2022 school year, how did you make time to attend the training?</p>	<p>Nominal:</p> <ul style="list-style-type: none"> • I adjusted my schedule (no leave taken or required to be taken) • I took professional development leave time • I took personal leave time • I did not attend any AT professional development opportunities • Other

Predictor Variable	Narrative Definition and Survey Item	Type of Variable and Response Options
Service delivery model	<p>Definition: Refers to whether the TVI serves as an itinerant teacher driving between schools, as a resource room vision specialist in one school, works at a specialized school for the blind with many other vision professionals, or in a different capacity.</p> <p>Survey item: For the 2021-2022 school year, which service delivery model best describes how you spend most of your time as a TVI?</p>	<p>Nominal:</p> <ul style="list-style-type: none"> • Itinerant TVI • Resource room TVI • TVI in school for the blind • Other
Number of additional TVIs in district	<p>Definition: Refers to the number of additional TVIs who work in the same district/school with the participant.</p> <p>Survey item: How many TVIs other than yourself work in your district?</p>	<p>Ratio (Participant-specified response)</p>
Percent of weekly service time teaching AT	<p>Definition: Refers to the percentage of the participant's weekly service time that they believe they spend teaching and supporting AT.</p> <p>Survey item: For the 2021-2022 school year, what percentage of your total weekly service time with students is spent providing AT instruction and supports?</p>	<p>Ordinal</p> <ul style="list-style-type: none"> • 81-100% of my weekly service time • 61-80% of my weekly service time • 41-60% of my weekly service time • 21-40% of my weekly service time • 0-20% of my weekly service time
Ability to purchase new AT	<p>Definition: Refers to how readily the participant believes they can have new AT solutions purchased for use with students.</p> <p>Survey item: How readily can you have new AT solutions (e.g., devices and software) purchased to trial and use with students?</p>	<p>Ordinal:</p> <ul style="list-style-type: none"> • Always • Usually • Occasionally • Rarely • Never

Appendix B

Survey of TVI Experiences and Assistive Technology Self-Efficacy

Welcome!

You are being invited to participate in a research study. Allen Huang of the University of Memphis, Department of Instructional Design and Technology is in charge of the study. He is being guided by Dr. Clif Mims.

The purpose of this research is to explore the experiences of teachers of students with visual impairments (TVI) relating to assistive technology (AT), as well as their AT self-efficacy (i.e., TVIs' belief that they can perform the AT-specific duties necessary to support their students' successful use of AT). You are being invited to participate because you are actively working as a licensed/certified/endorsed TVI in the United States for the 2021-2022 school year.

Should you agree to participate you will be asked to complete a 30-question online survey. Your participation should take less than 15 minutes to complete the survey. Participating in this study is completely voluntary, and if you decide to participate now, you may change your mind and stop at any point. You may choose not to answer any survey question and stop the survey at any time by closing the browser window. There are no foreseeable risks involved in participating in this study other than those encountered in day-to-day life.

You will not be paid for taking part in this study. However, as a participant in this research study, you may directly benefit if you are 1 of 5 participants randomly selected to receive a \$20 gift card (Odds of winning are approximately 1.25%). In order to be eligible to be entered into this drawing you must consent to provide an email address to be contacted at if you are selected.

If you have questions about the research study, you may contact Allen Huang at ahuang1@memphis.edu or 908-400-0170 or Dr. Clif Mims who is supervising this research, at clifmims@memphis.edu or 901-678-5672. If you have questions about your rights as a research subject, please contact the University of Memphis Institutional Review Board at 901-678-2705

ELECTRONIC CONSENT

Please select your choice below. You may print a copy of this consent document for your records.

Clicking on the “Agree” button indicates that you:

- Have read the above information
- Voluntarily agree to participate
- Are 18 years of age or older
- Are licensed/certified/endorsed as a TVI in at least 1 state in the United States (including provisional licenses/emergency waivers)
- Are actively employed and working as a TVI for the 2021-2022 school year

Consent Do you agree to participate in this research study?

Agree (1)

Disagree (2)

Descriptive 1 What is your gender?

Male (1)

Female (2)

Non-binary / third gender (3)

Prefer not to say (4)

Descriptive 2 In which state do you currently serve as a TVI?(If you work in multiple states, select the state in which you provide the most service hours.)

▼ Alabama (1) ... Wyoming (52)

In this section, answer each item as accurately as possible based on your personal experience as a TVI.

Q1 What is your age?

(Enter a specific number using numerals)

Q2 How many years of experience do you have as a TVI?

(Enter a specific number using numerals. Enter 0 if you are in your first year of teaching as a TVI)

Q3 Did you receive university training to become a TVI?

(“Full-time” is defined as having a full course load and not working during your training. “Part-time” is defined as having a course load such that you may have worked during your training. A “degree” refers to a Bachelor’s, Master’s, or Doctoral degree. A “certificate” refers to a credential awarded for taking specialized set of relevant coursework with fewer total credit hours than a degree)

- Yes - Attended full-time and earned a degree (1)
 - Yes - Attended full-time and earned a certificate (2)
 - Yes - Attended part-time and earned a degree (3)
 - Yes - Attended part-time and earned a certificate (4)
 - Currently enrolled in a university training program to earn a degree (5)
 - Currently enrolled in a university training program to earn a certificate (6)
 - No, I did not receive university training to become a TVI (7)
-

Q4 What was your path to full TVI licensure?

("Licensure" refers to any license, certification, or endorsement required and managed by a state. A "provisional license" is an emergency waiver that allows an individual to work in a certain role prior to meeting all the requirements for full licensure, often due to a shortage of qualified individuals.)

I completed a university training program and then met my state's licensure requirements.

I did not work as a TVI during my university training. (1)

I worked as a TVI under a provisional license while enrolled in a university training program. I completed the program and then met my state's licensure requirements. (2)

I am working as a TVI under a provisional license and am enrolled in a university training program. I will complete my program and then meet my state's licensure requirements. (3)

I met my state's licensure requirements without participation in a university training program (e.g., took a Praxis ® or similar test only) (4)

Other (Please describe) (5)

Q5 How was vision-specific assistive technology (AT) content like specific concepts, devices, skills, and instructional strategies presented during your university training program?

- In a VI course dedicated to vision-specific AT content (1)
 - In a VI course that was not dedicated solely to vision-specific AT (2)
 - Across several courses throughout the program that were not dedicated solely to vision-specific AT content (3)
 - In a non-VI course (e.g., general AT course that included vision-specific AT) (4)
 - Not addressed in any coursework throughout the program (5)
-

Q6 Prior to the COVID-19 pandemic (before March 2020), how would you rate the availability of AT-specific professional development opportunities for you to attend, in-person or online?

- Many opportunities (1)
 - Some opportunities (2)
 - Very few opportunities (3)
 - No opportunities (4)
 - Not applicable - I was not a TVI at that time (5)
-

Q7 During the 2021-2022 school year, how would you rate the availability of AT-specific professional development opportunities for you to attend, in-person or online?

- Many opportunities (1)
 - Some opportunities (2)
 - Very few opportunities (3)
 - No opportunities (4)
-

Q8 If you attended an AT-specific professional development opportunity (in-person or online) during the 2021-2022 school year, how did you make time to attend the training?

(If multiple response options apply, select the method you are mostly like use in the future)

- I adjusted my schedule (no leave taken or required to be taken) (1)
- I took professional development leave time (2)
- I took personal leave time (3)
- I did not attend any AT professional development opportunities (4)
- Other (5) _____

Q9 For the 2021-2022 school year, which service delivery model best describes how you spend most of your time as a TVI?

- Itinerant TVI (1)
- Resource room TVI (2)
- TVI in school for the blind (3)
- Other (4) _____

Q10 How many TVI's other than yourself work in your district?
(Enter a specific number using numerals)

Q11 For the 2021-2022 school year, what percentage of your total weekly service time with students is spent providing AT instruction and supports?
(Select the option that most closely matches your experience)

- 81-100% of my weekly service time (1)
 - 61-80% of my weekly service time (2)
 - 41-60% of my weekly service time (3)
 - 21-40% of my weekly service time (4)
 - 0-20% of my weekly service time (5)
-

Q12 How readily can you have new AT solutions (e.g., devices and software) purchased to trial and use with students?

- Always (1)
- Usually (2)
- Occasionally (3)
- Rarely (4)
- Never (5)

This section of the survey is designed to gain a better understanding of the kinds of tasks and skills related to assistive technology (AT) that create difficulties for TVIs. For the following items, AT is defined as high-tech vision-specific devices and software used by individuals who are blind or visually impaired to achieve improved access to their educational environment. Please indicate how strongly you agree or disagree with the following statements regarding AT tasks or skills.

Q1 I can identify a broad spectrum of AT in the field of visual impairments.

- 1 Strongly Disagree (1)
 - 2 Moderately Disagree (2)
 - 3 Disagree Slightly (3)
 - 4 Agree Slightly (4)
 - 5 Moderately Agree (5)
 - 6 Strongly Agree (6)
-

Q2 I can use a variety of AT assessment strategies for determining my students' needs.

1 Strongly Disagree (1)

2 Moderately Disagree (2)

3 Disagree Slightly (3)

4 Agree Slightly (4)

5 Moderately Agree (5)

6 Strongly Agree (6)

Q3 I can identify AT that is appropriate for my students.

- 1 Strongly Disagree (1)
 - 2 Moderately Disagree (2)
 - 3 Disagree Slightly (3)
 - 4 Agree Slightly (4)
 - 5 Moderately Agree (5)
 - 6 Strongly Agree (6)
-

Q4 I can search for alternative AT if the set of AT I am familiar with does not meet my student's needs.

- 1 Strongly Disagree (1)
- 2 Moderately Disagree (2)
- 3 Disagree Slightly (3)
- 4 Agree Slightly (4)
- 5 Moderately Agree (5)
- 6 Strongly Agree (6)

Q5 I am able to access AT experts to support my AT decision making.

1 Strongly Disagree (1)

2 Moderately Disagree (2)

3 Disagree Slightly (3)

4 Agree Slightly (4)

5 Moderately Agree (5)

6 Strongly Agree (6)

Q6 I am able to access AT professional development opportunities to support my AT decision making.

1 Strongly Disagree (1)

2 Moderately Disagree (2)

3 Disagree Slightly (3)

4 Agree Slightly (4)

5 Moderately Agree (5)

6 Strongly Agree (6)

Q7 I know how to procure AT that I have determined appropriate for my students.

- 1 Strongly Disagree (1)
 - 2 Moderately Disagree (2)
 - 3 Disagree Slightly (3)
 - 4 Agree Slightly (4)
 - 5 Moderately Agree (5)
 - 6 Strongly Agree (6)
-

Q8 I can advocate to my supervisors for the purchasing of AT appropriate for my students.

- 1 Strongly Disagree (1)
- 2 Moderately Disagree (2)
- 3 Disagree Slightly (3)
- 4 Agree Slightly (4)
- 5 Moderately Agree (5)
- 6 Strongly Agree (6)

Q9 I can use my students' AT.

1 Strongly Disagree (1)

2 Moderately Disagree (2)

3 Disagree Slightly (3)

4 Agree Slightly (4)

5 Moderately Agree (5)

6 Strongly Agree (6)

Q10 I can teach new AT skills to my students.

- 1 Strongly Disagree (1)
 - 2 Moderately Disagree (2)
 - 3 Disagree Slightly (3)
 - 4 Agree Slightly (4)
 - 5 Moderately Agree (5)
 - 6 Strongly Agree (6)
-

Q11 I can gauge student mastery of AT I have taught.

- 1 Strongly Disagree (1)
 - 2 Moderately Disagree (2)
 - 3 Disagree Slightly (3)
 - 4 Agree Slightly (4)
 - 5 Moderately Agree (5)
 - 6 Strongly Agree (6)
-

Q12 I can troubleshoot AT issues my students experience.

1 Strongly Disagree (1)

2 Moderately Disagree (2)

3 Disagree Slightly (3)

4 Agree Slightly (4)

5 Moderately Agree (5)

6 Strongly Agree (6)

Q13 I can quickly learn about a specific type of AT.

- 1 Strongly Disagree (1)
 - 2 Moderately Disagree (2)
 - 3 Disagree Slightly (3)
 - 4 Agree Slightly (4)
 - 5 Moderately Agree (5)
 - 6 Strongly Agree (6)
-

Q14 I can generalize the use AT for a variety of tasks and applications.

- 1 Strongly Disagree (1)
 - 2 Moderately Disagree (2)
 - 3 Disagree Slightly (3)
 - 4 Agree Slightly (4)
 - 5 Moderately Agree (5)
 - 6 Strongly Agree (6)
-

Q15 I can implement AT in my students' classes.

- 1 Strongly Disagree (1)
 - 2 Moderately Disagree (2)
 - 3 Disagree Slightly (3)
 - 4 Agree Slightly (4)
 - 5 Moderately Agree (5)
 - 6 Strongly Agree (6)
-

Q16 I can help other teachers understand proper applications of AT.

- 1 Strongly Disagree (1)
- 2 Moderately Disagree (2)
- 3 Disagree Slightly (3)
- 4 Agree Slightly (4)
- 5 Moderately Agree (5)
- 6 Strongly Agree (6)

Please provide any additional comments you have regarding your AT-related TVI experiences and how you believe they have influenced your ability to teach and support AT with your students.

Thank you! You have completed the survey. At this time, you may choose to enter yourself into a random drawing for one of five \$20 gift cards. In order to enter the drawing, you must be willing to provide an email address that will be used to contact you if you are selected. There is no way for your email address to be linked with your specific survey responses.

If you would like to enter the drawing, select the link labeled "Enter Drawing" below, and you will be taken to a separate form outside of Qualtrics where you can provide your email address. Once completed, or if you are not interested in entering the drawing, select the "Next" arrow at the bottom right of the screen to complete the survey.

[Enter Drawing](#)

Appendix C



Institutional Review Board
Division of Research and Innovation
Office of Research Compliance
University of Memphis
315 Admin Bldg
Memphis, TN 38152-3370

March 15, 2022

PI Name: Allen Huang

Co-Investigators:

Advisor and/or Co-PI: Clif Mims, Craig Shepherd

Submission Type: Initial

Title: PREDICTING ASSISTIVE TECHNOLOGY SELF-EFFICACY IN TEACHERS OF STUDENTS
WITH VISUAL IMPAIRMENTS

IRB ID: #PRO-FY2022-295

Exempt Approval: March 15, 2022

The University of Memphis Institutional Review Board, FWA00006815, has reviewed your submission in accordance with all applicable statuses and regulations as well as ethical principles.

Approval of this project is given with the following obligations:

1. When the project is finished a completion submission is required
2. Any changes to the approved protocol requires board approval prior to implementation
3. When necessary submit an incident/adverse events for board review
4. Human subjects training is required every 2 years and is to be kept current at citiprogram.org.

For any additional questions or concerns please contact us at irb@memphis.edu or 901.678.2705

Thank you,

James P. Whelan, Ph.D.

Institutional Review Board Chair

The University of Memphis.