Preparing Teachers to Provide Struggling Readers with Access to the Content Area Curriculum Using Technology

BY

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Abstract

Reading is the foundation of all learning, but explicit reading instruction declines after fourth grade (Guthrie & Davis, 2003). A struggling reader will falter in grasping the content area curriculum, impeding yearly progress and widening the achievement gap (Dell et al., 2016; Edyburn, 2015). Therefore, preservice teachers need explicit guidance for improving struggling readers' content literacy skills. Compensatory reading tools are available to assist struggling readers (Dell et al., 2016; MacArthur, Ferretti, Okolo, & Cavalier, 2001); however, little research examines general educators' use of assistive technology to support diverse learners. The research is particularly weak in examining the intersection of general educators using assistive technology to support struggling readers.

To address this need, a self-guided online course module was developed incorporating the principles of universal design for learning and hosted on Nearpod with a companion website designed in Wix. Situated within the frameworks of transformational learning (Mezirow, 1997) and self-efficacy (Bandura, 1986) this design-based research study was designed to determine the extent to which engagement with a self-guided online course module increased preservice teachers' sense of efficacy and competence at improving struggling readers' skills using assistive technology. Using mixed methods, the study examined how the participants reported their sense of efficacy in assisting struggling readers' access to the content area curriculum, how they expressed their knowledge and attitudes concerning use of assistive technology, and if they demonstrated competence using, integrating, and evaluating use of assistive technology to assist students who struggle with reading in the content areas.

Thirty-eight preservice teachers enrolled in an elementary education literacy methods course engaged with the course module over a four-week period. Key data collection methods included pre- and post-intervention surveys, open-ended journal responses, discussion board posts, section exit tickets, and a final course assessment. The overall findings demonstrate that study participants expressed an improved sense of efficacy towards working with struggling readers and demonstrated competence using and recommending a range of assistive technology tools to support diverse learners reading needs in the content area curriculum.

Keywords: assistive technology, content area literacy, preservice teachers, self-efficacy, transformative learning.

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Table of Contents

LIST OF TABLES

List of Figures

CHAPTER I

Introduction

Preparing Teachers to Provide Struggling Readers with Access to the Content Area Curriculum Using Technology

Reflective of the nation's changing demographics (U.S. Department of Education, 2016, 2018) and education policy (Cortiella, 2006; Every Student Succeeds Act, 2015; No Child Left Behind Act of 2001, 2002), today's inclusive classroom demands general[1] education teachers be skilled at meeting the needs of diverse students, encompassing language, culture, and disability. Prior to the *Education for All Handicapped Children Act* in 1975, it was rare for students with disabilities to be educated alongside typically developing peers. The landmark law guaranteed all school-aged children a free and appropriate education in the least restrictive environment (Individuals with Disabilities Education Improvement Act, 2004). Renamed the *Individuals with Disabilities Education Act* (IDEA), the 1997 and 2004 reauthorizations added requirements that influence teacher preparation: general education teachers must be included on the individual education program (IEP) team, students with disabilities must participate in standardized assessments, and assistive technology must be considered in the IEP (Individuals with Disabilities Education Improvement Act, 2004). Nearly a million public school students received special education services in 2017, and the majority spent at least 80% of the day in general education classrooms (U.S. Department of Education, National Center for Education Statistics, 2018).

[1] *Regular education* and *general education* synonymously describe what a typically developing student is expected to learn at each grade level. However, *general education* is preferred for its more positive connotation (Webster, 2017) and will be used throughout this study.

Subsequent federal mandates—No Child Left Behind (2002) and its successor, Every Student Succeeds Act (2015)—tie school funding and teacher evaluation to student performance as measured by achievement on standardized tests (Bush, 2001; Cortiella, 2006; Every Student Succeeds Act, 2015), such as New Jersey Student Learning Assessments (NJSLA) (New Jersey Department of Education, 2019). Ninety-five percent of all students, including those with disabilities, are required to participate in standardized testing (National Center for Fair & Open Testing, 2017). The assessment outcomes influence school funding and teacher retention (Cortiella, 2006; Every Student Succeeds Act, 2015; No Child Left Behind Act of 2001, 2002; Wright, 2005). Thus, federal laws have increased the stakes for general education teachers to meet the needs of diverse student populations in inclusive environments (McCray & McHatton, 2011; McTighe & Brown, 2005).

Teacher preparation programs must prepare candidates for the current classroom climate. General and special education teachers must be equally skilled at differentiating instruction to meet diverse learners' needs. The standards that guide teacher preparation program development, set forth by the Council for Accreditation of Educator Preparation, compel the inclusion of all students. Standard 4 requires that preservice teachers are proficient at designing, implementing, and assessing curriculum experiences for diverse students, "based on ethnicity, race, socioeconomic status, gender, *exceptionalities* [emphasis added], language, religion, sexual orientation, and geographical area" (Gollnick, 2011, p. 2). The standard emerged from research showing that preservice teachers are ill-equipped to teach a diverse student population (NCATE, 2014). Therefore, teacher preparation programs must enhance preservice teachers' pedagogical practices to support student learning in an inclusive classroom.

Diverse learners' needs are numerous and varied; yet, reading is the foundation of all learning. Students struggling to read on grade level flounder in their academic achievement (Dell et al., 2016) hindering their progress as they advance through school and widening the achievement gap (Edyburn, 2015). These difficulties can adversely impact teachers' perception of efficacy, especially when students with disabilities perform poorly on standardized assessments. Considering in 2017, 90% of eighth grade students with disabilities scored below proficient on standardized reading tests with 61% scoring below basic (U.S. Department of Education, 2018), it is essential to increase teachers' abilities to support struggling readers. There is a range of compensatory technology[2] tools widely available to assist struggling readers, (Dell et al., 2016; MacArthur, Ferretti, Okolo, & Cavalier, 2001), but general education teachers are not yet prepared to embed technology into their classrooms (Hutchison, 2012; Hutchison & Reinking, 2010). Only a few special education teacher preparation programs offer assistive technology courses (Judge & Simms, 2009).

To be successful in teaching diverse learners, a teacher must have confidence in her skills. Much research considers self-efficacy's contribution to preservice teachers' success and perseverance in teaching (Durgunoglu & Hughes, 2010; Gibson & Dembo, 1984; Skaalvik & Skaalvik, 2007; Soodak & Podell, 1997; Tschannen-Moran & Hoy, 2007). Given that there is a correlation between preservice teachers' level of self-efficacy and student outcomes (Evans & Tribble, 1986; Ross, 1992; Soodak & Podell, 1997; Tschannen-Moran & Woolfolk Hoy, 2001), sense of efficacy is a crucial component to consider when exploring teacher preparation enhancement. Teacher efficacy contributes to student success; therefore, teachers must have

[2] This study addresses assistive technology—supports that facilitate students' access to the curriculum content. It differs from educational or instructional technologies that convey content (e.g., word processing software, educational games, etc.).

confidence in their abilities to influence the success of all learners (Carlson, Lee, & Schroll, 2004; Durgunoglu & Hughes, 2010; Ross, 1992; Skaalvik & Skaalvik, 2007; Soodak & Podell, 1997; Tschannen-Moran & Woolfolk Hoy, 2001). Comparatively, teachers' attitudes and perceptions towards technology use influence both the teachers' willingness to embed technology in pedagogical practices and students' attitudes regarding it. Simply said, a teacher with high confidence and ability in integrating technology is more likely to support students' use (Bitner & Bitner, 2002).

Problem Statement

Progress towards preparing preservice teachers to teach in inclusive settings has been made over the last two decades by teacher preparation programs offering introductory courses on inclusion and characteristics of students with disabilities (Allday, Neilsen-Gatti, & Hudson, 2013; Harvey, Yssel, Bauserman, & Merbler, 2010; Pugach & Blanton, 2012; Turner, 2003). However, without required courses on methods for teaching students with disabilities (Kennedy, Hart, & Kellems, 2011), preservice teachers report feeling underprepared with a low sense of efficacy towards teaching the range of students they are held accountable for educating (Buell, Hallam, Gamel-McCormick, & Scheer, 1999; Hastings & Oakford, 2003; Lombardi & Hunka, 2001; McCray & McHatton, 2011; Soodak & Podell, 1997). Furthermore, preservice teachers do not view teaching students with disabilities as their responsibility (Boling, 2007). Such perceptions are problematic given that teachers' beliefs about their teaching abilities impact students' performance (Florian, Young, & Rouse, 2010; Sanders & Rivers, 1996).

A review of teacher preparation requirements at this study's site revealed requirements consistent with national trends. At the institution where this study occurred, general education teacher preparation focuses on whole-class methods courses whereas special education teacher

preparation coursework is student-centered (Brownell, Ross, Colón, & McCallum, 2005; Farr, 2019). As Buckley (2005) observed after studying middle school inclusive social studies teachers, "Regular education teachers tend to plan globally rather than focusing on individuals" (p. 176). However, rapidly changing classroom demographics and teacher accountability regulations mean that general education teachers are now responsible for educating diverse students (McCray & McHatton, 2011; Shippen, Crites, Houchins, Ramsey, & Simon, 2005). Therefore, general education teacher preparation programs need to incorporate inclusive teaching methods into required coursework. Stringency of state certification requirements prevent the addition of courses; instead, content must be embedded in currently required coursework (Kennedy et al., 2011; McCray & McHatton, 2011).

Preservice teachers' college coursework and field experiences inform the attitudes they carry into their teaching careers (Hastings & Oakford, 2003); therefore, embedding strategies for including diverse learners is an essential element of teacher preparation coursework (Kavale, 2007). Preservice teachers will be challenged to differentiate instruction in their classrooms; therefore, they need opportunities to learn during their teacher preparation coursework. Given the likelihood of being responsible for educating struggling readers, this study focuses on integrating assistive technology to provide access to content area (e.g., science, social studies, and mathematics) curriculum. The intent is to increase preservice teachers' sense of efficacy and competence at improving struggling readers' access by engaging with a course module[3]. The study pertains to preservice teachers who are seeking elementary certification and specifically addresses students grades four through eight—the population of students for whom learning ability is directly correlated to content area literacy skills (Zorfass, Fideler, Clay, & Brann,

[3] Strict state requirements mean that general education teacher preparation programs are at capacity (Kennedy et al., 2011; McCray & McHatton, 2011) so requiring an additional course is not feasible.

2007). It is anticipated that the intervention module will provide the context for enhancing teacher education to increase preservice teacher self-efficacy, and by extension, their willingness, enjoyment, and effectiveness at teaching learners with diverse needs in an inclusive, welcoming environment.

Definition of Terms

Diverse Learners

The study's intent is to improve preservice teachers' decision-making abilities to support the range of student abilities they should expect to encounter in a general education classroom. The term 'diverse learner' is used to describe "students from racially, ethnically, culturally, and linguistically diverse families, [those from] communities of lower socioeconomic status" (Saravia-Shore, 2008, p. 42), and students with disabilities, as defined by the Americans with Disabilities Act and IDEA (Americans with Disabilities Act of 1990, 1990; Individuals with Disabilities Education Act of 2004, 2004). In this study, 'inclusive classroom' acknowledges the ever-changing education landscape where the 'typical' classroom comprises diverse learners and students with disabilities

Struggling Readers

Reading development occurs over six stages; this study pertains to stages three to five—"the 'reading to learn' stages when texts become more varied, complex, and challenging linguistically and cognitively" (Chall & Jacobs, 2003, p. 14). The introductory module offers preservice teachers tools and strategies to improve outcomes for students whose reading abilities are below grade level. As Alvermann (2002) aptly recognizes, "The struggling reader label is a contested term and one that means different things to different people. It is sometimes used to refer to youth with clinically diagnosed reading disabilities as well as to those who are English

language learners (ELLs), 'at-risk,' underachieving, unmotivated, disenchanted, or generally unsuccessful in school literacy tasks that involve print-based texts" (Alvermann, 2002, p. 195). This study seeks to boost preservice teachers' sense of efficacy and ability to improve the skills of students who "are thought to be achieving below their 'full potential' as readers" (Alvermann, 2002, p. 195). The term, while imperfect, will be used throughout the study to refer to those whose reading skills preclude their full acquisition of content matter.

Assistive Technology

Several terms describe technology use in the classroom: educational technology, instructional technology, information technology, and assistive technology. In this study, the term *assistive technology* is used as it succinctly describes a student-centered approach to technology implementation. To paraphrase IDEA, assistive technology is both devices and services used to help students with disabilities access the curriculum and participate in the least restrictive environment (Individuals with Disabilities Education Act of 2004, 2004). This study expands the definition to include diverse learners, as defined above; it is not restricted to only those students who receive services under a 504 plan or Individualized Education Plan (IEP).

Research Questions

This design-based research study examines the extent to which a self-guided course module improves general education preservice teachers' experience making decisions to support struggling readers' access to the content area curriculum. I hypothesized that the intervention will increase participants' awareness and knowledge of assistive technology to support struggling readers. The module's exercises are intended to reduce the experience barrier (Flanagan, Bouck, & Richardson, 2013); that is, by increasing knowledge of and confidence in using assistive technology, preservice teachers are more likely to regularly integrate it into

pedagogical practice. The study investigates the following research questions: (1) To what extent does engagement with a self-guided course module influence preservice teachers' conceptions regarding their abilities to assist struggling readers access the content area curriculum? Sub-questions are: a) How do preservice teachers report their sense of efficacy in assisting struggling readers' access to the content area curriculum? How does engaging with the module impact this? (2) How do preservice teachers express their knowledge and attitudes concerning use of assistive technology, and what changes are evident after engaging with the module? (3) After completing the module, do preservice teachers demonstrate competence using, integrating, and evaluating use of assistive technology to assist students who struggle with reading in the content area curriculum?

Theoretical Frameworks

This study situates preservice teachers experiences within the theories of transformational learning (Mezirow, 1997, 2009) and self-efficacy (Bandura, 1977, 1986, 1997). Experiences can change beliefs (Mezirow, 1997; Ukpokodu, 2009); therefore, providing experiences that foster transformative learning can influence preservice teachers' beliefs and practice towards including diverse learners in the general education classroom.

Transformational Learning

Transformational learning occurs when learners change their "frames of reference through critical reflection on the assumptions upon which [their] interpretations, beliefs, and habits of mind or points of view are based" (Mezirow, 1997, p. 7). Frames of reference are a learner's preconceived notions that are reified as habits of mind, an abstract way of thinking influenced by culture and upbringing, and articulated in a point of view—how the habit of mind is interpreted and shared. They drive decisions and action, and ideas that do not conform to

frames of references are dismissed. However, given experiences that prompt reflection, points of view can be altered (Mezirow, 1997). Mezirow (1997, 2000, 2009) outline stages by which learners progress through transformative learning experiences: critical examination of one's values, beliefs, and understanding; exploration of alternatives to one's perspective; acquisition of new knowledge and skills; practice of new roles; and decision-making based on the revised viewpoints. The stages represent three themes: learning through experiences, critical reflection, and discourse (Brown, 2006; Mezirow, 1990). Combined, they challenge a learner to reconsider preconceived notions and biases, and engage in a "process by learning how to think critically for themselves rather than take assumptions supporting a point of view for granted" (Mezirow, 2009, p. 103).

It is essential for teacher educators to create spaces in which preservice teachers can evaluate, adjust, and refine their frames of reference to become more "empathic and open to other perspectives" (Mezirow, 1997, p. 10). The learning environment must create opportunities for the learner to identify and challenge her preconceived frames of reference and habits of mind. It must guide the learner to engage in discourse and critical reflection; otherwise, the learner will reject that which does not fit her schema (Mezirow, 2009). Experiences with critical reflection and role exploration have led to transformational learning experiences among college business students (Brock, 2010), preservice teachers involved in service learning projects (Carrington & Selva, 2010; Goldberg, McCormick Richburg, & Wood, 2006), preservice teachers learning about social studies pedagogy (Ukpokodu, 2009), and nursing students (Plotnikoff, Hugo, & Casey, 2001). Each study revealed that explicit opportunities for reflection, discussion, and skill development fostered transformative learning.

Teacher Efficacy

An increased sense of teacher efficacy positively influences student outcomes (Sanders & Rivers, 1996). Creating opportunities for transformative learning can provide preservice teachers with an increased sense of efficacy towards teaching unfamiliar populations of students. Self-efficacy emerged from Bandura's social cognitive theory (1986), which delineates the symbiotic relationship between an individual's behavior, thinking, and environment. One's self-efficacy level determines an individual's reaction and likelihood to persevere when faced with adversity (Bandura, 1977, 1986, 1997). Bandura (1977, 1986, 1997) posited there are four areas that contribute to self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, emotional and physiological states. Awareness of and engaging in specific endeavors to enhance these factors can increase a teacher's self-efficacy and hence positively impact student outcomes. Self-efficacy contributes to teacher efficacy, which is the teacher's sense of the degree to which she can impart change in the classroom (Goddard, Hoy, & Hoy, 2000; Knoblauch & Hoy, 2008; Soodak & Podell, 1997). Teachers' perceptions of their skills impact their performance in the classroom (Carlson, Lee, & Schroll, 2004; Durgunoglu & Hughes, 2010; Ross, 1992; Skaalvik & Skaalvik, 2007; Soodak & Podell, 1997; Tschannen-Moran & Woolfolk Hoy, 2001). Teachers with higher self-efficacy are more likely to persevere, stick with challenging students, remain in the profession, and set higher goals (Pendergast, Garvis, & Keogh, 2011; Skaalvik & Skaalvik, 2007; Soodak & Podell, 1997; Tschannen-Moran & Woolfolk Hoy, 2001).

General education teachers have indicated lower self-efficacy towards working with students with disabilities than special educators (Buell et al., 1999). Teachers with a low sense of efficacy are pessimistic about diverse learners' success, less motivated to assist diverse learners, and more likely to resign than counterparts with high teacher efficacy (Woolfolk, Rosoff, & Hoy,

1990). Therefore, to improve outcomes for diverse learners in the general education classroom, it is essential to transform preservice teachers' way of thinking about inclusion.

Engaging in transformative learning experiences will bolster general education preservice teachers' sense of efficacy towards inclusion. This, in turn, will enhance their abilities to work with students with disabilities/diverse learners (Jung, 2007; Shippen et al., 2005). Coursework and field experiences tailored to teaching students with disabilities improve preservice teachers' dispositions and self-efficacy (Buell et al., 1999; Jung, 2007; Kim, 2011; Shippen et al., 2005). Shippen et al. (2005) concluded, "an introductory course in exceptionality significantly changed the attitudes of both future general and future special educators" (p. 97). Furthermore, the study indicated that preservice teachers' anxiety levels decreased and receptivity levels towards working with students with disabilities increased as a result of their transformative learning experience (Shippen et al., 2005).

Teacher efficacy is influenced by participation in training; experiences in unfamiliar situations, such as inclusive classrooms, can improve a teacher's attitudes towards the situation and thereby increase her sense of efficacy (Soodak & Podell, 1997; Weisel & Dror, 2006). Beginning teachers feel overwhelmed (McKay, 2016), so it is critical to influence preservice teachers' perceptions of diverse learners during coursework to improve their sense of efficacy which impacts student success (Lago-Delello, 1998).

CHAPTER II

Literature Review

The review of the literature revealed studies on three pertinent topics: effects of low teacher efficacy due to inadequate understanding of student characteristics, lack of knowledge and training on supporting struggling readers, and inexperience making decisions to effectively embed assistive technology tools and strategies. Examination of studies in these areas establishes the need for the proposed intervention.

Sense of Efficacy Working with Diverse Learners

Self-efficacy, a facet of social cognitive theory, is an individual's belief in his ability to succeed; one's sense of efficacy contributes to one's reaction and likelihood to persevere when faced with adversity (Bandura, 1977, 1986, 1997). Bandura asserted that experiences in four areas contribute to self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, and emotional and physiological states. Mastery experiences (e.g., coursework), provide space for an individual to gain competence in new skills. Vicarious experiences are those in which an individual learns by watching another (e.g., mentor teacher). Gaining confidence through verbal persuasion occurs when others (e.g., professors, peers, mentor teachers) encourage one's success. Finally, emotional and physiological states influence sense of efficacy. Apprehension, or conversely, certainty, impacts one's conception of ability. Combined, these factors influence beliefs in capabilities. Awareness of and engaging in positive endeavors to enhance a teacher's self-efficacy will positively impact student outcomes. This is known as teacher efficacy; that is, a teacher with strong confidence in her ability to influence and motivate her students will be more apt to bolster her students' successes (Goddard, Hoy, & Hoy, 2000; Hoy & Spero, 2005). By contrast, a teacher hesitant in her teaching ability or doubtful of her role in influencing positive

student outcomes will have students who are more likely to falter (Soodak & Podell, 1997; Tschannen-Moran & Woolfolk Hoy, 2001). Teachers with higher self-efficacy are more likely to persevere, remain in the profession, and set higher goals (Pendergast, Garvis, & Keogh, 2011; Skaalvik & Skaalvik, 2007; Tschannen-Moran & Woolfolk Hoy, 2001). Two major themes emerge from the plethora of literature devoted to teachers' self-efficacy: preservice teachers' sense of efficacy and attitude guide their relationship with diverse learners in the classroom, and an emphasis on pedagogical methods appropriate for instructing and assessing diverse learners is essential in coursework and field experiences to increase preservice teachers' sense of efficacy. There is a direct correlation between preservice teachers' levels of self-efficacy, attitude, and student outcomes (Buell et al., 1999; Minor, Onwuegbuzie, Witcher, & James, 2002; Pendergast et al., 2011; Tschannen-Moran & Woolfolk Hoy, 2001). Preservice teachers self-report that effective teachers possess an enthusiasm for teaching and have a student-centered view of instruction. They further acknowledge that gender, culture, and content knowledge influence their beliefs (Minor et al., 2002; Witcher & Onwuegbuzie, 1999). However, there is disagreement over what constitutes 'culture,' 'diversity,' and 'multiculturalism' among preservice teachers (Silverman, 2010). In a small survey of preservice teachers in Georgia, Silverman (2010) explored how preservice teachers make sense of these concepts as they relate to efficacy, teacher responsibility, and advocacy. She concluded that to increase preservice teachers' sense of efficacy towards working with diverse learners, a deeper understanding of what constitutes a diverse learner must be developed.

Working with students with disabilities is included when discussing cultural competence. Similar to working with culturally and linguistically diverse students, coursework and field experiences tailored to teaching students with disabilities improve teachers' dispositions and

self-efficacy (Buell et al., 1999; Jung, 2007; Kim, 2011; Shippen et al., 2005). General education teachers have indicated lower self-efficacy than special educators towards working with students with special needs (Buell et al., 1999). After surveying 289 teachers in Ohio, Buell et al. were dismayed that general educators reported a "lack of confidence in adapting materials and curriculum, managing behavior problems, giving individual assistance, and writing behavioral objectives…[not only because] these are skills critical for successful inclusion, but they are also necessary to effectively teach all students" (Buell et al., 1999, p. 153). While it is crucial to consider that much has changed regarding inclusion since 1995, the study still provides valuable findings. The majority of general education teachers, represented by an impressive 50% response rate, overwhelmingly felt inadequately prepared and without proper resources to instruct students with special needs (Buell et al., 1999). An intervention targeted at improving teacher efficacy working with diverse populations will benefit the elusive 'average' population in addition to those who comprise the diverse learner cohort.

Ten years after Buell et al.'s research, Jung (2007) verified that coursework and field experiences engaging with students with disabilities factor into a preservice teacher's sense of efficacy. He compared sixty-eight freshmen enrolled in a required diversity course to fifty-seven upperclassmen with teaching experience in an inclusive environment (Jung, 2007). Unsurprisingly, the freshman, after a hypothetical experience, reported favorable attitudes towards inclusion. In contrast, the student teachers' self-efficacy diminished after their professional experience, noting that post-field experiences, preservice teachers lack confidence in their capacity to teach students with disabilities. These results mirror Pendergast et al.'s (2011) results that preservice teachers overestimate confidence in working with students with diverse populations. This finding is one that needs further analysis; yet, it supports the notion that

coursework and field experiences influence preservice teachers' sense of self-efficacy, hence offering varied experience in both settings is essential.

Teachers, college faculty, and researchers acknowledge the deficiency of multicultural coursework in general education teacher preparation programs (Kolano, Dávila, Lachance, & Coffey, 2014; Morrier, Irving, Dandy, Dmitriyev, & Ukeje, 2007) despite evidence that teacher efficacy is increased with deep mindfulness of diverse and exceptional students (Busch, 2010; Byrnes, Kiger, & Manning, 1997; Doorn & Schumm, 2013; Flores & Smith, 2009; Lopes-Murphy, 2014). This awareness is best developed through authentic experiences with a diverse population of students (Cherng & Halpin, 2016; Jones, 2002; Kolano et al., 2014). Similarly, that preservice teachers' anxiety levels decreased and receptivity levels towards working with students with disabilities increased (Shippen et al., 2005) indicates that mastery experiences, such as coursework, improve sense of efficacy. A survey of teacher education faculty notes improvements to inclusive education preparation and collaboration since the inception of IDEA, yet it identifies a need to facilitate trans-discipline/major collaboration to align preservice teacher programs with in-service co-teaching expectations (Harvey, Yssel, Bauserman, & Merbler, 2010). Again, careful attention to teacher education coursework is needed to enhance the mastery and vicarious experiences that enhance preservice teachers' sense of self-efficacy.

Lack of Knowledge and Training for Supporting Struggling Readers in the Content Areas

Broadly defined, struggling readers are those who fail to adequately make meaning from grade level text. The term encompasses those who are inaccurate or slow readers, have language processing disorders (e.g., dyslexia) (Washburn, Joshi, & Cantrell, 2011), have problems with comprehending printed text, word recognition and fluency, and show low motivation or interest in reading (Guthrie & Davis, 2003). Inadequate subject matter knowledge and deficient domain

vocabulary further contribute to readers' difficulty within content areas (Chall & Jacobs, 2003). Regardless of whether the impediment to readers' success is related to culture, socioeconomic status, language deficiencies, or cognitive challenges, the potential for falling behind in their studies is the same. Preservice teachers must be taught to help struggling readers gain access to the curriculum to prevent decline in academic achievement.

By fourth grade, students rely on reading to derive meaning from text (Chall & Jacobs, 2003; Gajria, Jitendra, Sood, & Sacks, 2007). Learners who fail to demonstrate established reading skills only continue to lag (Hasselbring & Goin, 2004) because by fourth grade explicit reading strategy instruction declines and is relegated to language arts classes (Guthrie & Davis, 2003). However, reading comprehension remains a challenge for many students in grade four through eight who struggle to derive content through text (Akhondi, Malayeri, & Samad, 2011; Gajria et al., 2007; Guthrie & Davis, 2003). Compounding the problem is that content becomes increasingly more complex and lengthier (Reed & Lynn, 2016). Therefore, underdeveloped reading abilities impede student's academic progress as they move through the grades (Chall & Jacobs, 2003; Edyburn, 2015).

Preservice teachers identify supporting struggling readers as a significant challenge (Duffy & Atkinson, 2001). Therefore, it is essential to strive to improve preservice teachers' effectiveness at enhancing struggling readers' ability to learn from printed text. Duffy and Atkinson's (2001) work emphasizes the need for this proposed research. In their study, they discovered that although preservice teachers completed rigorous reading methods coursework, they expressed feelings of inadequacy towards teaching struggling readers. This attitude prevailed until they received explicit instruction on ways to directly assist struggling readers (Duffy & Atkinson, 2001). Duffy and Atkinson (2001) concurred that preservice teachers' sense

of efficacy was as important as their pedagogical knowledge; they emphasized that preservice teachers are more likely to attempt to engage struggling readers if the preservice teachers believe they are prepared to do so. Comparably, Chambers Cantrell, David Burns, and Callaway (2008) observed that targeted professional development improves content area teachers' perceptions regarding literacy instruction and support. They concluded that their study "demonstrates the need for professional development that addresses students' literacy needs, specifically for students for whom literacy learning is especially difficult" (Chambers Cantrell et al., 2008, p. 91). In establishing the need for their study, Chambers Cantrell, et al. (2008) referenced Greenleaf, Schoenbach, Cziko and Mueller's (2001) research indicating that the remedial approach to content area literacy contributes to low confidence working with struggling readers. Combined, these two studies provide support for the need for the proposed research.

Further corroborating this finding is that efficacy also contributes to the likelihood that a teacher selects a technological option to support struggling readers (Holden & Rada, 2011). If a teacher is unprepared, technological supports will not be offered to the student (Okolo & Diedrich, 2014). Yet, a meta-analysis of special education research (Kavale, 2007) revealed two key findings: teachers' instructional decisions influence achievement of students with disabilities, and 'text enhancement' increases reading comprehension ability of students with disabilities. Instructional strategies that incorporated computer use for text enhancement produced a 40% increase in reading comprehension for students with disabilities (Kavale, 2007). Additionally, Wang, Ertmer, and Newby (2004) showed that engaging preservice teachers through vicarious experiences (e.g., video-based case studies) increased their sense of efficacy towards using technology in the classroom.

Note that this intervention focuses on access to the content area[4] curriculum. The intent is to introduce preservice teachers to technology supports that enable struggling readers to derive content from text. It does not intend to marginalize or replace direct reading instruction. The assistive technology tools will alleviate strain on cognitive load (Sweller, 1994). The tools and strategies will provide ways for struggling readers to improve reading ability when confronted with what Greenleaf, Schoenback, Cziko and Mueller (2001, p. 18) refer to as the 'literacy ceiling': the point at which student success is limited by the ability to construct meaning from printed text.

Evidence-Based Tools

The researcher designed a self-guided online module showcasing evidence-based tools and strategies that incorporate the principles of Universal Design for Learning (Rose & Meyer, 2002) by offering multiple options for information representation, student engagement, and expression. These tools and strategies have been found to be effective at supporting struggling readers using a range of modalities. This section details how evidence-based tools are embedded in the module.

Text-to-speech, that is, audio synchronized with text often supported with highlighting, is one of the earliest technological reading supports. Text-to-speech has been found to have positive outcomes for struggling readers (e.g., Calfee, Chambliss, & Beretz, 1991; Higgins and Raskin, 2004; Leong, 1992; Olson & Wise, 1992; and Wood, Moxley, Tighe, Wagner, 2018). Text-to-speech technology offers immediate text adaptations. "Text adaptations have a far more

[4] A growing field, disciplinary literacy, is related but not specifically addressed by this intervention. Disciplinary literacy (Brozo, Moorman, Meyer, & Stewart, 2013) focuses on skills unique to learning discipline-specific content (e.g., in mathematics or physics). The intervention is intended to introduce general education students to technology tools for reading. The tools and strategies provide broad access. It is beyond the scope of the project to delve into discipline-specific content.

significant impact on student success in the general curriculum than do other adaptations" (Dyck & Pemberton, 2002, p. 28). Dyck and Pemberton (2002) recognized text-to-speech as an option for bypass reading in which the text is read aloud to the student, increasing comprehension, vocabulary skills, and fluency. Hecker, Burns, Katz, Elkind, and Elkind (2002) observed that text-to-speech significantly improved attention to text while decreasing the amount of time students spent reading the same passage. A study of 104 high school students using text-to-speech supports in content area subjects resulted in improved reading fluency, comprehension skills, and vocabulary due to audio-supported text (Stodden, Roberts, Takahashu, Park, & Stodden, 2012). Text-to-speech is particularly beneficial for upper elementary, middle, and high school students who have difficulty with advanced multisyllabic vocabulary (Archer, Gleason, & Vachon, 2003). Robertson (2014) reported on a graduate student's master thesis work wherein students in grades four through six showed improved fluency and comprehension after a six-week period using text-to-speech programs. This study also emphasized the importance of effective teacher training on tool implementation. In the module designed for this study, participants learn where to obtain e-texts (e.g., Project Gutenberg, Bookshare, and Learning Ally) and how to use tools that read on-screen content (e.g., Snap and Read and iOS speak feature).

The module also teaches how to adapt text by decreasing the reading level (Dyck and Pemberton, 2002). This approach is appropriate for students who read well below grade level. It is known as simplifying or adapting the text. Multisyllabic vocabulary is substituted with simpler synonyms, words and paragraphs are shortened, and pictures are sometimes added to aid in comprehension (Browder, Trela, & Jimenez, 2007; Mims, Hudson, & Browder, 2012). Tools such as Newsela, Snap and Read, Rewordify, and Mercury Reader allow teachers and students to

remove distractions and reduce the Lexile reading level (Hudson, Browder, & Wakeman 2013). These tools allow students to read the same content as their peers yet at a level that is appropriate for their skill set (Erickson, Musselwhite, Ziolkowski, 2002; Silver-Pacuilla & Ruedel, 2004).

Zabala (1995) recognized the need to individualize learners' experiences based on strengths, interests, needs, environment, and tasks. Thus, throughout the study module, participants have an opportunity to explore customization of user settings. These include visual settings, such as adjusting font, spacing, color, and highlighting. While some may regard these as personal preferences, changes to visual settings for students who struggle to read may enhance the reading experience. For example, Rello and Baeza-Yates (2016) studied 97 students (48 with dyslexia) and determined "font types have an impact on readability for both people with and without dyslexia" (p. 24). Their work builds on that of O'Brien, Mansfield, and Legge (2005) and Rello, Pielot, and Marcos (2015) who concluded that increased font size improved readability outcomes for readers with dyslexia. Thus, the module encourages participants to try various fonts and sizes, and become familiar with options for altering user settings based on individual student needs (as emphasized by the SETT framework (Zabala, 1995)).

Tools for highlighting, masking, sticky notes, dictionary/thesaurus access, and explanatory hyperlinks are collectively referred to as embedded supports (Anderson-Inman, 2007; Anderson-Inman & Horney, 1997). The module prompts study participants to explore and consider the use of these tools to provide scaffolding (Quintana et al., 2004) and cognitive load reduction (Sweller, 1994). The use of embedded supports further promotes the principles of universal design for learning by offering options for learning through multiple modalities (Rose & Meyer, 2002).

Using graphic organizers, a scaffold for visualizing and organizing information (Hua & Keenan, 2014), improves reading comprehension and focus for students with learning disabilities (Kim, Vaughn, Wanzek, & Wei, 2004; Swanson & Hoskyn, 2001). Dexter and Hughes' (2011) meta-analysis of 16 empirical studies (*N*=808) revealed that upper elementary, middle and high school students show improved comprehension, vocabulary knowledge, and skills drawing inferences when guided to use graphic organizers. They concluded that positive outcomes were observed when students with learning disabilities were given explicit guidance on correctly completing the graphic organizer. Therefore, the module encourages using a graphic organizer tool (i.e., Lucid Chart) and offers graphic organizer templates for participants to use as a study aid.

Closed-captions are another beneficial scaffold included in the module. Numerous studies have indicated that students found using closed captions as a learning aid improved comprehension, information retention, and motivation to stay on task (Bowe & Kaufman, 2001; Linder, 2016; Rickelman, Henk & Layton, 1991; Shea, 2000). The benefit is not limited to students with hearing impairment; rather, students who are English language learners, have low literacy skills, or lack sufficient attention for prolonged focus all benefit from video captions. Turning captions on for all students, for all video presentations, offer an alternative means of representing the information (Burgstahler, 2002). Therefore, the module prompts participants to use captions to see the benefit themselves and make note of them for future use.

Finally, the module encourages use of presentation tools with synthesized speech (i.e.,Voki) to offer alternate means of both information presentation and student expression (Rose & Meyer, 2002). Presentation tools that offer speech synthesis enables teachers to offer content in multiple modalities (e.g., an avatar created in Voki provides spoken prompts to the

student to supplement written instructions). Students can create their own avatars to read aloud written work. In this way, they receive independent audio feedback for editing (MacArthur, 1996; Raskind and Higgins, 1995) and have access to text-to-speech benefits as described above. The module tasks present opportunities for the preservice teachers to explore the features of tools that have been found to be beneficial to supporting struggling readers.

Inexperience Making Decisions to Effectively Embed Assistive Technology

This study proposed that integrating an assistive technology course module in preservice teachers' coursework would contribute to their efficacy and knowledge towards working with struggling readers. IDEA (2004) mandates that assistive technology (AT) be considered for *all* students who receive special education services (Rhodes, 2007). Students with high incidence disabilities (e.g., emotional and/or behavioral disorders, learning disabilities, mild intellectual disabilities, high-functioning autism, attention-deficit hyperactivity disorder, and speech and language impairment) spend a majority of their school day in general education classrooms (Gage, Lierheimer, & Goran, 2012; New Jersey Department of Education, 2017). Therefore, it is imperative for both general and special education teachers to be knowledgeable about using and integrating assistive technology into the curriculum. However, teachers who lack knowledge and awareness of assistive technology tools, services, and the law have limited access to resources and funding, and are unsure how to integrate assistive technology into the curriculum (Benton-Borghi, 2015; Bouck, 2016; Flanagan et al., 2013; Okolo & Diedrich, 2014; Quinn et al., 2009).

This is unsurprising given that teachers generally report challenges to incorporating technology (educational, instructional, and assistive) in their instruction. Hutchison and Reinking's (2010) survey of 1,441 kindergarten through 12th grade literacy teachers showed that a resounding 82% expressed they did not have adequate professional development to integrate

technology, and 89% indicated lack of time was an issue. This survey followed their extensive review of studies, published between 1999 and 2008, identifying challenges to technology use. More recent research indicates that the barriers remain. They include lack of: professional development supporting its integration; time to learn how to operate the technology and integrate its use; support (technical and pedagogical); and access to the technology (Bitner & Bitner, 2002; Cook, Sawyer, & Lee, 2013; Flanagan et al., 2013; Hutchison, 2012; Hutchison & Reinking, 2010; Puckett, Judge, & Brozo, 2009). Harris, Mishra and Koehler (2009) reported that teachers expressed that even when they received instruction on operating the software, they were not given ample instruction or practice on how to embed it into their pedagogical practice. This reinforces assertions Richardson (2002) made that integration is an essential component of successful technological use.

Many of the reviewed studies were dedicated to exploring how general education teachers use technology as an instructional or communication tool (e.g., word processing, email, presentation, and research). Studies that focus on technology as a tool for differentiated instruction tend to limit their sample to special education teachers (e.g., Flanagan et al., 2013; Izzo, Murray, & Novak, 2008; Twyman & Tindal, 2006) or studied students with disabilities without examining the teachers' role (e.g., Elkind, Cohen, & Murray, 1993; Hasselbring & Goin, 2004; Hecker, Burns, Katz, Elkind, & Elkind, 2002; Jeffs, Behrmann, & Bannan-Ritland, 2005; Moorman, Boon, Keller-Bell, Stagliano, & Jeffs, 2010). A few studies were reviewed that examined general education teachers' preparedness for supporting struggling readers without using technology (e.g., McCutchen, Green, Abbott, & Sanders, 2009; Washburn et al., 2011). One study detailed a summer institute acclimating general education teachers to use assistive technology to support content area literacy (Puckett et al., 2009). Despite the passage of time and

technology improvement, researchers noted that assistive technology knowledge and implementation had not progressed as much as one would expect (Benton-Borghi, 2015). Notably, Okolo and Diedrich (2014) observed an inverse relationship between the number of academic research studies conducted to the rate technology is blossoming in schools; academic research on the use of assistive technology in schools, particularly focused on students with high-incidence disabilities, is lacking. This current research was needed to fill this obvious gap.

Flanagan et al. (2013) discovered that while special education teachers recognize assistive technology's effectiveness in building literacy skills, assistive technology tools and services across the continuum (from inexpensive low-tech items to high-tech computer and tablet technology) are not being regularly used with diverse learners. This mirrors Okolo and Diedrick's (2014) findings that the majority of special educators acknowledge that assistive technology can improve access to the curriculum; yet, it is not regularly implemented, particularly with students who are placed in the general education classroom. Bouck's (2016) secondary analysis of the *National Longitudinal Transition Study-2,* which sought to determine assistive technology integration at the secondary level, and Quinn et al.'s (2009) exploration of assistive technology use from kindergarten to high school concluded that students with high-incidence disabilities, who would most benefit from the regular use of the tools and devices in the general education classroom, do not have regular access to assistive technology. While these are only a few examples, each with its own limitations, the researchers overwhelmingly agree that despite an abundance of research demonstrating the effectiveness of supported e-text tools (e.g., text-to-speech, text highlighting, multimedia content, and graphic organizers) for improving reading skills of a range of students with disabilities (e.g., classified with specific learning disability, speech language impairment, and/or ADHD) (Anderson-Inman, 2009;

Elkind, Black, & Murray, 1996; Floyd & Judge, 2012; Hecker et al., 2002; Moorman et al., 2010; Stodden, Roberts, Takahashi, Park, & Stodden, 2012), assistive technology use in the general education classroom is lacking. This underutilization is due to lack of knowledge, skills, and ability to embed assistive technology into the curriculum (Bouck, 2016; Flanagan et al., 2013; Okolo & Diedrich, 2014; Quinn et al., 2009) and poor teacher preparation education (Judge & Simms, 2009; Naraian & Surabian, 2014; Van Laarhoven et al., 2008). As a result, a majority of students with diverse needs are not receiving the services they are legally entitled.

Preservice teacher perception of efficacy and knowledge of assistive technology contribute to promoting a learning environment conducive to meeting the needs of all learners, particularly in gaining access to the content area curriculum through strong reading comprehension skills. Duffy (1998) concluded that, "The key to developing inspired teachers lies in instilling belief in themselves and in their ability to decide how best to promote the visions they have for their students" (p. 780). Interaction with a course module promoting the use of assistive technology with diverse students contributes a path to this success. It is anticipated that preservice teachers participating in this study will emerge with an enhanced sense of efficacy and refined skills at integrating assistive technology to promote learning among struggling readers.

Research Gap

Much research has examined the causal relationship between teachers' sense of efficacy and pedagogical knowledge as well as how special education teachers interact with assistive technology. However, little research examines general educators' use of assistive technology to support diverse learners. The research is particularly weak in examining the intersection of general educators using assistive technology to support struggling readers. Therefore, the study addresses this gap in the research.

Design Conjecture

The high-level conjecture of this design-based research study is that challenging one's beliefs and assumptions, developing knowledge and skills, and forming new perspectives is essential to fostering transformative learning and enhancing preservice teachers' sense of efficacy. Combined, the embodiments will address three challenges preservice teachers have in supporting struggling readers in the content area curriculum: 1) inadequate understanding of student characteristics, 2) lack of knowledge of tools and strategies to assist struggling readers, and 3) inexperience making decisions embedding tools and strategies to support struggling readers. This introductory design is constrained to students who struggle with content area literacy in grades four through eight and focuses on tools for making meaning from printed text.

Embodiments

Transformative learning occurs when learners[5] engage with interactive, learner-centered designs (Ukopodu, 2009). Thus, the conjecture will be reified in several embodiments that support experiences, reflection, and discourse. The tools and materials include simulations, video testimonials and demonstrations, and hands-on exploration. The task and participant structures involve discussion board postings and self-reflection through journal responses.

Challenging Beliefs and Assumptions

To bolster their sense of efficacy towards working with diverse learners, preservice teachers must analyze their preconceived notions (Silverman, 2010). Simulations and observations of best practices will provide preservice teachers with mastery and vicarious experiences needed to challenge their pre-existing understandings and enhance their sense of

[5] The term "learner(s)" in the method and data sections refer to the preservice teachers who are participating in the study and interacting with the self-guided course module. This term is not to be confused with the 'diverse learners' that the preservice teachers are working to assist.

efficacy (Bandura, 1986, 1997) and promote progress through the stages of transformative learning.

Simulated Experiences. Experience in real-life situations, whether in person or online, contributes to transformative learning (Plotnikoff, Hugo, & Casey, 2001). Experiences simulating what it is like to be a diverse learner will act as a 'disorienting dilemma' which sparks transformative learning (Mezirow, 2000). Learners "are unlikely to reconsider their deeply held beliefs and unconscious assumptions unless these are deliberately confronted and challenged" (McDiarmid & Price, 1990, in Garmon, 2005, p. 283). Placing the preservice teacher in the role of a learner will challenge preconceived notions of diverse learner's characteristics and experiences. These preconceptions likely include that the diverse learner is not trying hard enough or is not capable of doing the work (Shade & Stewart, 2001). It is anticipated that participating in a simulated experience (Bandura, 1986, 1997) that puts the learner in the diverse learners' shoes will broaden her viewpoint, create a sense of empathy (Palmer & Menard-Warwick, 2012), and promote a more positive attitude towards teaching diverse learners.

Observe Demonstrations of Best Practice. Another embodiment to challenge beliefs and assumptions is to observe examples of best practice. It occurs in two forms: one providing mastery experiences via enhanced podcasts and the other presenting vicarious experiences through video modeling (Van Laarhoven et al., 2008). Known as content acquisition podcasts (CAP), these multimedia instructional materials teach about strategies and tools for differentiating instruction (Kennedy, Alves, & Rodgers, 2015; Kennedy, Hart, & Kellems, 2011). The podcasts provided the content needed for the learner to consider new ways to approach teaching diverse learners. Video testimonials teach about using tools and strategies to support content area literacy in inclusive classrooms. These design elements promoted the increase of

self-efficacy and the "exploration of options for new roles, relationships, and actions" (Mezirow, 2000, p. 22) that contribute to a reconceptualized point of view.

Developing Knowledge and Skills

This component is essential to transforming the learner's understanding of diverse learners as "acquiring knowledge and skills for implementing one's plans" (Mezirow, 2000, p. 22) and is a stage within transformative learning that offers mastery experiences to bolster sense of efficacy. As preservice teachers gain familiarity and confidence with using the tools and strategies, their sense of efficacy towards implementing them with students will increase (McCray & McHatton, 2011). Mezirow (2000) noted the importance of developing new skills and planning a course of action in facilitating transformative learning. Having time to acquire skills and implement tools and strategies that support improving content area literacy will enhance preservice teachers' performance in working with diverse learners (Puckett et al., 2009).

Practice with Tools. Mastery experiences present opportunities to learn content and skills needed to ensure successful outcomes. In this design, preservice teachers worked through scaffolded tasks (Quintana et al., 2004) learning to use tools (Anderson & Petch-Hogan, 2001) that can support diverse learners who struggle with content area literacy. This embodiment took the form of the toolkit component of the design. The toolkit offers hands-on practice to guide the preservice teachers through the use of a variety of compensatory tools (e.g., text-to-speech, embedded supports, captioning, etc.) and addresses multiple modalities (e.g., video presentations, collaborative discussion, writing, recording, etc.).

Strategy Research. Watching video testimonials, demonstrations, and content acquisition podcasts provided knowledge regarding teaching diverse learners and using assistive technology tools and strategies. The videos shared expert knowledge on strategies for

differentiating lesson content to meet diverse learners' needs in the general education classroom (Quintana et al., 2004).

Forming New Perspectives

A key component of transformative learning is critical reflection where learners analyze and reimagine the assumptions on which their thinking has been based (Mezirow, 1990). Critical reflection on an experience challenges the learner to contemplate how the new information fits or rebels against preconceived ideas. It influences how the learner interprets the new information to reconstruct frames of reference. Embodiments to initiate critical reflection are essential to the design.

Self-Assessment. Self-assessment is needed so that preservice teachers can examine their own beliefs and attitudes (Kagan, 1992). Preservice teachers have identified important characteristics of a successful teacher as including a student-centered approach, knowledgeable about subject matter, and enthusiastic about teaching (Minor, Onwuegbuzie, Witcher, & James, 2002). Student-centered teaching is a constructivist approach in which student engagement and learning is driven by a central essential question and facilitated through active, hands-on learning (Kember, 2009; Pedersen & Liu, 2003). Yet, it is difficult to be enthusiastic and create engaging learning environments when sense of efficacy is low. Reflective journaling (Brock, 2010; Lastrapes & Negishi, 2012; Ukpokodu, 2009) provides a space for the learner to critically reflect on the experiences produced by the design. It encourages self-analysis that promotes awareness and sensitivity when confronted with an unfamiliar situation (Palmer & Menard-Warwick, 2012). Self-assessment prompts a learner to further progress through the stages of transformative learning. It promotes self-examination of uncomfortable feelings, assessment of assumptions, and exploration of new beliefs, thoughts, and roles (Mezirow, 2000). It also encourages

examination of one's emotional and physiological response to the design experiences (Bandura, 1986).

Discussions with Peers. Learners discussed (McNamara & Kendeou, 2017), reflected on (Edelson, 2001), and provided and received constructive feedback (Mulholland & Wallace, 2001) essential to building efficacy through verbal persuasion (Bandura, 1986). Learners participated in discussion board postings in the learning environment. The board prompts provided opportunities for the learner to discuss the experiences that they shared to plan "a course of action…[and] provisional[ly] try…new roles" (Mezirow, 2000, p. 22). The discussion promoted the synthesis of information as learners shared information they gained when working through the simulation, trying out the tools and strategies, and observing the podcasts. As learners shared their learning, the group collectively analyzed and explored courses of action (Mezirow, 2000). I anticipated that this collective work would act as a vicarious experience, providing positive persuasion to boost confidence levels and support physiological and emotional learning (Bandura, 1986; Mezirow, 2000).

Mediating Processes

The design embodiments were selected to lead to mediating processes demonstrating the ability to consider student characteristics, use compensatory tools and strategies to assist struggling readers, and make informed decisions embedding tools and strategies to support struggling readers. As a result of working through the simulations, preservice teachers considered student characteristics and reflected on the feelings that the experience generated (e.g., frustration, inadequacy, shame, anger, etc.). Working through the toolkit prompted the ability to use tools and make choices about tool use to support diverse learners who struggle with content area literacy. Identifying strategies for tool use and decision-making emerged from

hands-on experimentation and watching podcasts, testimonials, and demonstrations. Discussion board posts, reflection journal entries, and survey responses revealed new perspectives and internalization of experiences.

Outcome

I anticipated that interacting with the design's embodiments, as evidenced through the corresponding mediating processes, would result in the learner's ability to make recommendations for using tools and strategies to support students who struggle with content area literacy supporting struggling readers in the content area classroom. The conjectures, embodiments, mediating processes and outcome are illustrated in Figure 1.

High level conjecture
The high level conjecture is that challenging one's beliefs and assumptions, developing knowledge and skills, and forming new perspectives is essential to fostering transformative learning and enhancing preservice teachers' sense of efficacy. Combined, the embodiments will address three challenges preservice teachers' have in supporting struggling readers in the content area curriculum: 1) inadequate understanding of struggling readers' needs, 2) lack of knowledge of tools and strategies to assist struggling readers, and 3) inexperience making decisions embedding tools and strategies to support struggling readers.

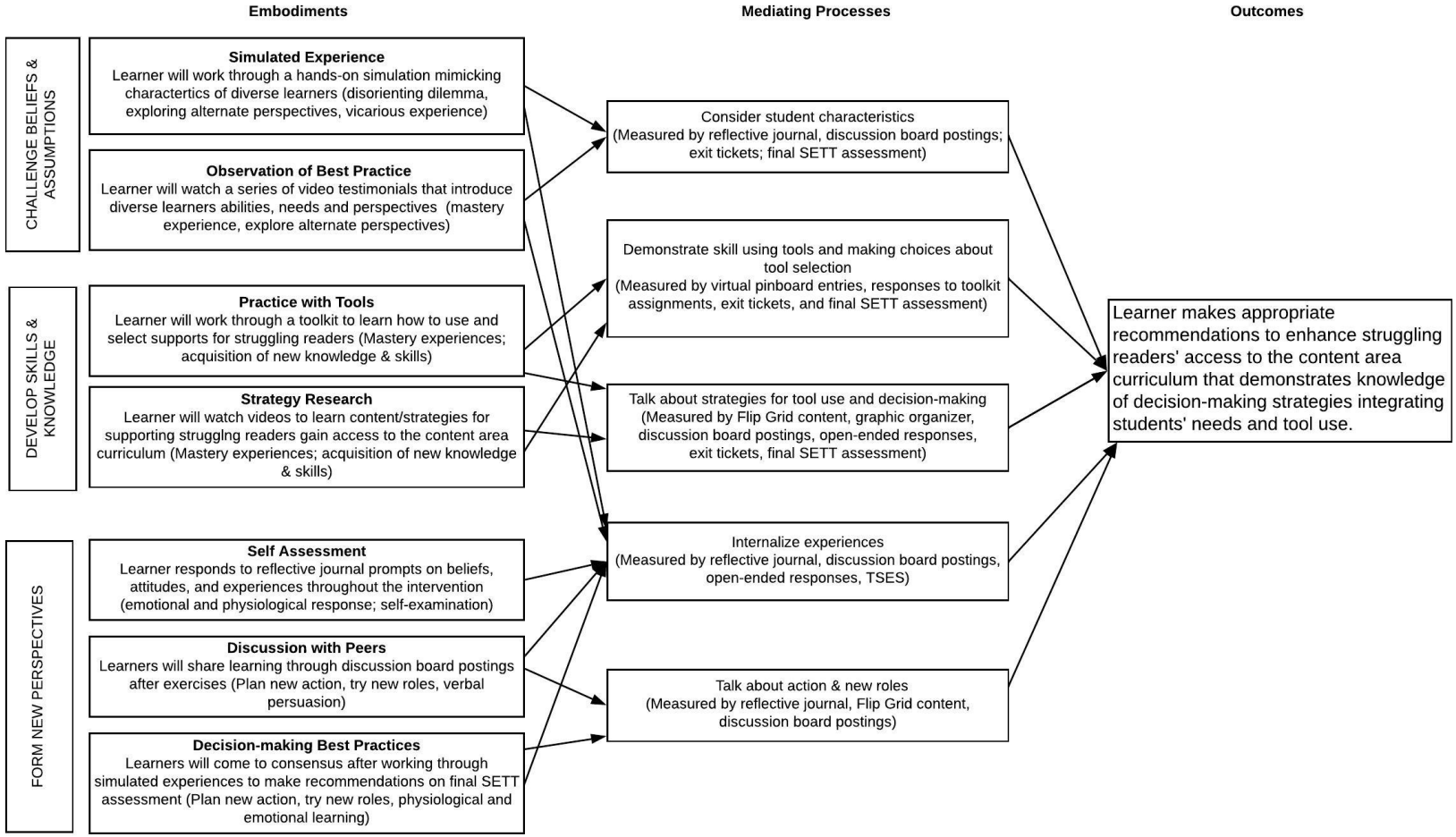


Figure 1. Conjecture map

Learning Environment Design

The designed intervention, a self-guided course module, was modeled on a pedagogical framework combining universal design for learning (UDL) and the technology, pedagogy, and content knowledge (TPACK) model (Benton-Borghi, 2015; Marino, Sameshima, & Beecher, 2009). UDL aims to provide access to learning for all students proactively. That is, lessons are designed to meet all students' needs instead of producing 'one size fits all' lessons that are then modified for different abilities (Rose & Meyer, 2002). TPACK emerged from Shulman's (1986) model of pedagogical and content knowledge; the technological aspect was added as schools entered the digital age. Benton-Borghi (2015) recognized that UDL, which guides content presentation and student interaction, is only one piece of the puzzle, so she combined it with TPACK to present a model for how teachers "represent the content,… engage the students, and …assess student understanding of content from multiple perspectives" (p. 296). See Figure 2.

Reflecting relevant professional standards (i.e., Council for Exceptional Children (CEC), International Society for Technology in Education (ISTE), and International Literacy Association (ILA)), the module design guided preservice teachers through the decision-making process using the SETT Framework (Zabala, 1995) and referencing Quality Indicators for Assistive Technology (QIAT) (QIAT Leadership Team, 2012). The SETT framework prompts consideration of the **S**tudent in a given **E**nvironment completing certain **T**asks to make recommendations for appropriate **T**ools. QIAT provides decision-making matrices for evidenced-based deployment of AT (Zabala et al., 2000).

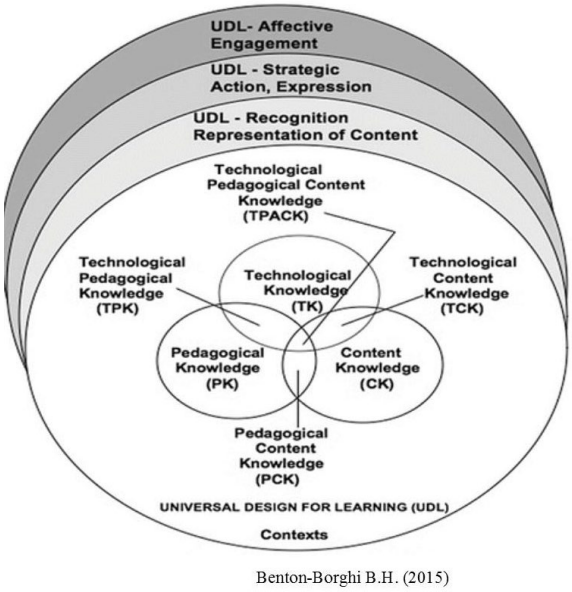


Figure 2. Combined UDL and TPACK models. Adapted from "*Intersection and impact of Universal Design for Learning (UDL) and Technological, Pedagogical, and Content Knowledge (TPACK) on Twenty-First century teacher preparation: UDL-infused TPACK practitioner's model*," by B. H. Benton-Borghi, 2015, p. 296.

The critical task was to enhance preservice teachers' awareness and knowledge of assistive technology to support struggling readers through engagement with a course module. The objectives were intended to reduce the experience barrier (Flanagan et al., 2013); that is, by increasing knowledge of, and confidence in using assistive technology, preservice teachers were more likely to regularly integrate it into pedagogical practice. The module's objectives were to: (1) acclimate preservice teachers to the benefits of assistive technology; (2) provide opportunities to explore and reflect on assistive technology that supports literacy; (3) teach preservice teachers to design lessons based on the UDL principles (Rose & Meyer, 2002) that proactively embed supports to assist struggling readers; and (4) guide preservice teachers through the decision-making process using the SETT framework and QIAT indicators (Zabala, 1995; Zabala et al.,

2000). The module's tasks were hosted on *Nearpod* (www.nearpod.com), an online platform for delivering interactive content, and a companion website. They are consistent with the UDL principles—multiple means of representation (present information in multiple formats); expression (accept learner responses in a varied ways); and engagement (involve learners in different activities) (Rose, Meyer, & Hitchcock, 2005).

The module teaches tools and strategies that teachers can implement to support students in circumventing obstacles to their reading comprehension skills in the content area curriculum. Embedding them in practice offers equal access to content area curriculum through differentiated instruction. In the module, preservice teachers engaged in exercises intended to broaden their knowledge and use of assistive technology; consequently, I anticipated this would improve their sense of efficacy at using assistive technology to support struggling readers in the content area curriculum.

Module Procedures

The self-paced course module was designed in accordance with Mayer's (2008) evidence-based three-pronged model of managing cognitive load that offers guidelines to reduce extraneous processing, monitor essential processing, and promote generative processing. First, the preservice teachers (a.k.a. the learners) worked through activities introducing the benefits of assistive technology and the concepts of UDL, the SETT Framework and QIAT. An example activity is watching video testimonials of individuals reliant on assistive technology and reflecting on how the tools and strategies enhance independence and academic success. They explored classroom scenarios acclimating them to diverse students' needs. Throughout the design, scaffolds such as graphic organizers, explanatory sidebars, voiceovers, and illustrations were embedded to reduce cognitive load (Quintana et al., 2004) and make thinking visible

(Quintana, 2006). Checkpoints (i.e. Section Exit Tickets) were integrated throughout the module to monitor student progress. These served dual purposes: check for understanding and serve as mile markers should the learner fail to complete the entire module.

Challenging One's Beliefs and Assumptions

The design first motivated the learner's *need to know* by situating the learning in an authentic context (Edelson, 2001; Edelson & Reiser, 2006). It was intended to provide learners with opportunities to challenge their preconceived notions and develop new knowledge that supports transformative learning (Mezirow, 1997). This design focused on improving content area literacy. The introductory activities asked the learner to assume the roles of students with disabilities attempting reading tasks that proved difficult for them. The virtual spaces promoted transformational play in which the learner actively engaged with the content in a space that mimicked reality (Barab, Gresalfi, & Arici, 2009).

Simulation

To build motivation (Edelson, 2001) and empathy (Mezirow, 1997), and create vicarious experiences (Bandura, 1986), participants donned a struggling reader's persona and attempted to complete tasks that required content area literacy skills. I anticipated that the simulated experience would serve as a 'disorienting dilemma' (Mezirow, 2000) causing learners to think deeply about needs of struggling readers in ways not previously considered. The simulation activity was designed to help reduce anxiety about inclusion among general education preservice teachers (Shippen et al., 2005). The module presented a student describing his abilities, tasks, and struggles, and was followed by simulations in Understood—For Learning and Attention Issues (Understood.org, 2019) (see Appendix A). The learner heard from, say, a fifth grader with dyslexia required to type a report. Next, the learner participated in an exercise that mimicked the

student's typical experience. For example, as the learner attempted to type, the keyboard layout altered. That is, when the learner typed 'q', 'p' would appear instead. After completing the simulation activity, the learner reflected on the experience by responding to sentence stems (Milner, 2006) in the reflective journal (Lastrapes & Negishi, 2012).

Observation of Best Practice

Learners watched video testimonials and demonstrations that introduced diverse learners' abilities, needs, and perspectives as well as examples of technology that could be used to address obstacles. The learners recorded their reflections in journal responses and noted what they found perplexing, interesting, and would like to learn more about. They also discussed their thoughts with their peers via discussion board posts on the companion website.

Developing Knowledge and Skills

Practice with Tools

The next part involved practicing with compensatory tools for assisting students who struggle with reading in the content areas. In this segment, participants engaged with multiple product demonstration videos and applications for practice. These included text-to-speech, embedded support, online references, interactive illustrations, just-in-time prompts, and explanatory videos. For example, the preservice teacher watched a demonstration video on *Voice Dream Reader* (Voice Dream LLC) that offers robust reading assistance (see Appendix A). After viewing, she was prompted to explore the app's features. The scaffolded, hands-on experience offered hints and tips to teach the learner how to use the app (Quintana et al., 2004). Throughout the experience, the preservice teacher responded to embedded prompts designed to encourage reflection (Quintana et al., 2004) on how the tools could be used to differentiate experiences (see Appendix A). For example, learners may have discovered that "using computer-assisted

vocabulary instruction [is] more effective than traditional methods, listening to others read [is] a way of enhancing students' incidental vocabulary knowledge, and preteaching vocabulary in assigned materials facilitated comprehension" (Alvermann, 2002, p. 194). As participants worked, they saved tools they deemed useful to the student's task in their toolkit virtual pinboard (see Appendix A). They accessed these tools when debriefing with their teammates via discussion boards, made changes to it as they worked, referred to it when discussing progress with peers via discussion board postings. Playing with the toolkit in a virtual environment (Barab et al., 2009) was intended to construct new knowledge; responding to the embedded prompts would assist in making connections to prior knowledge (Edelson, 2001).

Strategy Research

After gaining experiences as a diverse learner and trying out compensatory tools, the module presented research on the use of strategies. The learner interacted with content acquisition podcasts (CAP) (Kennedy, Alves, & Rodgers, 2015) to acquire information on specific topics, such as those found on www.SpedIntro.com (see Appendix A). For instance, to gain experience on how to help an eighth-grade student struggling with science vocabulary, the participants would watch *Improving Vocabulary Instruction for Science SWD* and *Embedded Supports to Differentiate Instruction for Struggling Students.* Learners took notes in graphic organizers (Appendix A) to, once again, support knowledge construction and refinement (Edelson, 2001). At the same time, the graphic organizer acted as a model for providing multiple means of action and expression (Rose & Meyer, 2002).

Forming New Perspectives

Self-Assessment

Through responses to reflective journal prompts such as *While I took on the role of a*

diverse student, I was thinking…, Insights I have about my student's use are…, and *When I think about my students, they struggle most with…,* the learner considered the experiences and assessed the impact they have on their thinking. The learner had the option to record some responses in the *FlipGrid* (Microsoft, 2018) format to allow her to think aloud to present thoughts, in accordance with UDL guidelines of multiple means of expression (Rose & Meyer, 2002).

Discussions with Peers

Periodically throughout the module, participants discussed experiences via discussion board postings. They synthesized new knowledge, discussed how the experiences challenged their preconceived notions, and made recommendations. Participants, again, had the option to video record responses on *FlipGrid* (Microsoft, 2018). Learners made recommendations that encouraged reflection on the student's needs and abilities and offered suggestions for tools and strategies to support completion of the given task. This segment supported connecting new knowledge to existing knowledge structures (Edelson, 2001) and drew on the reflections learners made when engaging in the various roles (Woolfolk, Rosoff, & Hoy, 1990).

Decision-Making Best Practices

The intervention concluded with the learner completing the SETT Framework for three students (see Appendix B). The assessment detailed the preservice teachers' roles and reflected knowledge gained from the simulations, hands-on tool use, and observations of best practices. Finally, learners took the post-survey to allow for comparison to the pre-test.

CHAPTER III

Research Design

This design-based research study (Design-Based Research Collective, 2003) addressed the challenges preservice teachers experience in supporting struggling readers' success in the content area curriculum. I hypothesized that the intervention would bolster participants' awareness and knowledge of assistive technology to support struggling readers' success in the content area curriculum. It was predicted that this awareness would impact their sense of efficacy in embedding assistive technology in pedagogical practice.

Setting

The study was implemented at a mid-sized liberal arts college with a long history of teacher preparation ("History – State School," 2016) in New Jersey. The nationally accredited School of Education offers a range of certifications from early childhood to secondary and counselor education. 1222 students (768 undergraduate and 454 graduate) were enrolled in 2016 (Popper, 2017). Ninety-three percent are New Jersey residents, with the majority of others from the northeast region. Three hundred seventy-three elementary education students were enrolled in Spring 2016 (Popper, 2017). Comparable to national teaching population trends (U.S. Department of Education, 2016), 76% of education undergraduates are White; 11% are Hispanic and 5% are Asian; 94% are female (Popper, 2017). The site was selected because of its reputation for producing highly qualified teachers ("State School | School of Education," 2017) while being representative of New Jersey's teaching population.

Sample

This study sought to enhance preservice teachers' sense of efficacy and knowledge of assistive technology to assist struggling readers in the general education classroom. The study

was a voluntary component within *RAL 321: Literacy Learning Across the Curriculum*. The required course, usually taken by students in the Fall of their senior year, combines methods classes with field experiences for practical application of content. It meets four times per week: twice in the college classroom and twice in the field. The field placements span kindergarten through grade five. There were 45 students enrolled over the three sections of the course. Two sections were taught by the same adjunct instructor[6] while the third section was taught by a different adjunct instructor. Forty-three learners consented to participating in the study, but five did not complete any study tasks. Thus, the sample consisted of 38 learners (34 female and 4 male). Thirty-five participants were seniors; the remaining three were juniors.

Participants were selected using a convenience sampling design (Gall, Gall, & Borg, 2015). All students enrolled in RAL 321 were asked to volunteer for the study. The sample was not randomized because students enrolled (not arbitrarily assigned) in the course were recruited (Gall et al., 2015). Participants were offered proof of professional development hours and proof of participation in a research study to include on their resumes.

Procedure

The research was conducted with preservice teachers enrolled in all three sections of RAL 321 in Fall 2019. I was not an instructor of RAL 321, but introduced the study, requested participation, and answered questions to all course sections in Week 4 of the semester. I sent a follow-up email requesting volunteers and reiterating the study's purpose and timeline. The pre- and post-intervention surveys were distributed via Rutgers' Qualtrics software after the consent forms were completed. Participants had the option of completing the module even if they did not consent to participate in the research. Access to modules opened after completion of the pre-

[6] The researcher is not a course instructor.

survey and closed in Week 8 allowing participants ample time to complete it. It was anticipated that participants could complete the study (inclusive of pre/post surveys and module activities) in four hours--the equivalent of three class sessions. Refer to Table 1 for project timeline. Participants self-reported the time they spent completing the module. Sixteen participants reported spending more than four hours on module tasks; fourteen reported spending two to three hours on the tasks. Four participants reported spending one to two hours engaged with the module. The remaining four participants did not respond to the question. Most participants (*n*=31) completed the module in one session. Six participants completed it in two sessions, and one participant logged in five times. I was available via email or scheduled appointments to troubleshoot technical issues in the module (e.g., replace dead links, provide access to other document formats). The post-survey link was accessed at the module's completion.

Table 1

Project Timeline

Research Procedure	Time & Location	Estimated Participant Engagement Time	Responsible Party
Introduction to study with follow-up recruitment email	Fall 2019 semester Week 4 in RAL 321 classroom		PI
Consent form followed by pre-intervention survey	Fall 2019 semester Week 4 to Week 5 online via Rutgers Qualtrics	7 minutes	Study participants
Intervention: Online course module	Fall 2019 semester Weeks 5 through 8 online via Nearpod.com	3.5 hours	Study participants

Table 1 (continued).

Intervention: Technical assistance	Fall 2019 semester Weeks 5 through 8 online via email/by appointment	N/A	PI
Post-Intervention survey (final activity in course module)	Fall 2019 semester Week 8 online via Rutgers Qualtrics	10 minutes	Study participants
Post-Intervention opinion survey	Fall 2019 semester Week 8-9 online via Rutgers Qualtrics	15 minutes	Study participants
Data analysis	November-December 2019		PI
Study write up	January-February 2020		PI

Data Collection

I conjectured that the embodiments of the design (i.e., simulated experiences, video podcasts and demonstrations, hands-on experiences, decision-making practice, self-assessment, and discussions with peers) would lead to several mediating processes (see Figure 1): broadly categorized as demonstrating ability to (1) consider student characteristics, (2) use compensatory tools and strategies, and (3) make informed decisions embedding tools and strategies to support struggling readers' access to the content area curriculum. Based on the embodiments and corresponding mediating processes, I conjectured that after the intervention, preservice teachers would be able to make recommendations for supporting readers who struggle with content area literacy as shown by transformed perspectives and enhanced sense of efficacy when

demonstrating tool use, and talking about strategies for tool use, decision-making, and incorporating new roles.

Measures

Design-based research studies are supported by theory with clear links to embodiments and mediating processes. The studies are iterative, collect process data, and occur in an authentic environment with collaboration between researchers and practitioners (Cobb et al., 2003; Collins, Joseph, & Bielaczyc, 2004; Design-Based Research Collective, 2003; Shavelson, Phillips, Towne, & Feuer, 2003). Design-based research intends to determine the extent to which elements in a designed environment are linked to the concomitant outcomes; therefore, it is essential to design data collection measures that illustrate why the outcome occurred (Design-Based Research Collective, 2003; Sandoval, 2014). Hence, both quantitative and qualitative measures were used to enable interpretation of how well the intervention influenced preservice teachers' sense of efficacy, knowledge of assistive technology, and decision-making ability. Data was collected using a pre/post-intervention survey and researcher-created course materials that generate process data (Sandoval, 2014).

Pre/Post Intervention Surveys

The pre-survey collected demographic information (e.g., major, prior formal assistive technology training hours) followed by a two-part survey assessing sense of efficacy and knowledge of technology tools to support struggling readers.

Part 1: Sense of Efficacy (26 items). The pre- and post-intervention surveys addressed the research question studying how preservice elementary education teachers described their sense of efficacy to assist struggling readers access the content area curriculum. Participants completed an adjusted *Teacher Sense of Efficacy Scale* (TSES) (Tschannen-Moran & Woolfolk

Hoy, 2001). The scale, a seminal instrument, improves upon previous efficacy scales (Bandura, 1997; Gibson & Dembo, 1984) as it is generalizable to a range of grades and subject areas (Tschannen-Moran & Woolfolk Hoy, 2001). The survey consists of three subscales measuring efficacy in student engagement, instructional strategies, and classroom management along a nine-point Likert-type scale (ranging from nothing to a great deal) (Tschannen-Moran & Woolfolk Hoy, 2001). The researchers' construct validity analysis revealed the instrument to be reliable and valid (Tschannen-Moran & Woolfolk Hoy, 2001).

The TSES was modified to assess the participants' level of self-efficacy regarding preparedness to provide struggling readers with access to content areas and comfort with technology (see Appendix B). The eight questions on classroom management efficacy were excluded as they do not pertain to this research. Five items from Benton-Borghi's (2006) *Teacher's Beliefs Inventory* were added to assess participants' sense of efficacy using technology tools with struggling readers. Benton-Borghi's (2006) instrument was found to be reliable, with an alpha of .878. (See instrument in Appendix B for detailed revisions). Questions regarding instructional strategy and student engagement were not removed because if a teacher demonstrates low levels of efficacy with instructional strategies and student engagement, by association, she is likely to have a low sense of efficacy using technology to assist struggling readers (EL-Daou, 2016; Soodak & Podell, 1997; Tschannen-Moran & Woolfolk Hoy, 2001). The adjusted 26-items evaluate efficacy in three subscales: student engagement (ten items), instructional strategies (ten items), and technology use (six items).

Part 2: Perceived Knowledge and Use of AT (33 Items). As noted by Pendergast et al. (2011), Durgunoglu and Hughes (2010), and Tschannen-Moran and Hoy (2007), preservice teachers overestimate their sense of efficacy prior to field experiences. Novice teachers' sense of

efficacy is often reported as less confident than their preservice counterparts. Therefore, given that preservice teachers' sense of efficacy tends to be high, it is important to consider whether preservice teachers' knowledge (both perceived and demonstrated) corroborates their reported sense of efficacy (Durgunoglu & Hughes, 2010). The survey's second part measured how preservice teachers expressed their knowledge and attitudes concerning use of assistive technology, and if engaging with the assistive technology course module affected this. The questions gathered information regarding participants' perceived knowledge about AT that they gathered during field placement experiences and in teacher preparation coursework. The results were useful to determine if the preservice teachers recognized assistive technology use in the schools, whether they were receiving instruction in the college classroom regarding its incorporation, and if they were aware of barriers to its successful integration. The instrument is a modified version of Lee and Vega's (2005) *AT Survey*. Lee and Vega grounded the survey on CEC and ISTE's professional standards of 1998 and 1999, respectively. Both organizations' standards "dictate that teachers must have the ability to (a) integrate all forms of technology during instructional planning, (b) use assistive technology during assessment, and (c) create appropriate technology-based adaptations and modifications for students with disabilities" (Marino, Sameshima, & Beecher, 2009, p. 190).

The original *AT Survey* contained four multiple-choice demographic questions, 20 five-point Likert-scale items, and 15 open-ended questions to query participants' perceived knowledge, experience, and challenges using AT in the classroom (Lee & Vega, 2005). All of Lee and Vega's (2005) Likert-type questions were included. The original survey was administered in 2002-2003; CEC revised their professional competencies in 2015; the ISTE standards were updated in 2017. The instrument was modified to be consistent with the new

standards. Six Likert-scale questions were added to incorporate the updated professional competencies (see items marked with an asterisk * in Appendix B). Eight additional questions were added from Puckett et al.'s (2004) Project ACCESS survey. They speak directly to participants' confidence teaching literacy strategies and using technology for literacy (noted with a carat (^) on survey). The internal reliability of Puckett et al.'s instrument was calculated at .95. A measure with a reliability coefficient higher than .8 is considered reliable (Gall et al., 2015). Finally, Lee and Vega (2005) conducted a mixed methods study in which they asked 15 open-ended questions that sought input on classroom environment, student characteristics, and assistive technology use. These redundant questions were eliminated; only one open-ended question was included: *What do you consider to be a barrier to AT use in the classroom and/or school?* Lee and Vega did not address the measure's reliability or validity other than to reference that the professional standards guided its creation. However, two assistive technology experts reviewed the revised survey and found it to be valid. The survey questions represent six factors: knowledge of access to assistive technology (eight items), tool use (eight items), teacher preparation (four items), making accommodations (four items), teaching reading (five items), and school support (four items).

Once participants completed the pre-intervention survey, they received the code to access the intervention module. The final module task was the post-intervention survey, identical to the pre-survey, excluding the demographic information.

Demonstrated Knowledge of AT

Participants completed researcher-created module activities to demonstrate knowledge of technology selection, use, and evaluation. Assignments were embedded within the module and submitted within the Nearpod platform or on the companion website. These included objective

and subjective educational activities such as journal responses, hands-on activities, polls, discussion board postings, self-reflection, section exit tickets, and a final assessment. The section tickets combined objective and subjective items to serve as formative assessments gauging understanding as participants progressed through the module (see Appendix A for an example). Created by the researcher and her colleagues who teach a graduate-level assistive technology course, the final assessment required participants to respond to four case-based scenarios (Harrington, 1995) modeled on the SETT Framework (Zabala, 1995). The participants were provided information about hypothetical students' reading abilities, the environment in which the activities occur, and the tasks that need to be completed. Respondents analyzed this information to recommend appropriate tools and provide a rationale to justify each recommendation. The assessment is regularly used in the graduate course required for candidates seeking New Jersey Teacher of Students with Disabilities certification. Table 2 provides examples of data sources, and Appendix D contains a printout of the module.

Table 2

Examples of Data Sources

Source	Example
Reflective journal sentence stems (Milner, 2006)	● While I took on the role of a diverse student, I was thinking… ● Insights I have about my student's use are… ● When I think about my students, they struggle most with…. ● I'd like to know more about...
Tool demonstration responses	● Explain the implications and/or concerns of removing distractions from webpages using *Snap and Read Universal*. Did it work the way you expected it to? Was the integrity of the content maintained? ● What book did you download? What settings in *Voice Dream Reader* did you change and why?

Table 2 (continued).

Discussion board entries	● What does Beth need in this case to complete her task? ● Based on the tools we explored in this module, what revisions do you propose?
Polls	● How likely are you to use this [tool] with the student you profiled in part one? ● Which tool did you spend the most time exploring? ● I'd like to explore apps that help teach children to read (e.g. phonics and vocabulary practice)...
Section Exit Tickets	● Describe a characteristic of a struggling reader. ● Is it part of your responsibility as a classroom teacher to think about assistive technology that can support your students? (Yes/No) ● True/False: Assistive technology must be considered for every student with an IEP
Final Outcome Assessment	Reflecting on the session's activities, suggest tools to help students gain access to the content area curriculum and indicate ways the suggestions adhere to the SETT Framework. Descriptions of the student, environment, and task are provided.

Table 3 makes explicit the relationship between the research questions and data sources.

Table 3

Relationship between Research Questions and Data Collection Measure

Research Question	Data Source	Timeline
To what extent does engagement with the AT course module influence preservice teachers' conceptions regarding their abilities to assist struggling readers access the content area curriculum?		
a. How do preservice teachers report their sense of efficacy in assisting struggling readers' access to the content area curriculum? Does engaging with the module impact their confidence level?	Intervention Surveys (Appendix B)	Pre- and post-intervention (Week 4 and Week 10)

Table 3 (continued).

b. How do preservice teachers express their knowledge and attitudes concerning use of AT, and what changes are evident after engaging with the module?	Reflective journal; tool demonstrations; section exit tickets; discussion board posts; poll answers	During intervention (Weeks 5-9)
c. After completing the module, do preservice teachers demonstrate competence using, integrating, and evaluating use of AT to assist students who struggle with reading in the content areas?	Course Assessment (Appendix B) Module data	End of intervention (by Week 9)

Reliability

The internal reliability of the intervention survey and subscales was calculated. Using SPSS, Cronbach's alpha was calculated for both parts of the intervention survey: 1) the adapted Teacher Sense of Efficacy Scale (26 items; Likert-scale 1-9)(Benton-Borghi, 2006; Tschannen-Moran & Woolfolk Hoy, 2001), and 2) the AT Survey (33 items; Likert-scale 1 to 5) (Lee & Vega, 2005, Puckett et al., 2004) . The results are displayed in Table 4. Tschannen-Moran and Woolfolk Hoy (2001) provided reliability for the original measure; it is displayed in Table 5. The results demonstrate that the internal reliability of the adapted study is comparable to the original TSES. Note, Lee and Vega (2005) did not include any reliability scoring. Thus, the part 2 of the intervention survey's reliability was conducted using this study's data.

Table 4
Means for Intervention Survey total score and subscales

Intervention Survey with Subscales	**Pre-test**			**Post-test**		
	Mean	SD	α	Mean	SD	α
TSES (overall)	**6.55**	**1.68**	**.94**	**7.89**	**1.12**	**.98**
Engagement	7.10	1.42	.83	7.87	1.08	.93
Instructional Strategies	6.52	1.57	.90	7.77	1.08	.96
Technology	5.67	1.91	.85	7.94	1.07	.92

Table 4 (continued).

AT Survey (overall)	**2.93**	**1.22**	**.91**	**4.30**	**.73**	**.98**
Access	2.75	1.19	.90	4.32	.67	.89
Decision	2.54	1.13	.84	4.36	.62	.72
Professional development	2.88	1.36	.66	4.07	.97	.64
Reading	3.71	1.07	.92	4.36	.66	.84
School	3.18	1.06	.81	4.00	.79	.84
Tool	2.78	1.16	.84	4.45	.62	.86

Table 5

Means for Original TSES total score and subscales—Long Form (Tschannen-Moran & Woolfolk Hoy, 2001)

	Mean	**SD**	**α**
TSES	7.1	.94	.94
Instructional Strategies	6.7	1.1	.91
Engagement	37.71	11.12	.87

Module Tasks

To ensure reliability of assessment of the open-ended module tasks, an assistive technology expert acted as a second coder and evaluated a subset (20%) of the responses. There was 92% agreement between the principal investigator and second coder. Discrepancies were resolved through discussion and refinement of the codebook.

Data Analysis

The goal of the study was to determine the extent to which the intervention influenced preservice teachers' sense of efficacy, knowledge of assistive technology, and decision-making ability to recommend appropriate tools and strategies to support struggling readers in the content area curriculum. It was designed to promote transformative learning to enhance the preservice teachers' sense of efficacy at integrating assistive technology (AT) to support struggling readers in the content area curriculum. The research questions focused on three challenges preservice teachers have when supporting struggling readers: inadequate understanding of struggling readers' needs, lack of knowledge of tools and strategies, and inexperience making decisions to

embed tools and strategies. The module tasks were designed to elicit learning in each area. This chapter details data that measured the extent to which the module impacted transformative learning and effects on learners' sense of efficacy and presents the study's findings.

Data Sources

Three sub-questions were posed to determine the extent to which engagement with the assistive technology course module influenced preservice teachers' conceptions regarding their abilities to assist struggling readers access the content area curriculum: 1) How do preservice teachers report their sense of efficacy in assisting struggling readers' access to the content area curriculum? Does engaging with the module impact their confidence level?, 2) How do preservice teachers express their knowledge and attitudes concerning use of AT, and what changes are evident after engaging with the module?, and 3) After completing the module, do preservice teachers demonstrate competence using, integrating, and evaluating use of assistive technology to assist students who struggle with reading in the content areas? The module was comprised of 57 tasks, collecting both quantitative and qualitative data, aligned with the theoretical framework undergirding the module's development. Table 6 aligns each task with the mediating processes it is designed to produce. Table 7 lists the number and percent of tasks associated with each theme.

Table 6

Alignment of Tasks to Theory

Theme	**Develop skills and knowledge**
Mediating process:	Practice tools/strategy research
Section Exit	Briefly define assistive technology. In your classroom, can only students who have IEPs use assistive technology?

Tickets: Objective	Is it part of your responsibility as a classroom teacher to think about assistive technology that can support your students? Assistive technology must be considered for every student with an IEP Name one resource for helping you make decisions about using assistive technology in your classroom. Which of these describe a means of engagement in UDL? Where can students with print disabilities obtain free copyrighted materials? What tool enables a student to listen to a book while displaying the text? What does it mean to level text?
Section Ticket Open-Ended Questions	Describe a feature of Newsela or Snap and Read that you would like to explore more?
Module Activities	Poll: Do you read e-books? Poll: Have you used Newsela with your students (or have you seen it used during a practicum experience)? Poll: Which did you explore? Draw It: Post your outline screenshot here. Use the toolbar on the bottom left to attach your screenshot to this space. (See the red arrow in the image to the left?) What book did you download? What settings did you change and why? (Feel free to post your answer as a Flipgrid; see companion website for details.) What did you think of ClaroPDF? Would you use it with your students? (Flipgrid response optional.) Explain the implications and/or concerns of removing distractions from webpages using Snap and Read Universal. Did it work the way you expected it to? Was the integrity of the content maintained? (Feel free to respond via Flipgrid.) Collaborate!: Pinterest Board

Theme	**Challenge Beliefs and Assumptions**	
Mediating Process:	Consider Student Characteristics	Internalize

Section Exit Tickets: Objective	In what ways do you think assistive technology can benefit students? Check all that apply. Describe a characteristic of a struggling reader. When thinking about suggesting technology to help a student, what do you FIRST need to consider?

	What are the observations/insights you have after experiencing the simulation on Understood?	Rate: how did you feel after engaging with the simulation?
	Which tool would you like to try with your students?	How confident are you in your abilities at identifying a struggling reader in your class after working on this section?
	The students I see in my field placement have trouble with…	How does this section impact your beliefs on inclusion?
Section Ticket: Open-Ended Questions		How likely are you to try out reading an e-book yourself?
		How do you rate your confidence in using a level text with your students?
		Share some insights you have on your own attitude regarding teaching diverse learners...
		How confident do you feel in your abilities to support students using embedded tools after this section?
		Rate how well you understood the information in this section 5.
		After this brief overview of assistive technology, rate how you feel regarding your confidence in helping students access the curriculum using technology.
	Think about your field experiences and finish this sentence: "When I think about my student*(*s) who struggle with reading, he/they struggle(s) most with…"	What do you think about assistive technology now? Are you more familiar with it than you originally thought? Are you using any, or is your cooperating teacher? How did it make you feel to watch this video?
Module Activities		Now that you have explored the simulation, reflect on the experience. Finish this sentence: "While I took on the role of a diverse student, I was thinking?"
	Discussion board: Who struggles in your class?	Do you recognize any of your students? Include any questions you have at this point.
	Discussion board: Thinking about struggling readers	After working on section 3, I'd like to know more about....

		After working on section 4, I'd like to know more about.... After working on section 5, I'd like to know more about.... Discussion board: Newsela
Theme	**Form New Perspectives**	
Mediating Processes:	Strategy Tool Use/Decision Making	Talk About New Roles and Action
Section Ticket: Open-Ended Questions	Think about a tool that you tried in this section. What tool is it? Now that you have tried out this tool, complete this sentence: I feel…. Think about a tool you used in this section and finish this sentence: "When was using the [insert tool] I thought about… and this made me realize..."	What insights can you share after working on this section? Now that you have explored several tools and participated in discussion board posts, describe some thoughts you have regarding comments your colleagues have made about using technology. How has the module and your interactions colleagues impacted your considering of teaching diverse learners? How does this section make you feel about your role of being accountable for diverse learners in your classroom?
Module Activities	SETT planning worksheet Final SETT	Discussion board: What does Dave need (part 1) Discussion board: Newsela Discussion board: What does Dave need (part 2) Discussion board: What does Beth need? Discussion board: Snap & Read, Rewordify, or Mercury Reader?

Table 7
Number and percent of tasks associated with each theme

Connection to Theme	Mediating Process	Number of Tasks	Percent of Module	Average number of tasks completed	Average percent of completion
Challenge beliefs and assumptions	Consider student characteristics	9	16%	6.8	76
Develop knowledge and skills	Demonstrate skill using tools and making choices about tool selection	18	32%	12.5	84
	Talk about strategies for tool use and decision-making	6	10%	4	64
Challenge beliefs and assumptions	Internalize experiences	15	26%	12.5	84
Form new perspectives	Talk about action and new roles	9	16%	5	55
	Total	57	100%	40.8	72

Intervention Survey

To answer the first question, I analyzed pre- and post-intervention survey data to reveal the extent to which learners internalized engagement with the module. Specific focus was given to survey items that pertained directly to: measuring sense of efficacy working with struggling readers (three questions); using technology to support readers (four questions); making accommodations to support students' needs (three questions) as well as learners' professed level of knowledge to provide access to the curriculum using AT (four questions); tools use (four questions); teacher preparation (three questions); and accommodating students' needs (three

questions). I further analyzed learners' professed level of knowledge, training and decision-making abilities (seven questions). Data was cleaned by first deleting data for learners who did not consent to study participation (n=2). Then, data were sorted by unique identifier, and duplicate responses were removed. Each learner was assigned a participant number. Pre- and post-intervention survey data were sorted by participant number so that comparisons by learner could be made. After reviewing module data, pre- and post-intervention survey responses from those who did not complete study tasks were deleted (n=5). Data were uploaded into SPSS for analysis. I calculated descriptive statistics on the 18 survey items, and used paired samples t-tests to compare the learners' perceived knowledge and use of assistive technology prior to and after participating in the intervention regarding how knowledgeable they are about selecting assistive technology for students who struggle in the classroom, and using technology to support instructional assessment, planning and delivery. Paired samples t-tests were used to determine if the intervention has a statistically significant effect on sense of efficacy (Gall et al., 2015).

Module Tasks

To answer the second question, I analyzed the extent to which learners demonstrated knowledge of assistive technology tools and strategies. Multiple choice exit ticket answers, tool activity results, and poll answers were reviewed for correctness to determine learners' demonstrated knowledge of tool use (see Table 8 for number of each type of task). I measured frequency of completion and analyzed responses for evidence that learning occurred (i.e., responses were graded for correctness). Descriptive statistics were calculated and compared to data produced by the intervention surveys and final course assessment.

Table 8

Module Tasks

Name	Type	Number of questions	Percent of Module
Section Exit Tickets	Objective questions (e.g., Yes/No/Unsure: Can only students who have IEPs use assistive technology?)	12	21
	Subjective questions (e.g., What insights can you share after working on this section?)	18	32
	Open-ended journal responses (e.g., Write a few sentences that describe the options that could be useful to a student like Dave.)	10	18
	Polls (e.g., Do you read e-books?)	3	5
Module Activities	Tool-kit collection	1	2
	Evidence of tool use (e.g., Post your Snap and Read outline screenshot here)	3	5
	Decision-making planning	2	3
	Discussion board posts	7	12
SETT Final Assessment		1	2

Next, I examined how learners considered student characteristics and strategies for tool use, and talked about action and new roles through their responses to open-ended 1) reflective journal prompts; 2) section exit tickets; and 3) discussion board posts. Data were imported into NVivo for coding. A deductive coding process (O'Leary, 2004) was used to analyze the open-ended journal responses, exit ticket responses, and discussion board posts to identify emergence

of mediating processes that generate evidence of transformational learning and enhanced sense of efficacy. Specifically, responses were analyzed to determine the extent to which learners' responses correlated with the three theoretical themes: challenge existing beliefs and assumptions, develop skills and knowledge, and form new perspectives. Codes were collapsed into the three main themes and frequencies were tallied. Table 9 presents the coding scheme, derived from Mezirow's theory of transformational learning and Bandura's theory of self-efficacy. To ensure reliability, an assistive technology expert applied the codes to a subset of the responses and attained 92% agreement with the principal investigator. Discrepancies were resolved through discussion and refinement of the codebook.

Table 9

Final Deductive Coding Scheme with codes and subcodes

THEME	DESCRIPTION	CODE/ SUB CODES	EXAMPLE
Challenge beliefs and assumptions	Evidence learner: experienced a disorienting dilemma that impacted attitudes, beliefs or assumptions, critically reflected on previous beliefs/assumptions; reflection produced uncomfortable feelings that prompted change	**CBA** CA DD CSC INT	"After completing the simulation, I thought about dyslexia in a different way." "I realized that I was not helping my students when I told them they needed to try harder and pay more attention."
Develop skills and knowledge	Evidence learner: demonstrated skill using tools and making choices about tool selection; acquired new knowledge and skills needed to implement action plans; determined how to use new knowledge	**DSK** ACT KS REC VE EMP	"Now that I have had time to play with changing the reading settings, I can see how it would be useful to use…." "After experiencing the simulation, I can relate to…"

Table 9 (continued).

Form new perspectives	Evidence learner: tried out new ideas and roles; talked about action and new roles; realized that feeling uncomfortable is connected to changing point of view; Internalized experiences, expressed confidence in ability to try out new roles/skills,	**FNP** INT TALK ROLE TRY NEW	"I'm going to try the strategy next week…" "I can see myself using the vocabulary strategies with my students."

Of the 586 coded items, 30% represented the theme *challenging beliefs and assumptions*, 32% represented *developing knowledge and skills*, and 38% represented *forming new perspectives*.

Final Assessment

To address the final question, I analyzed how preservice teachers demonstrated competence using, integrating, and evaluating use of assistive technology to assist students who struggle with reading in the content areas by reviewing related discussion board posts and grading the final course assessment. On average, 24.6 (65%) participants contributed to the three discussion board posts. 31 participants completed the final assessment in which learners were asked to synthesize their knowledge of assistive technology tools with specific students' needs. Two experts in the field independently graded 20% of the assessments. There was 89% agreement between the three coders, so the assessment has high inter-rater reliability.

CHAPTER IV

Findings

Forty-five preservice elementary education teachers were enrolled across the three course sections. Forty-three learners consented to participating in the study, but five did not complete any study tasks. Thus, the sample consisted of 38 learners (34 female and 4 male). Learners' class level and academic major are displayed in Tables 10 and 11. Table 12 lists the classroom grade that the participant was assigned for the field placement. Participants observed and worked with small groups of students at a suburban school in central New Jersey. Participants were assigned one classroom for the duration of the semester and worked with students in grades one through six.

Table 10

Learners' class level

Class level	Number	Percent
Junior	3	8%
Senior	35	92%

Table 11

Learners' academic major

Academic Major	Frequency	Percent
Art	1	2.6
Biology	1	2.6
English	7	18.4
History	6	15.8
iSTEM	3	7.9
Math	5	13.2
Psychology	8	21.1
Sociology	3	7.9
Spanish	4	10.5
N=	38	100.0

Table 12

Learners' assigned field placement grade in partner elementary school

Field Grade	Frequency	Percent
1st	4	10.5
2nd	3	7.9
3rd	6	15.8
4th	15	39.5
5th	5	13.2
6th	5	13.2
N=	38	100.0

The study participants reported experience teaching diverse student populations, including students who are English language learners (Table 13) and students with disabilities (Table 14).

Table 13

Learners who reported working with students who are English language learners

	Frequency	Percent
Yes	26	68.4
No	12	31.6
Total	38	100.0

Table 14

Learners who reported working with students with IEPs or 504s

	Frequency	Percent
Yes	17	44.7
No	15	39.5
Unsure	6	15.8
Total	38	100.0

Module Completion

Thirty-eight participants completed the study. Of these, 66% (*n*=25) completed more than 75% of module tasks. Table 15 reports completion rate of tasks representing each mediating process, as connected to theory (refer to Table 1 above aligning module tasks with theoretical themes). Table 16 reports overall completion of the study's tasks, and Table 17 illustrates participants' self-reported time spent on study tasks.

Table 15

Learners with more than 75% completion, by mediating process

Mediating Process	Number of Completers (percent)
Consider student characteristics	26 (68%)
Demonstrate skill using tools and making choices about tool selection	29 (76%)
Talk about strategies for tool use and decision-making	7 (19%)
Internalize experiences	27 (71%)
Talk about action and new roles	12 (31%)

Table 16

Overall Completion of Study Tasks

Name	Description	Number of participants	Percent of participants
Entire study	Seventy-five percent or more of all study tasks: pre/post surveys, section exit tickets, module components, discussion board posts, SETT final assessment	25	66%

See Appendix C for the breakdown of individual task completion.

Table 17

Self-reported time spent on module

	Frequency (*n*=38)	Percent
4+ hours	16	42%
2-3 hours	14	37%
1-2 hours	4	10%
Not reported	4	10%

Outcomes

Research Question 1

The first research sub-question asked: How do preservice teachers report their sense of efficacy in assisting struggling readers' access to the content area curriculum? Does engaging with the module impact their confidence level? To answer this, pre- and post-intervention survey data were analyzed. Descriptive statistics and paired samples *t*-tests were run for the complete survey. This was completed in two parts. Part 1 contained 26 items assessing sense of efficacy regarding student engagement, instructional strategies, and technology use. These items were measured on a 9-point Likert scale. Part 2 contained 33 items measuring efficacy towards assistive technology knowledge on a 5-point Likert scale. Ninety-eight percent of items (58/59) returned results that showed statistically significant improvement.

Descriptive Statistics

Data representative of each subscale is presented to offer a snapshot of the overall findings. Twenty-four survey items measuring sense of efficacy working with struggling readers (three questions), using technology to support readers (four questions), making accommodations to support students' needs (three questions) as well as learners' professed level of knowledge to provide access to the curriculum using AT (four questions), tools use (four questions), teacher preparation (three questions) and accommodating students' needs (three questions) revealed an

overall increase in the level of expressed self-efficacy and knowledge after the intervention. Overwhelmingly, the results were statistically significant across all items. This is illustrated in the Table 18 and figures 3 through 6 below, which note the means and variability (standard error) of the overall instrument and subscales, noting efficacy concerning working with struggling readers, accommodating students' needs, and using technology (see Figures 7-9), and professed knowledge of access, tool use, teacher preparation, and accommodating students' needs (see Figures 10-13).

Table 18
Means for Intervention Survey total score and subscales

Intervention Survey with Subscales	Pre-test			Post-test		
	Mean	*SD*	α	Mean	*SD*	α
Part 1 (overall)	**6.55**	**1.68**	**.94**	**7.89**	**1.12**	**.98**
Engagement	7.10	1.42	.83	7.87	1.08	.93
Instructional Strategies	6.52	1.57	.90	7.77	1.08	.96
Technology	5.67	1.91	.85	7.94	1.07	.92
Part 2 (overall)	**2.93**	**1.22**	**.91**	**4.30**	**.73**	**.98**
Access	2.71	1.20	.88	4.31	.67	.97
Making accommodations	2.67	1.13	.75	4.37	.63	.73
Teacher preparation	2.88	1.36	.66	4.07	.97	.64
Teaching reading	3.71	1.07	.92	4.36	.66	.84
School support	3.18	1.06	.81	4.00	.79	.84
Tool use	2.78	1.16	.84	4.45	.62	.86

Figure 3.

Mean for intervention survey part 1: Sense of efficacy with standard error noted

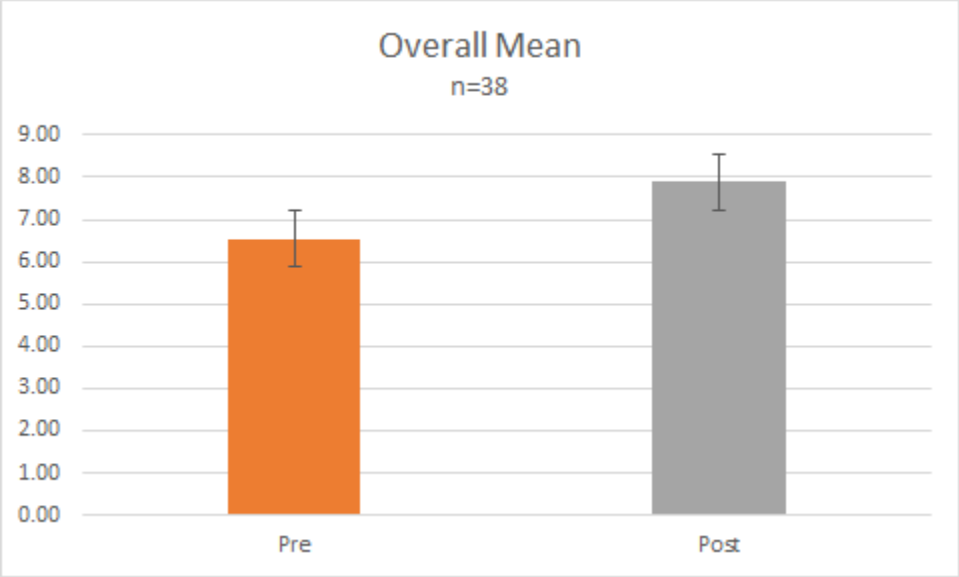


Figure 4.

Means for intervention survey part 1: Sense of efficacy subscales with standard error noted

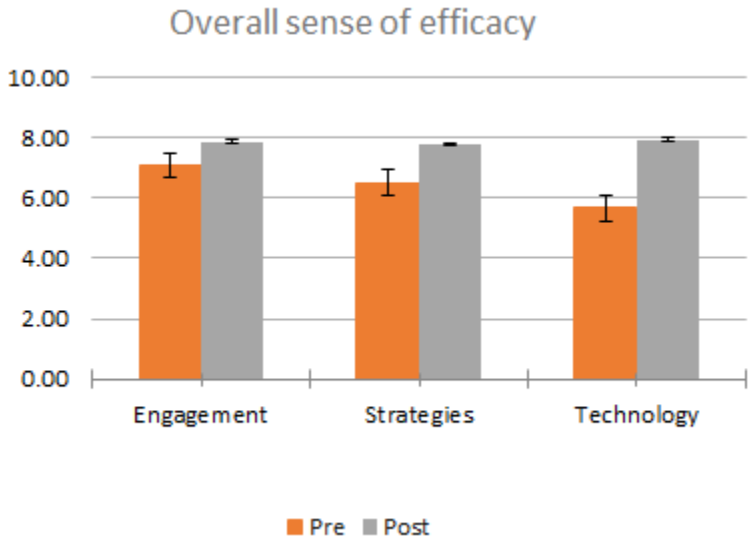


Figure 5.

Means for intervention survey part 2: Assistive technology knowledge with standard error noted

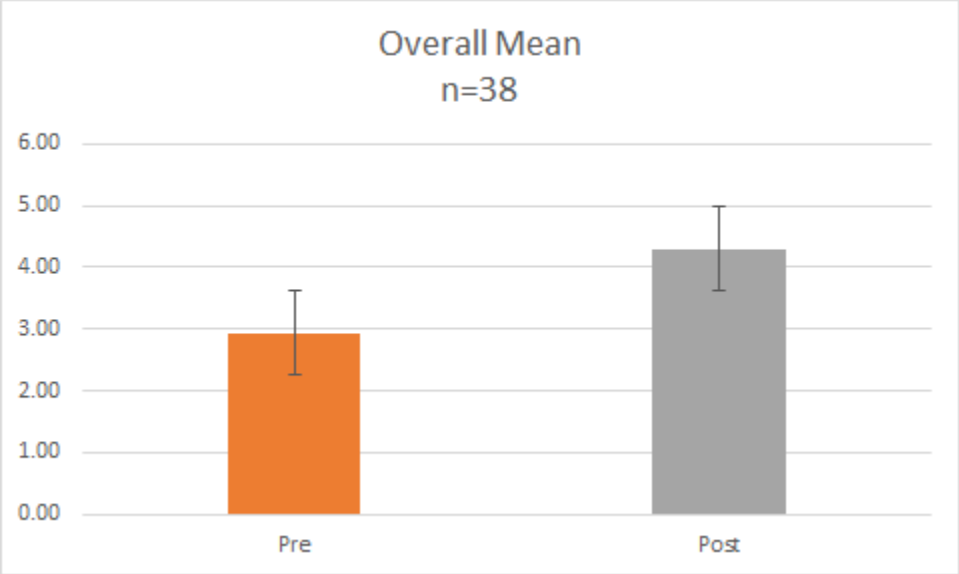


Figure 6.

Means for intervention survey part 2: Assistive technology knowledge subscales with standard error noted

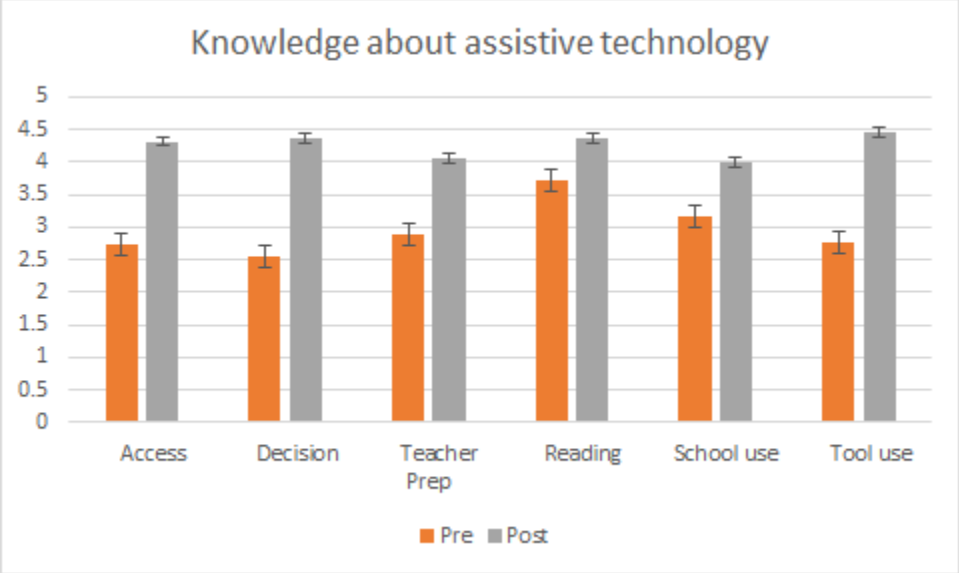


Figure 7.

Means for professed efficacy towards working with struggling readers with standard error noted

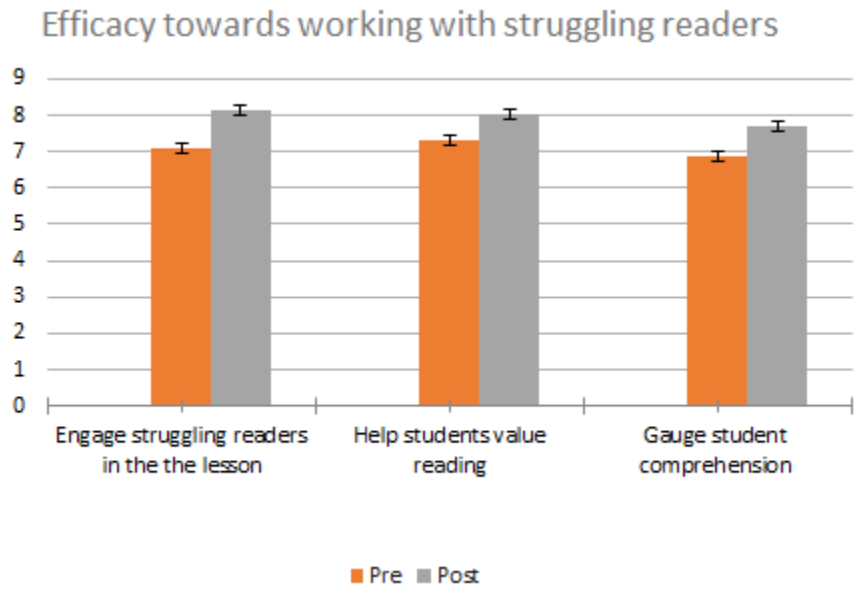


Figure 8.

Means for professed efficacy towards using technology with standard error noted

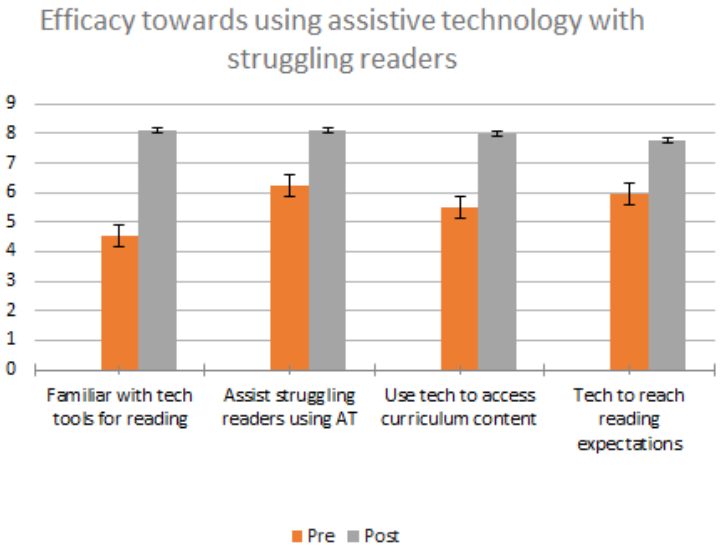


Figure 9.

Means for sense of efficacy accommodating students' needs with standard error noted

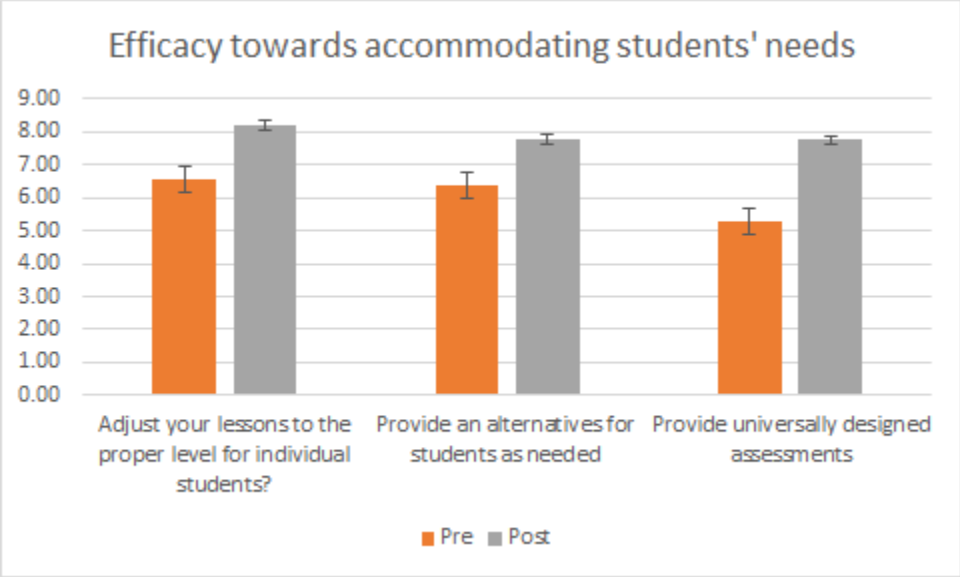


Figure 10.

Means for professed knowledge providing access to AT with standard error noted

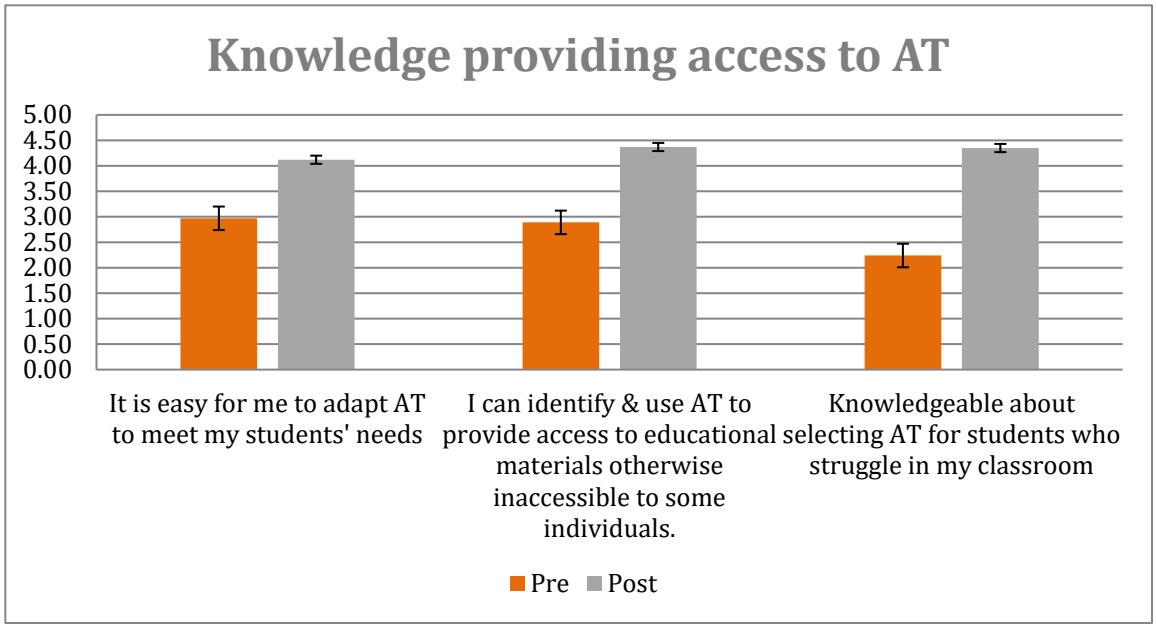


Figure 11.

Means for professed knowledge using AT tools with standard error noted

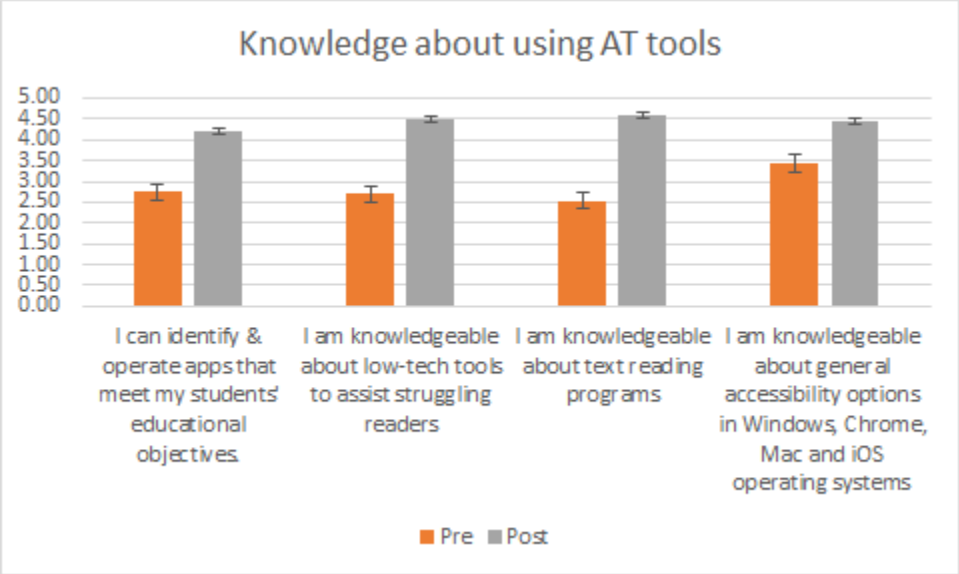


Figure 12.

Means for professed knowledge regarding level of teacher preparation with standard error noted

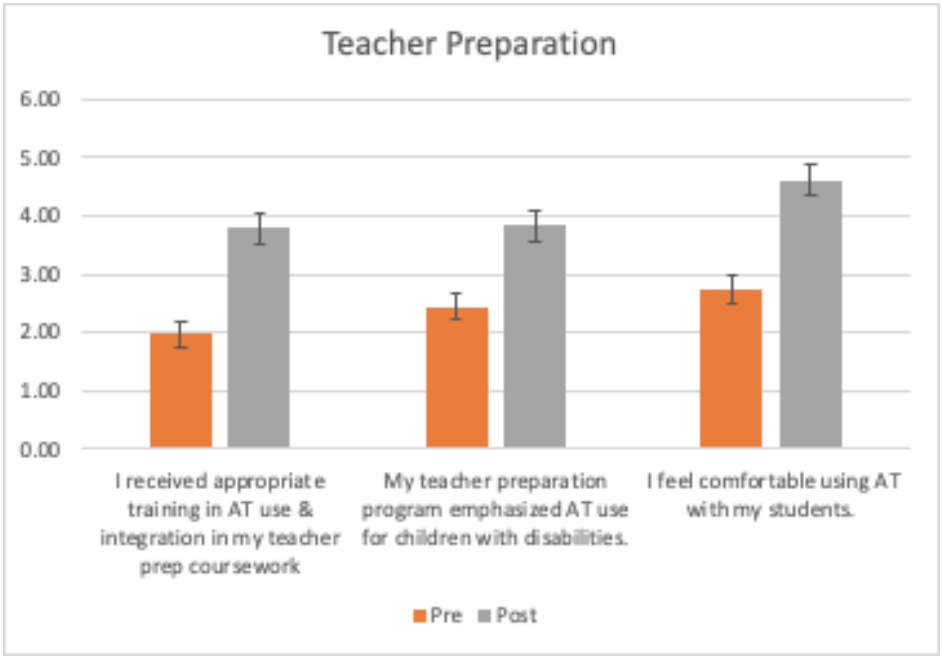
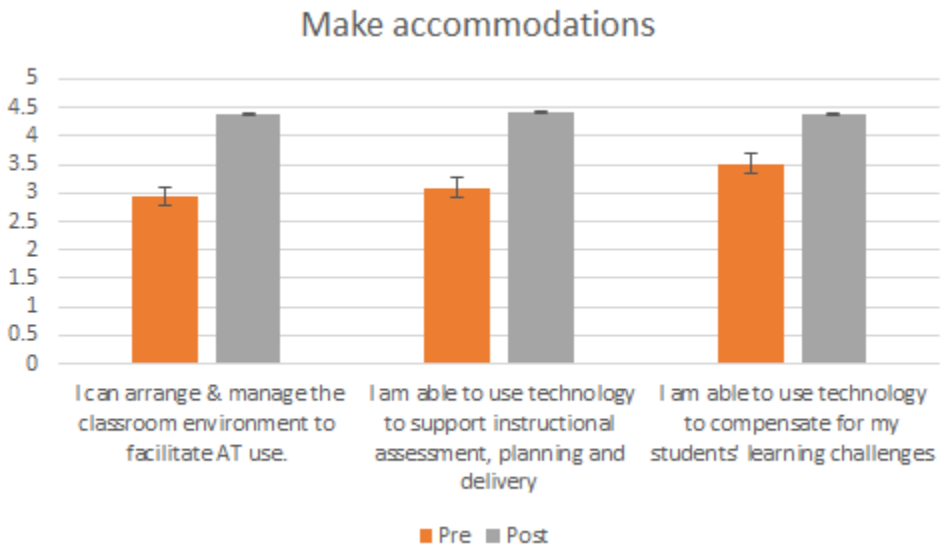


Figure 13.

Means for professed knowledge regarding ability to make accommodations to implement AT with standard error noted



Paired t-Tests

Intervention Survey Part 1. Dependent paired *t*-tests on three subsets were calculated to compare the participants' sense of efficacy towards their confidence reaching struggling readers and their ability to use technology to meet these needs prior to and just after participating in the intervention. All results demonstrated statistically significant difference between the participants' pre- and post-intervention professed efficacy. The subsets and the questions they contain are shown in Table 19.

Table 19

Intervention survey part 1: Sense of efficacy subset questions

Subset	Survey Question
Working with struggling readers	How much can you do to engage struggling readers in the lesson?
	How much can you do to help students value reading
	How much can you do to gauge the students' level of lesson comprehension
	How much can you do to adjust lessons to the appropriate level for individual students
Accommodating diverse learners' needs	How much can you do to provide an alternative explanation, example, or access method when students are unable to interact with the lesson/assignment as designed
	How much can you do to provide universally designed assessments to students with disabilities
	To what extent are you familiar with technology tools for reading
Using technology to support readers	To what extent can you assist struggling readers use technology tools to enhance their reading ability?
	To what extent can you use technology to help their students reach standards-based expectations in reading
	providing students who require text readers and accessible digital content with access to the curriculum content

There was significant increase in participants' confidence working with struggling readers after the intervention (M=7.96, SD=.98) in contrast to before it (M=7.1, SD=1.4), $t(111)=6.2$, p=.0001. Participants showed similar gains in accommodating students' needs from prior to the study (M=6.05, SD=1.69) to after it (M=7.91, SD=1.16), $t(112)=11.34$, p= .0001. Comparably, participants understanding of using technology tools to support readers (M=5.52, SD=1.86) significantly increased after the intervention (M=7.93, SD=1.09), $t(150)=14.16$, p= .0001. Results are displayed in Table 20.

Table 20

Paired samples t-test report: Sense of efficacy working with struggling readers

	Pre-test		Post-test				Sig.
n=38	*M*	*SD*	*M*	*SD*	*t*	*df*	(2-tailed)
Working with struggling readers	7.1	1.4	7.96	.98	6.22	111	.0001
Accommodating students' needs	6.05	1.69	7.91	1.16	11.34	112	.0001
Using technology to support readers	5.52	1.86	7.93	1.09	14.16	150	.0001

Intervention Survey Part 2. The second part of the intervention survey measured participants' professed knowledge using assistive technology in six areas: providing access, using AT tools, evaluating level of teacher preparation, making accommodations, finding support in school, and teaching reading, in general. Questions from the first four factors have been explored in-depth. The final two are not included in this analysis. The participants had limited experiences beyond their field experience classrooms and rarely interacted with school administrators. Also, the module did not teach reading strategies; rather, it focused on compensatory tools to support struggling readers access to the content area curriculum. They are supportive measures meant to enable struggling readers to understand the content while reading skills develop. Since the intervention occurred in a practicum for teaching reading in the content area, it is difficult to parse whether the gains for teaching reading were attributed to the module or to the time spent on coursework. The module spanned a quarter of the semester, so it is possible that gains were a result of coursework and not the intervention.

Table 21 details the questions covered in each subset.

Table 21

Intervention survey part: Professed knowledge regarding assistive technology use subset questions

Subset	Survey Question
Providing access to AT	It is easy to adapt AT to meet my students' needs I can identify and use AT to provide access to educational materials otherwise inaccessible to some individuals. I am knowledgeable about selecting AT fir students who struggle in my classroom. i
AT tool use	I can identify and operate the apps that meet my students' educational objectives I am knowledgeable about low-tech tools to assist struggling readers. I am knowledgeable about text reading programs/apps.
Teacher preparation	I received appropriate training in AT use and integration in my teacher prep coursework. My teacher preparation program emphasized AT use for children with disabilities.
Make accommodations	I feel comfortable using AT with my students. I can arrange and manage the classroom environment to facilitate AT use. I can arrange to use technology to support instruction, assessment, planning and delivery I am able to use technology to compensate for my students' learning challenges.

Dependent paired samples *t*-tests on four subsets were calculated to compare the participants' professed knowledge of incorporating assistive technology. Again, there was statistically significant improvement in all areas; in providing access to assistive technology, gains were made from before the study (M=3.13, SD=1.13) to after the study (M=4.29, SD=.68) $t(102)=10.38$, $p= .0001$. Similar improvements were made when demonstrating confidence using assistive technology tools from prior to the intervention (M=2.66, SD=1.08) to after (M=4.33, SD=.62), $t(104)=15.73$, $p= .0001$; considering level of teacher preparation before (M=2.39, SD=1.15) to after (M=4.08, SD=.98), $t(101)=12.91$, $p= .0001$; and confidence in making

accommodations from before the intervention (*M*=2.75, *SD*=1.16) to after it (*M*=4.39, *SD*=.62), *t(*101)=13.41, *p*= .0001. Thus, all of the results of the paired *t*-tests comparing subsets of professed knowledge of assistive technology indicated statistically significant improvement among the four factors (see Table 22). Note that the standard deviation reported post-intervention was much lower than that reported before the intervention. This leads to the conclusion that there was less variance among the participants' responses; thus, there was greater overall consistency in improved responses. The consistency of agreement among responses and that the data present statistically significant change from pre- to post-intervention helps support the claim that the intervention positively impacted participants' knowledge of using assistive technology to support diverse learners.

Table 22
Paired samples t-test report: Professed knowledge providing access to AT

	Pre-test		Post-test				Sig.
n=38	*M*	*SD*	*M*	*SD*	*t*	*df*	(2-tailed)
Providing access	3.13	1.13	4.29	.68	10.38	102	.0001
AT tools use	2.66	1.08	4.33	.62	15.73	104	.0001
Teacher preparation	2.39	1.15	4.08	.98	12.91	101	.0001
Making accommodations	2.75	1.16	4.39	.62	13.41	101	.0001

This trend towards improvement is also seen when considering that prior to this intervention, preservice teachers reported virtually no experience learning about assistive technology. Of 38 participants, 37 reported zero hours training. One participant indicated less than five hours. This data show that while AT had not been a previous focus, the intervention has had a positive impact on the participants' perception of preparedness. This data is supported by the average scores on the section exit tickets and final assessment discussed below.

There was one open-ended question on survey that asked participants to discuss the most significant barrier to assistive technology use in the classroom. The results were consistent with previous research (Bitner & Bitner, 2002; Cook, Sawyer, & Lee, 2013; Flanagan et al., 2013;

Hutchison, 2012; Hutchison & Reinking, 2010; Puckett et al., 2009). Reported barriers to successful assistive technology use were grouped under the themes representing lack of: access to resources; funding; knowledge of what assistive technology exists; teacher, student, and parent perception of using AT; administrative and parental support; technical use of how to operate tools; time to implement; and training for implementation. The frequency of themes evolved from pre- to post-intervention. As seen in Table 23, participants' concerns regarding availability of funding was the most significant barrier identified both before and after the intervention, accounting for more than a third of responses. However, concern over lack of knowledge, perceptions, technical use, and training all decreased as a result of engagement with the intervention. Factors beyond teachers' control (administrative and parental support, and time for use in the school day) remained unchanged. The only factor that increased from pre- to post- was concern over suitable access to assistive technology. Prior to the module, only 3% of responses considered the *amount of AT per student in each classroom*; whereas, after the module, 25% of responses spoke to a concern regarding lack of access to resources.

Table 23
Frequency and percentage of common barriers to AT use

	Pre-Intervention		Post-Intervention	
Code	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Total Responses	60		46	
Access	2	3%	11	25%
Funding	20	34%	15	34%
Knowledge	10	17%	6	13%
Perception	4	7%	1	2%
Support	2	3%	2	4%
Technical use	2	3%	0	0%
Time	5	8%	5	11%
Training	15	25%	4	9%
No barriers	0	0%	1	2%

Research Question 2

The second sub question studied how preservice teachers express their knowledge and attitudes concerning use of assistive technology, and what changes were evident after engaging with the module. Data analysis revealed that the module changed learners' understanding of supporting struggling readers' needs. As learners worked through module tasks that introduced characteristics of struggling readers, tools and strategies, and methods for making decisions, they contemplated how the learning impacted their thoughts about teaching struggling readers. They talked about concerns, demonstrated skills using tools, and internalized how to adapt their teaching style/philosophy. The data supported the conclusion that the module prompted learners to change their frame of reference (Mezirow, 1997), and thus transformed their level of efficacy in supporting struggling readers. Three main themes were evident in the participants' responses; as designed, the module encouraged participants to 1) challenge their beliefs and assumptions, 2) develop knowledge and skills, and 3) form new perspectives. Of the 383 coded items, 142 (38%) represented developing knowledge and skills, 125 (33%) represented forming new perspectives, and 116 (30%) represented challenging beliefs and assumptions.

Challenge Beliefs and Assumptions

Participant responses on section exit ticket open-ended question responses, discussion board postings, and journal responses reflected that interacting with many module tasks (e.g., the simulated experiences and observation of best practices) prompted the participants to reflect and revise previously held assumptions about their own abilities to support struggling readers. The simulated experience in which learners took on the role of a struggling reader led to insightful reflection. Learners were presented scenarios which prompted them to consider student characteristics and reflect on how this experience served as a disorienting dilemma (Mezirow, 1997). Once the learners walked in the struggling readers' shoes, so to speak, they reconsidered their preconceived notions. After the simulation, many participants expressed empathy and acknowledged stress induced by the experience. Participant 11 reported on a section exit ticket, "I felt confused. My eyes wandered from left to right constantly until I figured it out. Realized I was so focused on decoding that I did not really care what it actually read. Time ticking was stressful. Brings on anxiety." Comparably, Participant 17 reflected, "I think the disappointment and helplessness experienced when you can't understand what you are reading was very eye opening for me." Participant 20 observed, "It was really interesting to put myself in the perspective of a student and see what they have to face daily." and Participant 31 acknowledged, "I feel like I can better understand why some students shut down when working one on one and would rather not even try anymore." These responses are representative of all recorded on the section exit ticket, and similar reflections were mirrored by learners' answers on others prompts.

Responding to the journal stem *While I took on the role of a diverse student, I was thinking…,* Participant 10 shared a closely related experience to the one reported for Participant 11 above. She professed "how stressful reading actually is. The ticking clock and the scrambled

words in front of me caused me to constantly look from left to right. I was so focused on decoding the words that I did not pay attention to what the sentences were actually about." She continued to indicate that she internalized this feeling when she shared, "I now know how some of the students in my class feel. I can tell that they compare themselves to other students and feel inferior because they cannot read or comprehend at the same speed as their peers." Her sentiment was repeated by several other learners including Participant 2 who shared, "I had to unscramble the words to even understand a simple sentence. It was for sure frustrating since reading comes easy for me especially now." Participant 12 connected her simulation experience with a personal one:

> Recently, after a couple of severe concussions, I experienced reading struggles firsthand and now I really empathize with students who have trouble reading for any reason. This simulation reinforced those feelings--it is really hard for people who have never struggled with reading to know how these children feel!" She emphasized the value of the experience, noting "I think that all teachers should go through this simulation, because it will help them understand what some of their students are going through.

Similarly, Participant 42 observed the impact the simulation had on her perspective. She further internalized the experience prompting consideration of future action. "It took much longer to read them than it normally would for me. This added to my perspective from my students' eyes when they are struggling with reading and makes me wonder what actions I can take to make something this challenging become easier for them."

Next, learners watched a series of videos introducing them to individuals with disabilities whose lives are enhanced through assistive technology. The videos sparked conversations among the learners and promoted understanding the correlation between tool use and its impact on the lives of students with disabilities. On the discussion board, Participant 35 remarked, "AT helped them [students with disabilities] feel more self-sufficient and comfortable in school." Another, Participant 8, exclaimed, "[After watching Giesbert's video] I thought it was awesome that AT

gave him the power to live independently despite being completely paralyzed." Participant 19 concurred sharing, "This [Microsoft] video was so inspiring, as it showed how something like playing video games, which most people tend to take for granted, can exclude individuals with disabilities." Participant 17 was similarly impressed noting, "it was fascinating to see how high tech the AT has become and how technology truly can be life changing for people living with disabilities. I was especially impressed by the adapted video game controllers, because playing video games is something that is so simple for most of us, yet can be so marginalizing for a child whose disability keeps them from being able to play." In all, 21 learners participated in this exercise and all expressed how the videos impressed upon them that assistive technology levels the playing field and creates opportunities for individuals for whom none previously existed.

The experiences simulating students who struggle and observing best practice videos led to changes of mind (Mezirow, 1997) in how the preservice teachers would approach challenging situations. Participant 39 noted, "I knew it was hard for some students to read, but I am thankful for the simulation for making it a more personal experience for me. Now I can begin really working to assist my struggling readers." The participants shared a desire to make supporting struggling readers a priority. Participant 11 remarked, "Now that I know what a student feels when they struggle with reading, I feel more inclined to help them in any way possible. I would specifically want to remove all anxiety associated with reading and replace it with positive reinforcement. I want students to enjoy reading even if they have to overcome some obstacles. I do not want them to shy behind the categorization of 'struggling reader'." Similarly, Participant 15 realized, "it is also difficult for students who struggle to see how easy certain tasks are for their peers when they themselves greatly struggle." These reflections are consistent with other studies in which teachers expressed concerns that struggling readers' self-esteem is negatively

impacted by poor reading performance (Bryant, Linan-Thompson, Ugel, Hamff, & Hougen, 2001).

Developing Skills and Knowledge

It was anticipated that working with the toolkit would lead to improved sense of efficacy in supporting struggling readers in the content area classroom. The tasks were designed to encourage learners to demonstrate competence using and selecting a variety of assistive technology tools and talk about strategies for supporting struggling readers. Participant responses to questions in toolkit and discussion board postings were evaluated for evidence that the learner can correctly use and recommend a variety of tools.

Thirty-two percent of the module's tasks focused on developing learners' skills at using assistive technology tools and strategies. These tasks required learners to demonstrate competence and hence were assessed as correct or not correct. Twenty-three participants (61%) answered all 12 items for an average score of 88% correct. Table 24 lists numbers of completers and average score.

Table 24

Learner grades on practice with tools and strategies module objective tasks

Number of items completed (12 possible)	Number of participants (%)	Avg grade for completed items
12	23 (61%)	87.6%
11	7 (18%)	88.7%
10	0 (0%)	80.0%
9 or fewer	8 (21%)	68.5%

In addition to graded tasks, learners engaged in nine tasks that provided evidence that they interacted with the presented information. These items do not have a correct or incorrect answer;

rather, they ask learners to analyze information gained from the tasks and respond, thereby demonstrating their knowledge of tool use. That participants responded to these prompts indicated engagement with the module. Completion of these tasks are shown in Table 25.

Table 25

Participation rate of module tasks

Task	Prompt	Number of completers (%)
Poll	Do you read eBooks (yes/no)	33 (87)
Poll	Have you used Newsela with your students (or have you seen it used during a practicum experience)?(yes/no)	33 (87)
Poll	Poll: Which tool did you explore: Mercury Reader, Rewordify, or Snap and Read?	35 (92)
Screenshot	Draw It: Post your Snap and Read outline screenshot here.	31 (82)
Discussion board: Analyze tool features	Describe a feature of Newsela or Snap and Read that you would like to explore more?	8 (21)
Analyze tool features	Toolkit collection on virtual pinboard (Pinterest)	34 (89)
Journal: Analyze tool features	What book did you download? What settings did you change and why?	35 (92)
Journal: Analyze tool features	What did you think of ClaroPDF? Would you use it with your students?	30 (79)
Journal: Analyze tool features	Explain the implications and/or concerns of removing distractions from webpages using Snap and Read Universal. Did it work the way you expected it to? Was the integrity of the content maintained?	31 (82)

For example, learners described the book that they downloaded from Project Gutenberg and reported on changes they made to the Kindle app's settings. They could not answer that question

without working on the task. Sample responses include: “I downloaded a book titled, "The Legend of Sleepy Hollow" by Washington Irving. The first thing I changed was the size of the font and lowering the brightness since bright light irritates my eyes if I am staring at a screen for too long” (Participant 26); “When I played around downloading some books I did both chapter books and some picture books. I thought it was cool to change the language!” (Participant 2); and “I downloaded The Adventures of Sherlock Holmes by A. Conan Doyle. I chose to explore the flashcard setting because I thought this would be a great way to help students expand their vocabulary. Vocabulary often interferes with student comprehension so I wanted to see what tools there were to guide students in this department.”

Another task asked learners to contemplate the implications and/or concerns of removing distractions from webpages using Snap and Read Universal. The objective of this lesson was to encourage the learners to explore tool features and consider who may, or may not, benefit from the tool. Participant 7 remarked, “Yes it did work the way I expected it to. The integrity of the content was maintained. I think it would help with children struggling with ADHD and other attention disorders to remove the webpage's distractions.” Participant 4 offered an explanation that found the tool could be problematic for some students:

> Using Snap and Read Universal greatly removes all the advertisements and pictures that are incorporated in the news article. Though this may be helpful in keeping students strictly focused on the reading, I think it actually negatively impacts the students since there are little to no relevant photos connected to the article even if the article initially did have pictures. Many students use pictures to draw their attention and support their reading understanding or even remind them about what they just read. Now, with this tool, students no longer have this to their disposal. Rather, the integrity of the content was mingled with and the article does not serve the purpose it initially did.

In addition to tool specific tasks, participants responded to open-ended questions at the end of module sections three through five. These enabled learners to reflect on the tool use experiences and discussions with peers. Responses revealed the general consensus that there was

a lack of awareness about the existence of technology tools to support struggling readers. Participant 13 indicated, “I didn't know there were so many different programs for this purpose.” Participant 10 concurred expressing, “I was never aware of how many tools were actually available.” Learners also pondered how they could best support diverse learners: “I'd like to know more about ways to make the student feel more included” (Participant 32), “how [do I] notice students with [these] situations and … make them not feel so secluded in the classroom and their reading experience” (Participant 2), and “how as a teacher I can recognize whether my students actually do have learning disabilities or attention difficulties or if their struggles are more due to other factors affecting how my students learn and how they complete their work” (Participant 34). It is evidence that participants contemplated areas of weakness in their own knowledge, which is a component within the transformative learning process.

The task responses were also analyzed for talk among participants. Several responses offered evidence that participants benefited from vicarious experiences; that is, they reflected on the commonality of feeling first unprepared to help diverse learners (e.g., “I had felt a bit worried about how I would differentiate if students were very behind and how I could reach those that were truly struggling.” (Participant 10); “I always thought that teaching diverse learners is incredibly important, but seemed incredibly difficult to do” (Participant 17)) then acknowledged a shared change in perspective. For example, Participant 15 spoke directly about differing views on tool use when she wrote, “I thought it was interesting to see how many people liked Rewordify the best out of the three resources. I like this site a lot but I feel that Snap and Read has more options for students.” Other learners reflected on the tools in general. Participant 12 remarked, “Discussing these tools with my peers has helped me learn about them and come up with ideas about how to apply them in my classroom.” Participant 13 acknowledged a similar

sentiment claiming, “My colleagues had some great ideas about using AT that I had never thought of. Many of them also shared ideas that were similar to my own.” Another, Participant 10, shared, “I am now more aware of how I can best support diverse learners. It let me see different perspectives on the topic. This module gave me many resources I can use in the future” Participant 16 summarized that the experience “reinforced how important community is amongst teachers - that we can learn from each other in order to help our students. There is nothing wrong with looking to others for guidance in order to help our diverse group of learners.” Participant 31 concurred, sharing she feels “like I can always reach out and ask for advice when it comes to students.” Finally, Participant 27 aptly remarked, “I think hearing other perspectives is the only way to really learn. They may think of things I didn't and vice versa.” Clearly, there was consensus among participants that discussing the shared experience of tool exploration was beneficial and promoted learning through considering other participants’ experiences.

Some participants’ reflections alluded to having mastery experiences (Bandura, 1986). In contemplating how the module and interactions with colleagues impacted consideration of teaching diverse learners, participant 15 noted, “I always thought I would need to converse with other teachers or specialists in order to help my students but now I feel that I have more tools in my belt to attempt this more independently and confidently.” Another reflected, “I always thought that teaching all students who learn differently is hard but now I see that there are so many resources that are available to assist me in achieving this” (Participant 20). Participant 22 spoke for herself and her colleagues stating, “I think my colleagues all have pretty good ideas and are grasping the concepts of utilizing these technologies in the classroom.”

Form New Perspectives

After interacting with the embodiments, it was anticipated that learners would synthesize and reflect on their experiences. They would draw on these reflections to self-assess their abilities and plan a new course of action for supporting struggling readers in the content area curriculum. Evidence drawn from discussion board posts and open-ended journal responses indicates that the module generated this reflection.

Several participants reflected on how the module prompted their reflection and supported their sense of efficacy through a social emotional response (Bandura, 1986). Participant 34 exclaimed "[the module] has made me all the more excited to join the ranks of inspiring teachers." Participant 19 shared, "It made me feel just how important it is to support all the learners in my classroom, especially the diverse learners who need extra support." Many spoke of feeling more comfortable and confident working with diverse learners as a result of working on module tasks (i.e., participants 5, 12, 17, 20, 39, 42). Others shared how it produced feelings of empathy. Reflecting on her role being accountable for diverse learners, Participant 41 responded, "I feel it has helped me be able to understand how the child feels when struggling," and Participant 11 noted, "I know what a student feels when they struggle with reading." Thus, it can be said that the module tasks supported improving participants' sense of efficacy through producing emotional responses.

Working through the module encouraged participants to internalize the experiences to inform future teaching practices. Many reflected on improved attitudes and confidence in working with diverse learners. Others outlined specific plans they would incorporate. Participant 14 remarked, "I feel much more confident about teaching diverse learners now that I have learned all of these resources. This module helped me to learn that there really are SO many different ways students can have differentiated learning and that there is a way for everyone.

Similarly, Participant 17 shared, “I believe more than ever that teaching diverse learners is important and do-able. Participants 21 and 23 concurred: “I think teaching diverse learners will be easier now I have a lot of resources,” and “This module has completely changed the way I am going to approach teaching because of diverse learners.” Participant 13 reflected, “I believe that it's essential that no student gets left behind and these types of programs are exactly what I need to help all students understand my teaching.” In an open-ended section exit ticket response, another participant stated, “I realized that teachers should not fear teaching diverse learners since there are so many free resources” (Participant 3). Participant 22 agreed, “This module has made me more confident because now I know of all of the resources I can use in teaching diverse learners. It has improved my mentality because I dont [*sic*] think I would have come across most of these on my own in trying to find a solution for a struggling to student, so now that I have experience with them, I am more easily able to provide resources for diverse learners.”

Participant 31 concluded, “I feel like I have to make sure I am much more observant in the classroom so I can more quickly identify a student that might be struggling. Participant 19 offered these thoughts on future practice: “I can see how these tools are so important for students with reading disabilities, and how with all of the technology available, there is no reason for students who are struggling readers to not have access to these options in the classroom.” Participants 12 and 13 provided insight regarding the overall efficacy of the module. 12 noted, “This made me realize that differentiating instruction is easier than I thought!” and 13 reflected it “made me feel a bit more confident in ways to differentiate” and effused, “I only wish I had access to this module throughout my future teaching career.” Participant 34 pondered, “why are these resources not more well known?” Participant 5 expressed such appreciation for the content that she requested access to the module after the study concluded for future reference.

These examples represent a portion of the abundance of comparable reflections noting that as a result of working through the module, participants reflected on their previously held assumptions and experiences with module tasks, and internalized these experiences to reflect plans to alter their future teaching approaches. This was further corroborated by their achievement on tasks measuring how well they synthesized presented information to present informed decisions to support struggling readers' needs.

It must be noted that there were several designed components that did not garner the expected response. For example, while 33 (89%) participants created virtual pinboard toolkits, many did not elect to use them to keep track of the tools they explored. Despite several reminders to do so throughout the module, few took advantage of this tool. Comparably, no one elected to submit FlipGrid responses to share thoughts on open-ended questions. Each question contained a reminder of the option, but none chose to submit in this format. It would be pure conjecture to surmise the reason these elements were left unused. Exploration of possibilities will be discussed in Chapter 5.

Research Question 3

The final research question asked, after completing the module, do preservice teachers demonstrate competence using, integrating, and evaluating use of assistive technology to assist students who struggle with reading in the content areas? It is evident from the evaluative discussion board prompts (e.g., who struggles to read, what does Dave need, part 1 and part 2; and what does Beth need) and the final assessment that the majority of the participants demonstrated improved skill at synthesizing knowledge promoted by the module to make informed recommendations for assistive technology use for struggling readers.

Two discussion board prompts (who struggles to read and what does Dave need, part 1) pre-assessed participant understanding of the students' strengths and needs. The participants were proficient at identifying areas in which the student needed support (e.g., reduce frustration, increase motivation and comprehension, and provide vocabulary support). Their suggestions for solutions were generally appropriate (e.g., recognized that Dave would benefit from listening to the text) but vague (e.g., did not offer specifics on how to accomplish this). Responses after working through module tasks showed marked improvement in terms of appropriateness and specificity. For example, prior to the intervention, Participant 1 thought that a graphic novel would help Dave complete his required social studies reading tasks (i.e., learning about the American Revolution). However, after completing the module, Participant 1 offered more specific suggestions: "Dave has a plethora of tools he could use in order to minimize distractions, and to maximize understanding of the test. I think that Dave should use Snap and Read in order to best comply to his needs, in the least stressful way possible." This learner recognized that Snap and Read would provide Dave with the tools he needs to be successful. Similarly, Participant 19 offered this suggestion prior to the module: "Dave could benefit from a text-to-speech reader that he could follow along with in class, which also highlights each word as he goes so he can keep track of his place." After it, Participant 19 refined her response to suggest: "After learning about the leveled readings available, I think Dave would benefit from the Newsela app and Snap and Read above all. Since he has been having difficulty in social studies, I think Newsela would be useful for current events, while Snap and Read would be good for any assigned readings available on the web." Before the module, Participant 16 suggested, "Reading alongside an audiobook may increase Dave's interest as well as improve his comprehension skills." Yet, after it, Participant 16's modified response appropriately recommended, "Rewordify

would be beneficial as it would simplify the vocabulary and hopefully make Dave feel less frustrated as he learns to read." Notably, Participant 15 first suggested "an audio book or electronic device." Her response was refined after the module to specify:

> Dave needs to use Snap and Read so that he can better focus on the material. Audio books through the kindle app or Bookshare are other good resources. However, he may also benefit from watching videos with subtitles in order to relieve some of the stress of reading. In addition to this, Rewordify is another tool that would benefit his situation since he struggles with vocabulary.

The other participants offered comparable levels of improved specificity indicating that they had learned about tools that could benefit a student such as Dave.

Participants had equal success in offering suggestions for Beth, another hypothetical struggling reader. Participants correctly surmised that she may have dyslexia and "would benefit from the highlighting feature in AT. This way she knows which word she is reading, and it will be more apparent and help with the jumbling of the words on the page" (Participant 35). Other participants (i.e., 10, 13, 19, and 31) recognized the usefulness of highlighted text for Beth. Several others (i.e., 10, 16, 21, 22, 36, and 41), however, only noted the need for an audiobook. They did not distinguish between audio support provided by an audiobook and the audio synchronized with text provided by text-to-speech applications. While offering an audiobook would provide some support for Beth, this recommendation does not offer more than adequate support.

In the presented scenario for Dave, the majority (88%) appropriately recommended tools that would allow him to access his required social studies readings on an appropriate level. However, nearly a third of participants who appropriately recommended use of Snap and Read to remove webpage distractions also recommended Dave use Rewordify for vocabulary support. This indicates that there was not adequate explanation of Snap and Read's features because it has

embedded vocabulary support and would not work in conjunction with Rewordify. Apparently, the module design needs to be modified to clarify how to best select the tools that will offer the most benefit without overwhelming the struggling reader with too many options or features.

The final question on the exit tickets for sections three through five asked participants to consider what areas they would like to learn more about. The responses revealed reflection on the sections' content as well as a synthetization of the information to the participants' field placement experiences. Several themes surfaced among the responses: desire for exploration of more resources, questions pertaining to implementation logistics, availability of resources, and general perceptions of technology in schools.

Many participants indicated a desire to learn about resources beyond those covered in the module. A few participants requested information on students who need support in areas other than reading. Participant 21 requested information on "assistive technology for students who are blind" and Participant 27 wondered about "other resources for different disabilities." Several other participants acknowledged the plethora of available tools and sought knowledge on incorporating other resources for other subjects once they are certified teachers. Other participants questioned the availability of tools in the field. For example, Participant 36 queried, "Why do schools not know about these tools?" and Participant 20 indicated concern over whether she would have access in the district she teaches in. She asked, "how many school districts are actually open to using these tools?" Participant 19 acknowledged that low-tech options are widely available but "it would be useful to have more high-tech options for my students who could really benefit from them."

Additionally, there were many questions regarding how to garner support for the use of assistive technology in schools. Questions regarding logistics (e.g., how to implement,

troubleshoot technical issues, and garner support) dominated the questions from the simple such as can highlighted text can be printed (Participant 38) to the more complicated: ‘what to do if one of these programs fails, the technology fails/wifi is down, etc... and the student is unable to complete the assignment” (Participant 37); and “what to do when multiple students in my class are having difficulties and all need something different” (Participant 2). Extending from logistical issues was concern for support among administrators and even parents. From “how I can get schools to be more open with using technology” (Participant 4) to “What if [assistive technology] doesn't work for students? What if one student doesn't fit under any of the accommodations schools have in place? Would the school take a long time to help that student?” (Participant 38). Finally, participants recognized that funding could be a barrier to implementation. Participant 20 considered the digital divide (Abascal, Barbosa, Nicolle, & Zaphiris, 2016) when she reflected, “[What are] ways to provide these resources for families because some families don't have access to technology due to financial stress so how would they be able to help their child?” Participant 17 similarly remarked, “I would like to know more about the availability of ATs for reading comprehension in low income/ low resource school districts. Are these children at an automatic disadvantage?” Collectively, these concerns and comments indicate that the participants recognized the value of integrating assistive technology to support student. These queries prove that the participants are thoughtfully considering how they could implement assistive technology in their future practice.

Final Assessment

In the assessment, participants were provided descriptions of four students' characteristics, the environment they were working in, and the tasks they needed to complete. The participants needed to analyze this information and make decisions to recommend appropriate tools and strategies to improve the students' access to the curriculum. In answering, participants were required to decide on an appropriate tool, note the tools' features, and provide a rationale for the decision. Thirty-one participants completed this assessment for an average score of 86% correct. Reviewing the answers, participants performed nearly identically in making decisions for the four students: the average correct score for each hypothetical student is described in Table 26.

Table 26

Average correct score for each student described in final assessment, on a scale of 0 to 3

	Average score (percent)
Student A	2.71 (90%)
Student B	2.71 (90%)
Student C	2.71 (90%)
Student D	2.63 (88%)

Student D proved to be the most problematic. He was described as an eighth grader with autism, significant reading comprehension problems, who gets easily frustrated, has attention issues, and likes to be organized. The participants primarily recommended the correct tool but had difficulty articulating the features and rationale for the tool. However, overall, the participants correctly identified and rationalized appropriate tools and strategies for each of the proposed scenarios.

Summary

The participants' responses on the formative and summative assessments indicate progress over the course of the module. Generally speaking, participants who completed a higher percentage of module tasks also scored higher on the final assessment. Comparably, there was also statistically significant improvement from the pre- to post-intervention surveys. Overall, the numerous data sources analyzed revealed positive outcomes regarding increased sense of efficacy and competence using and recommending assistive technology tools to support struggling readers in the content area curriculum. There are aspects of the module that could use refinement; however, overall, the intervention proved to be successful at providing opportunities to promote transformative learning. Assessing the entirety of the module tasks, it can be concluded that the intervention influenced preservice teachers' sense of efficacy, knowledge of assistive technology, and decision-making ability to recommend appropriate tools and strategies to support struggling readers in the content area curriculum.

CHAPTER V

Discussion and Implications

This study has examined the effect a self-guided online course module on preservice teachers' perceptions regarding use of assistive technology to support struggling readers in the content area curriculum. This chapter reviews the study's findings in relation to the research literature and the study's research questions. It then presents suggestions for improving the module based on the study's outcome. Future research and action are proposed to ensure that assistive technology is embedded in teacher preparation programs.

Research Design

The study's goal was to address the lack of preparedness within elementary education teacher preparation programs in equipping future teachers with the confidence and knowledge to use assistive technology to support diverse learners. By reducing the experience barrier (Flanagan et al., 2013) using assistive technology, it was anticipated that preservice teachers were more likely to regularly integrate assistive technology into pedagogical practice. Specifically, the study addressed the gap in the research examining how preservice teachers are prepared to support struggling readers in the content area curriculum. The study focused on helping teachers of students in grades four through eight, for whom formal reading instruction declines yet strong literacy skills are crucial to continuing academic improvement (Zorfass et al., 2007). Prior research demonstrated that teachers' sense of efficacy directly correlates to their students' success (Florian et al., 2010; Sanders & Rivers, 1996). It also indicates that teachers feel underprepared to support diverse learners using assistive technology due to lack of training, knowledge of assistive technology, and resources (Benton-Borghi, 2015; Bouck, 2016; Flanagan et al., 2013; Okolo & Diedrich, 2014; Quinn et al., 2009). It was hypothesized that with targeted

experiences to observe experts and engage in dialogue with peers (Bandura 1986, 1997), preservice teachers would improve their sense of efficacy towards using assistive technology with diverse learners. It was further anticipated that engaging in activities that produced discomfort and promoted reflection would encourage transformative learning (Mezirow, 1997).

The primary research question driving the study was: To what extent does engagement with self-guided course module influence preservice teachers' conceptions regarding their abilities to assist struggling readers access the content area curriculum? Within this, the study examined three sub-questions a) How did preservice teachers report their sense of efficacy in assisting struggling readers' access to the content area curriculum? How did engaging with the module impact this? b) How did preservice teachers express their knowledge and attitudes concerning use of assistive technology, and what changes were evident after engaging with the module? c) After completing the module, did preservice teachers demonstrate competence using, integrating, and evaluating use of assistive technology to assist students who struggle with reading in the content area curriculum?

To answer these questions, this design-based research study implemented a researcher-designed self-guided online module that assessed progress using mixed methods. Participants' progress was analyzed from data gained from pre- and post-intervention surveys measuring sense of efficacy towards supporting struggling readers and integrating assistive technology in the content area curriculum (Benton-Borghi, 2015; Lee & Vega, 2005; Tschannen-Moran & Woolfolk Hoy, 2001). While the survey instrument measured progress over time, it could not reveal how design elements contributed to changes to learning. Thus, process data were collected in the form of participants' responses on section exit tickets, journal responses, and

discussion board postings. This process data provided a snapshot of progress throughout the module activities and supported why learning occurred.

Thirty-eight elementary education preservice teachers enrolled in a literacy methods course participated in the study. Data collection began mid-September 2019 and concluded in October 2019. The study began and concluded with a survey measuring participants professed sense of efficacy and knowledge using assistive technology. During the study, participants engaged with module tasks to demonstrate competence using the showcased tools and strategies. These tasks allowed a comparison between professed and attributed knowledge. A discussion of the key findings and implications for future research follows.

Summary of Findings

An abundance of data was analyzed to determine the extent to which the module influenced preservice teachers' conceptions regarding their abilities to assist struggling readers access the content area curriculum. The findings indicated that there was an increase in both professed and attributed knowledge using assistive technology which correlated with an increased sense of efficacy in working with struggling readers in the content area curriculum. This conclusion is supported by statistically significant increases from pre- to post-intervention survey results as well as by examining objective and subjective responses to module tasks. As indicated in Chapter IV, the module tasks prompted learners to change their frame of reference based on experiencing disorienting dilemmas, critical reflection on preconceived assumptions, and exploration of alternative possibilities (Mezirow, 1997). Thus, the participants' transformed approach led to increased levels of efficacy in supporting struggling readers. Three main themes were evident in the participants' responses to the module; as designed, the module encouraged

participants to challenge their beliefs and assumptions, develop knowledge and skills, and form new perspectives.

Challenge Beliefs and Assumptions

Simulated experiences and observation of best practices prompted participants to evaluate their previously held beliefs, consider student characteristics, and revise their positions on working with diverse learners. Responses generated after participating in related module tasks showed that participants reflected on their initial thoughts and reconsidered their plans for engaging struggling readers in the lesson. Given that the participants will be responsible for teaching a range of diverse learners (McCray & McHatton, 2011; McTighe & Brown, 2005), it is vital that they implement best pedagogical practice for teaching diverse learners but also that they explicitly contemplate what it means to be a diverse learner. Only by recognizing the obstacles that these students may confront will the preservice teachers be adequately prepared to teach them. The data indicate that the module tasks elicited thoughtful reflection. Notably, many remarked on the frustration they felt in the given scenarios and pledged to recall that discomfort when working with future students. These activities motivated the need to learn about assistive technology tools and strategies that can support struggling readers.

Develop Knowledge and Skills

After discovering a need to use assistive technology, participants embarked on a journey exploring evidence-based tools, such as text-to-speech, embedded supports, graphic organizers, presentation tools, and captioning. They witnessed individuals using the tools and had opportunities to practice using the tools. They were prompted to apply their discoveries to help their own students as well as make recommendations for hypothetical students. These tasks helped put the tool use in perspective and prompted insight into what could be potentially useful

or, conversely, problematic. To assess progress, participants answered objective and subjective questions on section exit tickets as well as demonstrated ability in embedded module tasks. It was expected that the participants would successfully demonstrate competence using the tools. That they expressed interest and began to envision application in future practice was a desired outcome that came to fruition. It must be noted that this was the participants initial exposure to assistive technology. That they made such positive gains and remarked on the usefulness of application further corroborates the need to implement assistive technology training in general education teacher preparation programs. At no point did participants question the need to consider these tools because they viewed the onus to be on the special education teacher; rather, they seemed to recognize the shared responsibility of educating all students in the classroom, regardless of culture, language, or level of ability. Instead, the participants discussed their findings with their peers and continue to plan action for the future, indicating they were developing new opinions and understanding of assistive technology use.

Form New Perspectives

Finally, participants demonstrated that they internalized the need for assistive technology and how it functions. As they worked, reflected, and discussed with peers, they demonstrated a change of mind and provided evidence that they were forming new perspectives on how to integrate assistive technology. Participants recognized that all students can benefit from assistive technology and continued to contemplate how to best embed it in practice. As they surmised at the start of the study, time and financial support for implementation continue to be a concern. Yet, they acknowledged the breadth of free or low-cost options that are widely available. Several participants remarked that they wish to continue learning about other assistive technology resources and began to form plans on how to integrate it beyond supporting struggling readers.

Notably, after the intervention, 25% expressed concerns about the lack of resources to support assistive technology in schools. Only 3% considered this to be a barrier prior to the module. One can surmise that this increase reflects participants realization of the importance of having access to assistive technology resources in the classroom. These conclusions again support the notion that a short yet intensive training on assistive technology is useful and necessary for preservice general education teachers. The results have strong implications for future research and practice.

In summary, the data supports that the module generated interest in the subject and the tasks illustrated the useful of assistive technology. The majority of participants successfully completed objective module tasks and appropriately reflected on open-ended responses. They observed and reflected on mastery experiences, and through discussion board postings, engaged in vicarious learning that further bolstered their understanding. Furthermore, as indicated in Chapter IV, the module generated an expressed interest in continuing to learn about assistive technology beyond the end of the module. This indicates that the module promoted thoughtful consideration about assistive technology and encouraged participants to plan to integrate it in future practice.

Implications

Practical Implications

Consistent with previous research (Judge & Simms, 2009), training opportunities introducing assistive technology have demonstrated positive outcomes. The study's positive outcomes bolster the premise that an online self-guided module designed on a TPACK-UDL framework (Benton-Borghi, 2015) can support learning among preservice teachers without the intervention of a course instructor. These findings suggest that general education teacher preparation programs should consider integrating a course module on assistive technology.

According to the data presented, a standalone module can be an effective means for introducing assistive technology. As such, preservice teachers gain knowledge in an area not typically addressed in general education teacher preparation (Kennedy et al., 2011) without having to add an additional course to the already full program of study (Kennedy et al., 2011; McCray & McHatton, 2011).

Future Implications

Given that few studies examine correlation between efficacy and assistive technology and there is minimal research on using compensatory tools for literacy among general educators, this study contributes to the field and attempts to narrow the research gap. However, it leads to further opportunities for research. First, the study should be replicated with additional cohorts to verify the demonstrated outcomes. It would be valuable to determine if outcomes are replicated. Another possibility is to run the study at another institution of higher education. As teacher preparation programs vary, it would be informative to determine if similar outcomes emerge from different programs. If the study is successful at an alternate study site, it would give further credence to the results. Finally, offering the study earlier in the teacher education preparation program may enable researchers to track if module participation resulted in changed attitudes and practice during field experiences.

Limitations

Although the study was determined to be successful, there are several limitations related to the design of the study that need consideration. First, there was no post-study assessment at a point later in time. Thus, it is not possible to determine if the outcomes influenced practice over time. Additionally, there is no evidence of preservice teachers working with students in their field placements, so there is no verification if the module made a difference in practice as well as

theory. In addition to the data collection measures detailed above, observation of preservice teachers interacting with struggling readers in the content area curriculum would further support observations and conclusions. Next, the limited number of participants resulted in a data set is too small to do factor analysis. Gains were observed; however, the small sample size in conjunction with the lack of triangulation of data indicates overall outcomes need to be celebrated with caution.

In terms of module design, there are several components that could have impacted study outcomes. First, the final assessment was an ungraded exam for which no course credit was given. As such, there was considerable disparity among the thoroughness of given responses compared to responses provided when the identical assessment was used as an exam (weighted 30% of course grade) in a graduate assistive technology course. While participants provided suitable answers to demonstrate competence, adding the weight of a grade would, no doubt, improve the richness of responses. Next, there was no way to determine how much time participants spent on module tasks. The final poll asked participants to self-report the time they dedicated to the module but there was no way to verify the accuracy of this information. Other than examining responses on section exit tickets, there is no method to confirm the degree to which participants attended to the module tasks. Therefore, general conclusions can be drawn regarding the efficacy of tasks; however, these conclusions would be bolstered if the module was able to display specific user statistics. Should that not be a possible feature, post-study interviews or focus groups could be instituted to gain specific feedback on the design.

Also, in regard to the design, post-study interviews or focus groups could inform why some features (e.g., virtual pinboard, FlipGrid responses, etc.) were ignored. It could be deciphered if it was user preference (i.e., participants preferred to type rather than video record

responses), technical issues that prevented suitable engagement, sheer number of module tasks, or another concern that inhibited participation in certain areas. Such information could inform future designs. Results from version one to version two could then be compared, adjusted, and again analyzed, in true design-based iterative fashion.

Recommendations for Future Research

Based on findings, implications, and limitations, there are several recommendations for future research. First, an improvement would be to assign the module for course credit. As discussed in the limitations section, the quality of responses varied from those generated on graded assignments. Given that the module requires a significant time commitment to complete, it would be appropriate to provide formal credit for its completion. Assigning it as a graded component would give it a more substantial bearing, reinforce the seriousness of the module's tasks, and potentially impact the richness of responses provided.

It is recommended that preservice teachers are required to complete the module prior to student teaching. It would be well served to remain a component of the literacy course in which this study was implemented. The experience would be improved by incorporating discussion of the module within the course meetings. Preservice teachers could complete the activities independently, but the added discussion component could serve to deepen learning and bolster connections to observations made during field visits. It would also be beneficial to have regular check-ins with an expert in assistive technology to remedy any issues that arise while working on the module.

Furthermore, it is recommended that the study is expanded to include tools and strategies that support writing in addition to reading. By extending the module's reach, improving literacy would be the outcome. Further iterations of the module could include discipline literacy, which

focuses not only on improving reading and writing in general but seeks to improve how students engage with texts specific to disciplines. A learner must parse a scientific text differently than a historical one.

Another recommendation would be to track preservice teachers progress through graduation and into their first years of teaching. Participants earning New Jersey teaching certification are required to pass the edTPA (Pearson Education, 2019). The participants' submissions could be examined for evidence of accommodating diverse learners' needs using assistive technology. Once the participants are certified teachers, another study could examine conditions such as how likely they are to regularly embed assistive technology to support the diverse learners, how supportive the administration is of assistive technology (in offering resources and professional development), and how competent they feel in comparison to peers who did not have any formal assistive technology training. Of the plethora of studies researched, none tracked how teacher preparation in assistive technology impacts in-service teacher efficacy and competency; therefore, thoughtful, extended study could significantly improve the quality of research currently available and counteract the inverted relationship between technology reliance in schools and number of empirical studies conducted (Okolo & Diedrich, 2014).

Conclusion

Based on a theoretical framework of using transformative learning to enhance teacher efficacy, the intervention, adhering to the UDL principles, aimed to build participants' awareness and knowledge of assistive technology to support struggling readers. This awareness impacted their sense of efficacy to embed assistive technology in pedagogical practice thus provided them with the competencies to offer students with diverse learning needs access to the content area curriculum. Despite limitations due to sample size, the study presented positive outcomes for

engaging preservice teachers in a self-guided online module promoting integrating of assistive technology in the general education classroom. Based on participant responses, it is anticipated they will seek out opportunities to embed assistive technology within their future teaching practices. In doing so, they will proactively support all students' needs in accordance to the principles of universal design for learning.

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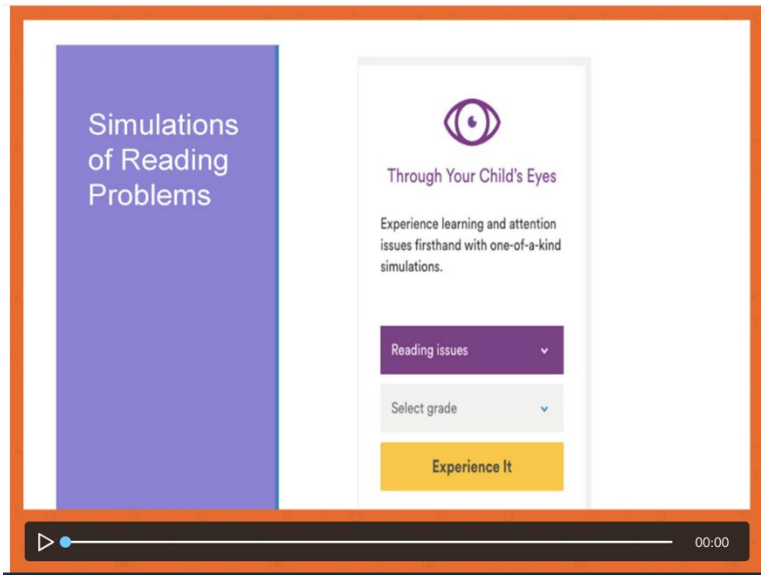
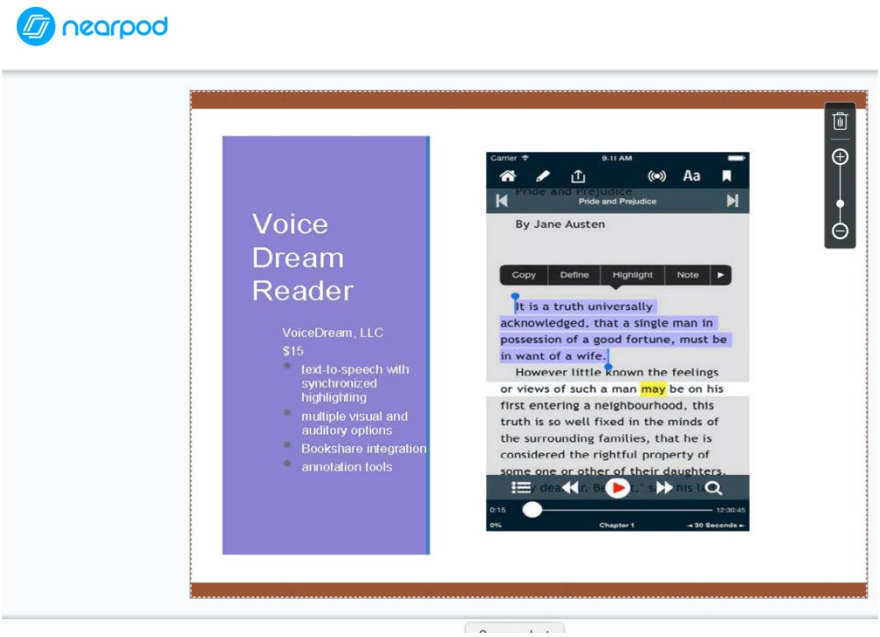
Appendix A

Design Elements

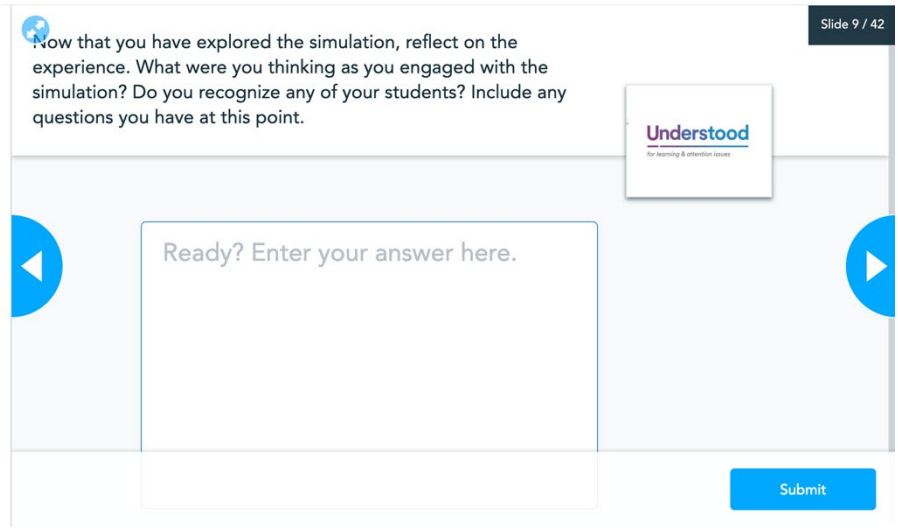
1. Simulated experience example (www.understood.org)



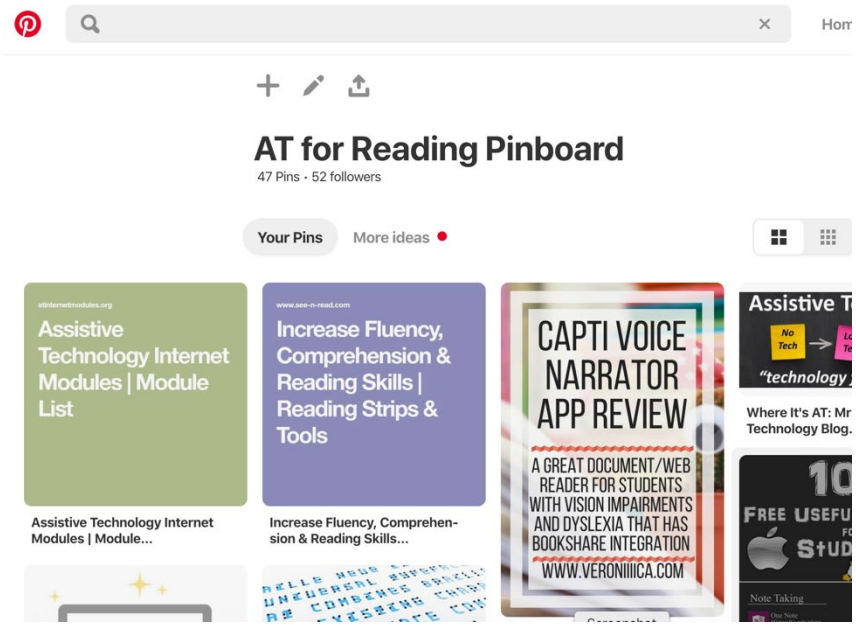
2. Sample toolkit component (Voice Dream Reader)



3. Sample reflection prompt



4. Sample toolkit virtual pinboard entry



5. Sample Content Acquisition Podcasts from SpedIntro.com

Topic	**Web address**
Students with Specific Learning	https://vimeo.com/channels/550360/72439473

Disabilities	
Accommodations and Modifications	https://vimeo.com/73576320
Improving Vocabulary Instruction for Science SWD	https://vimeo.com/channels/550360/193409505
Embedded Supports to Differentiate Instruction for Struggling Students	https://vimeo.com/channels/550360/74485935

6. Sample Graphic Organizer: CAP notes

7. Sample Section Exit Ticket

Section 1: Exit Ticket

Answer these questions before you move onto the next section. The questions are intended to help you gauge your learning.

* Required

1. **What is your unique identifier?** *

2. **Briefly define assistive technology.** *

3. **In your classroom, can only students who have IEPs use assistive technology?** *
Check all that apply.

- [ ] Yes. If a student does not have an IEP, s/he cannot use assistive technology
- [ ] I'm not sure how to answer this yet
- [ ] No. Any student can use assistive technology, but the school is only legally required to provide it for students who qualify.

4. **In what ways do you think assistive technology can benefit students? Check all that apply.** *
Check all that apply.

- [ ] 1. Can offer access to content s/he wouldn't otherwise have
- [ ] 2. Can help modify content to be on a more appropriate level
- [ ] 3. Can level the playing field by providing reasonable accommodations
- [ ] 4. Can assist a person live independently
- [ ] 5. Can provide financial compensation
- [ ] 6. Can offer a cure for a student's disability

5. **After this brief overview of assistive technology, rate how you feel regarding your confidence in helping students access the curriculum using technology.** *
Mark only one oval.

	1	2	3	4	5	
very afraid	◯	◯	◯	◯	◯	highly confident

Powered by Google Forms

8. Sample Final Assessment and Rubric

Participant identifier

Use the same identifier as you did for the module and surveys:
What is the name of your childhood street plus the name of your first pet, sibling, or best friend? (E.g. 'Main Mittens'.)
* Required

1. Identifier *

SETT Framework Assessment

Instructions:
1. Review the Student description, Environment(s) and Tasks column that list the reading components of a lesson that a student must complete.

2. Fill in the TOOLS by listing the technology tools you would recommend to make the writing components accessible to the students. Include both the generic term for the technology tool(s) and product names. Make sure your recommended solution(s) match(es) the task and the student's characteristics.

3. Offer a RATIONALE explaining your decision-making. WHY are you recommending these technology tools? Which specific features will help these students?

Student A

Student A	Environments	Tasks
4th grader Avid reader; no learning disabilities Has cerebral palsy with fine motor problems. Cannot hold a pencil or turn pages of a book but can type and swipe with one finger.	Inclusive 4th grade classroom with in-class support teacher iPads and laptops available An iPad mounting system is installed on the student's wheelchair.	Read a personal choice book

2. Recommended Tools (be specific and include where the student gets the book from) *

3. Rationale *

Student B

Student B	Environments	Tasks
6th grader with learning disabilities: • Reads on a 2nd grade level • Handwriting is illegible • Difficulty editing & spelling • Poor executive function skills; struggles with organization • Gets frustrated when not successful • Loves sports, likes listening to stories & watching movies	Inclusive middle school classrooms. Departmentalized. Computers and iPads available	Finding & reading websites to gather information for a social studies research project

4. Recommended Tools *

	FINAL ASSESSMENT RUBRIC	
Criteria	Ratings	Pts
Decision-making	3.0 pts: All decisions pertaining to technology tools for reading are appropriate for the students & tasks listed. 2.0 pts: Most decisions pertaining to technology tools for reading are appropriate for the students & tasks listed. 1.0 pts: Several decisions pertaining to technology tools for reading are not appropriate for the students &/or tasks listed.	3.0 pts
Quality of narrative	3.0 pts: Written well; writing shows professionalism, e.g., correct spelling & grammar, titles of software are capitalized 2.0 pts: Demonstrates understanding but the writing lacks professionalism in places & needs editing. 1.0 pts: Written poorly overall & needs substantial re-writing.	3.0 pts
Use of technical terms	3.0 pts: All titles & technical terms are correct. 2.0 pts: Contains a few errors in titles and/or technical terms 1.0 pts: Several errors in titles and technical terms or does not use technical terms.	3.0 pts
Specific features	3.0 pts: Discussion identifies specific features of apps/devices/websites that will help the student 2.0 pts: Discussion identifies 1 or 2 specific features of apps/devices/websites but does not adequately explain how they will help the student 1.0 pts: Specific features are not discussed	3.0 pts
Overall understanding	3.0 pts: The recommendations for all 3 students are appropriate & clearly justified. 2.0 pts: The recommendations for 2 students are appropriate & clearly justified. 1.0 pts: The recommendations for only 1 student are appropriate & clearly justified. Significant errors in the other two.	3.0 pts

Appendix B

Pre/Post Intervention Surveys

AT for Struggling Readers: Perceptions and Knowledge (PRE)

For statistical comparison purposes of pre- and post-survey responses, please select a unique identifier that you will remember. List it here and use the same identifier on the post-survey. What is the name of your childhood street plus the name of your first pet, sibling, or best friend? (E.g. 'Main Mittens'.)

_____

If you could choose your ideal placement, what grade level would you teach?

- ○ early childhood (1)
- ○ elementary (2)
- ○ middle school (3)
- ○ high school (4)
- ○ post-secondary (5)

What grade is your field placement?

- ○ 1st (1)
- ○ 2nd (2)
- ○ 3rd (3)
- ○ 4th (4)
- ○ 5th (5)
- ○ 6th (6)
- ○ Other:

What is your academic major?

- ○ African American Studies (1)
- ○ Art (2)
- ○ Biology (3)
- ○ English (4)
- ○ History (5)
- ○ iSTEM (6)
- ○ Mathematics (7)
- ○ Music (8)
- ○ Psychology (9)
- ○ Sociology (10)
- ○ Spanish (11)
- ○ Women's & Gender Studies (12)

Do you regularly work with students with IEPs or 504s?

- ○ Yes (1)
- ○ No (2)

Have you worked with English Language Learners?

- ○ Yes (23)
- ○ No (24)

Have you **completed** any assistive technology (AT) training during your teacher preparation coursework ?

- ○ Yes (1)
- ○ No (2)

Do your students have regular access to computers and/or tablets (e.g., iPads, Chromebooks, etc.) in the classroom? (If you are a preservice teacher, consider your most recent field experience placement.)

- ○ Yes (1)
- ○ No (2)
- ○ NA (3)

Display This Question:

If Do your students have regular access to computers and/or tablets (e.g., iPads, Chromebooks, etc.)... = Yes

How many devices (e.g., computers, iPads, Chromebooks, etc.) do your students have regular access to?

- ○ 1-4 (2)
- ○ 5-10 (3)
- ○ 10-25 (4)

Display This Question:

If Have you completed any assistive technology (AT) training during your teacher preparation coursew... = Yes

How many estimated total hours have you participated in AT training?

- ○ less than 5 hours (1)
- ○ 6-20 hours (2)
- ○ 20-40 hours (3)
- ○ More than 40 (4)

Directions: This questionnaire* is designed to help grasp a better understanding of the kinds of things teachers may experience. Please consider your teaching experiences (including all field placements –past and current) and indicate your beliefs about each of the statements below.

	Nothing (1)	2 (2)	Very little (3)	4 (4)	Some influence (5)	6 (6)	Quite a bit (7)	8 (8)	A great deal (9)
How much can you do to get students to believe they can do well in school work? (1)	○	○	○	○	○	○	○	○	○
How well can you respond to difficult questions from your students? (2)	○	○	○	○	○	○	○	○	○
How much can you do to get through to the most difficult students? (3)	○	○	○	○	○	○	○	○	○
How much can you do to motivate students who show low interest in school work? (4)	○	○	○	○	○	○	○	○	○
How much can you do to engage struggling readers in the the lesson? (5)	○	○	○	○	○	○	○	○	○
How much can you do to help your students value learning? (6)	○	○	○	○	○	○	○	○	○
How much can you do to help your students value reading? (7)	○	○	○	○	○	○	○	○	○
To what extent can you assist struggling readers use technology tools to enhance their learning? (8)	○	○	○	○	○	○	○	○	○
How much can you do to gauge student comprehension of what you have taught? (9)	○	○	○	○	○	○	○	○	○

To what extent can you craft good questions for your students? (10)	○	○	○	○	○	○	○	○	○
How much can you do to foster student creativity? (11)	○	○	○	○	○	○	○	○	○
How much can you do to improve the understanding of a student who is failing? (12)	○	○	○	○	○	○	○	○	○
How much can you use a variety of assessment strategies? (13)	○	○	○	○	○	○	○	○	○
How much can you do to adjust your lessons to the proper level for individual students? (14)	○	○	○	○	○	○	○	○	○
To what extent are you familiar with technology tools for reading? (15)	○	○	○	○	○	○	○	○	○
How much can you use a variety of technology tools to provide access to the curriculum? (16)	○	○	○	○	○	○	○	○	○
To what extent can you provide an alternative explanation, example, or access method when students are unable to interact with the lesson/assignment as originally designed? (17)	○	○	○	○	○	○	○	○	○
How well can you implement alternative strategies in your classroom? (18)	○	○	○	○	○	○	○	○	○

How well can you provide appropriate challenges for very capable students? (19)	○	○	○	○	○	○	○	○	○
How much can you do to help students reach standards-based accomplishment in Language Arts?* (20)	○	○	○	○	○	○	○	○	○
How much can you use technology to help students reach standards-based expectations in reading?* (21)	○	○	○	○	○	○	○	○	○
How much can you assist families in helping their children do well in school? (22)	○	○	○	○	○	○	○	○	○
How much can you do to help your students think critically? (23)	○	○	○	○	○	○	○	○	○
How much can you do to provide students who require text readers and accessible digital content, access to the curriculum content?* (24)	○	○	○	○	○	○	○	○	○
To what extent can you implement accommodations for assistive and accessible technology for students with disabilities in your classroom?* (25)	○	○	○	○	○	○	○	○	○

How much can you do to provide universally designed (digitally) assessments to evaluate learning by students with disabilities in your classroom?* (26)	○ ○ ○ ○ ○ ○ ○ ○ ○

This questionnaire is adapted from *Teachers' Sense of Efficacy Scale (TES) (*Tschannen-Moren & Hoy, 2001) with questions marked with an asterisk added from *Teacher's Beliefs Inventory* (Benton-Borghi, 2006).

* Benton-Borghi, B. H. (2006).*Teaching every student in the 21st century: Teacher efficacy and technology* (PhD Thesis). The Ohio State University.

Tschannen-Moran, M., & Woolfolk Hoy, A. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education, 17* (7), 783–805.
Consider your students in your teaching experiences (including field placements if you are not currently teaching) and indicate your beliefs about each of the statements below.

	Strongly Disagree (1)	Disagree (2)	Mixed feelings (3)	Agree (4)	Strongly Agree (5)	N/A (6)
I feel comfortable using AT with my students. (27)	○	○	○	○	○	○
AT information is easy to obtain in my school district. (28)	○	○	○	○	○	○
I received appropriate training in AT use & integration in my teacher preparation coursework. (29)	○	○	○	○	○	○
I have time to increase my technology-related knowledge & skills. (30)	○	○	○	○	○	○
AT assistance is readily available at my school. (31)	○	○	○	○	○	○
AT is an important part of the daily routine for all of my students. (32)	○	○	○	○	○	○
It is easy for me to adapt AT to meet my students' needs. (33)	○	○	○	○	○	○
I am knowledgeable of AT for students with sensory disorders (e.g., vision or hearing impairments). (34)	○	○	○	○	○	○
I am knowledgeable of community AT resources appropriate for my students and their families. (35)	○	○	○	○	○	○
I am able to use technology to compensate for my students' learning/performance barriers & challenges. (36)	○	○	○	○	○	○

I am able to use technology to support instructional assessment, planning and delivery.* (37)	○	○	○	○	○	○
I can identify & use AT to provide access to educational materials otherwise inaccessible to some individuals. (38)	○	○	○	○	○	○
I know how, when, & where to refer a student regarding AT. (39)	○	○	○	○	○	○
I am knowledgeable about how AT applies to students under IDEA.* (40)	○	○	○	○	○	○
I can arrange & manage the classroom environment to facilitate AT use. (41)	○	○	○	○	○	○
I am able to identify & operate software/apps that meet my students' educational objectives. (42)	○	○	○	○	○	○
My teacher preparation program emphasized AT use for children with disabilities. (43)	○	○	○	○	○	○
I am knowledgeable of reading software/apps for my students. (44)	○	○	○	○	○	○
I am knowledgeable about low-tech tools that can assist students develop their reading skills.* (45)	○	○	○	○	○	○

I am knowledgeable about built-in accessibility features available in computer operating systems (Mac, PC, iOS, and/or Android).* (46)	○	○	○	○	○	○
I have knowledge of AT assessment. (47)	○	○	○	○	○	○
I am knowledgeable of AT for those who have physical disabilities (i.e., fine or gross motor problems). (48)	○	○	○	○	○	○
I use AT to improve students' academic skills. (49)	○	○	○	○	○	○
I seek out professional development to expand expertise of AT to support access to and learning of challenging content.* (50)	○	○	○	○	○	○
I am knowledgeable about selecting AT for students who struggle in my classroom* (51)	○	○	○	○	○	○
I am knowledgeable about pre-reading strategies (lesson impressions, anticipation guides) ^ (52)	○	○	○	○	○	○
I am knowledgeable about active comprehension strategies (study guides, gisting, scrambled paragraphs, Venn diagrams) ^ (53)	○	○	○	○	○	○

I am knowledgeable about study reading strategies (cause/effect charts, concept mapping, spilt-page notetaking) ^ (54)	○	○	○	○	○	○
I am knowledgeable about reflective and elaborative strategies^ (55)	○	○	○	○	○	○
I am knowledgeable about text reading programs (VoiceDream Reader, Bookshare, Learning Ally, etc.) ^ (56)	○	○	○	○	○	○
I am knowledgeable about general accessibility options in Windows, Chrome, Mac and iOS operating systems (screen reading, magnification, etc.) ^ (57)	○	○	○	○	○	○
I am knowledgeable about state and district reading standards for all of my students ^ (58)	○	○	○	○	○	○

Note: * marks questions added to Lee and Vega's (2005) survey to reflect CEC 2015 and ISTE 2017 competencies. ^ indicates questions added from Puckett, K., Judge, S., & Brozo, W. (2009). Integrating Content Area Literacy and Assistive Technology: A Teacher Development Institute. *Southeastern Teacher Education Journal, 2*(2) p. 27-38.

What do you consider to be a barrier to assistive technology use in the classroom and/or school?

_____

_____

_____

_____

F19 POST AT for Struggling Readers: Perceptions and Knowledge

Start of Block: Default Block

POST AT for Struggling Readers: Perceptions and Knowledge
If you participated in the pre-survey, please complete this. Thank you!

For statistical comparison purposes of pre- and post-survey responses, please use the same identifier you selected for the pre-survey.

What is the name of your childhood street plus the name of your first pet, sibling, or best friend? (E.g. 'Main Mittens'.)

_____

Directions: This questionnaire* is designed to help grasp a better understanding of the kinds of things teachers may experience. Please consider your teaching experiences (including all field placements --past, current, and upcoming) and indicate your beliefs about each of the statements below.

	Nothing (1)	2 (2)	Very little (3)	4 (4)	Some influence (5)	6 (6)	Quite a bit (7)	8 (8)	A great deal (9)
How much can you do to get students to believe they can do well in school work? (1)	○	○	○	○	○	○	○	○	○
How well can you respond to difficult questions from your students? (2)	○	○	○	○	○	○	○	○	○
How much can you do to get through to the most difficult students? (3)	○	○	○	○	○	○	○	○	○
How much can you do to motivate students who show low interest in school work? (4)	○	○	○	○	○	○	○	○	○
How much can you do to engage struggling readers in the the lesson? (5)	○	○	○	○	○	○	○	○	○
How much can you do to help your students value learning? (6)	○	○	○	○	○	○	○	○	○
How much can you do to help your students value reading? (7)	○	○	○	○	○	○	○	○	○
To what extent can you assist struggling readers use technology tools to enhance their learning? (8)	○	○	○	○	○	○	○	○	○
How much can you do to gauge student comprehension of what you have taught? (9)	○	○	○	○	○	○	○	○	○

To what extent can you craft good questions for your students? (10)	○	○	○	○	○	○	○	○	○
How much can you do to foster student creativity? (11)	○	○	○	○	○	○	○	○	○
How much can you do to improve the understanding of a student who is failing? (12)	○	○	○	○	○	○	○	○	○
How much can you use a variety of assessment strategies? (13)	○	○	○	○	○	○	○	○	○
How much can you do to adjust your lessons to the proper level for individual students? (14)	○	○	○	○	○	○	○	○	○
To what extent are you familiar with technology tools for reading? (15)	○	○	○	○	○	○	○	○	○
How much can you use a variety of technology tools to provide access to the curriculum? (16)	○	○	○	○	○	○	○	○	○
To what extent can you provide an alternative explanation, example, or access method when students are unable to interact with the lesson/assignment as originally designed? (17)	○	○	○	○	○	○	○	○	○
How well can you implement alternative strategies in your classroom? (18)	○	○	○	○	○	○	○	○	○

How well can you provide appropriate challenges for very capable students? (19)	○	○	○	○	○	○	○	○	○
How much can you do to help students reach standards-based accomplishment in Language Arts?* (20)	○	○	○	○	○	○	○	○	○
How much can you use technology to help students reach standards-based expectations in reading?* (21)	○	○	○	○	○	○	○	○	○
How much can you assist families in helping their children do well in school? (22)	○	○	○	○	○	○	○	○	○
How much can you do to help your students think critically? (23)	○	○	○	○	○	○	○	○	○
How much can you do to provide students who require text readers and accessible digital content, access to the curriculum content?* (24)	○	○	○	○	○	○	○	○	○
To what extent can you implement accommodations for assistive and accessible technology for students with disabilities in your classroom?* (25)	○	○	○	○	○	○	○	○	○

How much can you do to provide universally designed (digitally) assessments to evaluate learning by students with disabilities in your classroom?* (26)	○ ○ ○ ○ ○ ○ ○ ○ ○

Consider your students in your teaching experiences (including field placements if you are not currently teaching) and indicate your beliefs about each of the statements below.

This questionnaire is adapted from *Teachers' Sense of Efficacy Scale (TES) (*Tschannen-Moren & Hoy, 2001) with questions marked with an asterisk added from *Teacher's Beliefs Inventory*

(Benton-Borghi, 2006). Benton-Borghi, B. H. (2006).*Teaching every student in the 21st century: Teacher efficacy and technology* (PhD Thesis). The Ohio State University.

Tschannen-Moran, M., & Woolfolk Hoy, A. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education, 17* (7), 783–805.

	Strongly Disagree (1)	Disagree (2)	Mixed feelings (3)	Agree (4)	Strongly Agree (5)	N/A (6)
I feel comfortable using AT with my students. (27)	○	○	○	○	○	○
AT information is easy to obtain in my school district. (28)	○	○	○	○	○	○
I received appropriate training in AT use & integration in my teacher preparation coursework. (29)	○	○	○	○	○	○
I have time to increase my technology-related knowledge & skills. (30)	○	○	○	○	○	○
AT assistance is readily available at my school. (31)	○	○	○	○	○	○
AT is an important part of the daily routine for all of my students. (32)	○	○	○	○	○	○
It is easy for me to adapt AT to meet my students' needs. (33)	○	○	○	○	○	○
I am knowledgeable of AT for students with sensory disorders (e.g., vision or hearing impairments). (34)	○	○	○	○	○	○
I am knowledgeable of community AT resources appropriate for my students and their families. (35)	○	○	○	○	○	○
I am able to use technology to compensate for my students' learning/performance barriers & challenges. (36)	○	○	○	○	○	○

I am able to use technology to support instructional assessment, planning and delivery.* (37)	○	○	○	○	○	○
I can identify & use AT to provide access to educational materials otherwise inaccessible to some individuals. (38)	○	○	○	○	○	○
I know how, when, & where to refer a student regarding AT. (39)	○	○	○	○	○	○
I am knowledgeable about how AT applies to students under IDEA.* (40)	○	○	○	○	○	○
I can arrange & manage the classroom environment to facilitate AT use. (41)	○	○	○	○	○	○
I am able to identify & operate software/apps that meet my students' educational objectives. (42)	○	○	○	○	○	○
My teacher preparation program emphasized AT use for children with disabilities. (43)	○	○	○	○	○	○
I am knowledgeable of reading software/apps for my students. (44)	○	○	○	○	○	○
I am knowledgeable about low-tech tools that can assist students develop their reading skills.* (45)	○	○	○	○	○	○

I am knowledgeable about built-in accessibility features available in computer operating systems (Mac, PC, iOS, and/or Android).* (46)	○	○	○	○	○	○
I have knowledge of AT assessment. (47)	○	○	○	○	○	○
I am knowledgeable of AT for those who have physical disabilities (i.e., fine or gross motor problems). (48)	○	○	○	○	○	○
I use AT to improve students' academic skills. (49)	○	○	○	○	○	○
I seek out professional development to expand expertise of AT to support access to and learning of challenging content.* (50)	○	○	○	○	○	○
I am knowledgeable about selecting AT for students who struggle in my classroom* (51)	○	○	○	○	○	○
I am knowledgeable about pre-reading strategies (lesson impressions, anticipation guides) ^ (52)	○	○	○	○	○	○
I am knowledgeable about active comprehension strategies (study guides, gisting, scrambled paragraphs, Venn diagrams) ^ (53)	○	○	○	○	○	○

I am knowledgeable about study reading strategies (cause/effect charts, concept mapping, spilt-page notetaking) ^ (54)	○	○	○	○	○	○
I am knowledgeable about reflective and elaborative strategies^ (55)	○	○	○	○	○	○
I am knowledgeable about text reading programs (VoiceDream Reader, Bookshare, Learning Ally, etc.) ^ (56)	○	○	○	○	○	○
I am knowledgeable about general accessibility options in Windows, Chrome, Mac and iOS operating systems (screen reading, magnification, etc.) ^ (57)	○	○	○	○	○	○
I am knowledgeable about state and district reading standards for all of my students ^ (58)	○	○	○	○	○	○

Note: * marks questions added to the original survey to reflect CEC 2015 and ISTE 2017 competencies. ^ indicates questions added from Puckett, K., Judge, S., & Brozo, W. (2009). Integrating Content Area Literacy and Assistive Technology: A Teacher Development Institute. *Southeastern Teacher Education Journal, 2*(2) p. 27-38.

What do you consider to be a barrier to assistive technology use in the classroom and/or school?

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_____

_____

_____

_____

Appendix C

Individual Task Completion Data

Table 1
Consider student characteristics

Percent of activities completed	Number of Completers	Percent of Completers
100%	4	10%
90-99%	0	0%
80-89%	11	29%
75-79%	11	29%
≤ 74%	12	32%

Table 2

Demonstrate skill using tools and making choices about tool selection

Percent of activities completed	Number of Completers	Percent of Completers
100%	15	39%
90-99%	6	16%
80-89%	8	21%
75-79%	0	0%
≤ 74%	9	24%

Table 3

Talk about strategies for tool use and decision-making

Percent of activities completed	Number of Completers	Percent of Completers
100%	1	3%
90-99%	0	0%
80-89%	6	16%
75-79%	0	0%
≤ 74%	31	81%

Table 4

Internalize experiences

Percent of tasks completed	Number of Completers	Percent of Completers
100%	10	26%
90-99%	11	29%
80-89%	5	13%
75-79%	1	3%
≤ 74%	11	29%

Table 5

Talk about action and new roles

Percent of tasks completed	Number of Completers	Percent of Completers
100%	0	0%
90-99%	0	0%
80-89%	3	8%
75-79%	9	23%
≤ 74%	25	66%
0%	1	3%