COMPARATIVE EFFECTIVENESS OF ONLINE TRAINING IN ASSISTIVE TECHNOLOGY AND ITS USE FOR DEVELOPMENT OF REHABILITATION PROFESSIONALS' INTERPROFESSIONALITY AND REFLECTIVENESS

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Assistive technology (AT) is used by individuals with disabilities in order to perform functions that might otherwise be difficult or impossible, and a professional designation common to the application of AT is the AT Professional (ATP) held by thousands of health professionals and suppliers. A novel hybrid continuing education certificate program was developed at the University of Pittsburgh to prepare practitioners for the ATP exam through a focus of interprofessional learning and reflective practice. In addition to an expected increase in content knowledge, I hypothesized that both interprofessional learning, defined as interactive and group-based education aimed at improving collaborative practice (Parsell & Bligh, 1999), and reflective practice (Schon, 1983), or the capacity to reflect on action so as to engage in a process of continuous learning, would increase after trainees' participation in the hybrid program as a result of the program's design. I conducted a mixed methods assessment consisting of validated questionnaires and a unique qualitative coding scheme on the certificate program. Twenty-eight trainees completed the program. A convenience sample of twenty-eight matched control subjects who completed a similar individual online certificate program was also included to draw marginal inferences between the two groups. Based on pre/post assessments analyzed through STATA and Dedoose data analysis software, trainee gains were made in areas of content knowledge, interprofessionality, and reflectiveness. Predictors of learning outcomes included a trainee's background knowledge, job, and expertise level. The hybrid training group had greater

increases in content knowledge, interprofessionality, and reflectiveness compared to the online group. Study limitations include selection bias, insufficient pre/post data from the control group, the author's role in the program, and the particular treatment level. This study may be of interest to higher education administrators, faculty in education, health sciences, and those interested in the implications of online vs. hybrid continuing education programs. As the findings are concretely related to AT, continuing education, and online programs, my recommendations will assist those developing AT programs and the trainees that are taking them, as a result of more comprehensive and effective pedagogy and content. Subsequently, these findings may also assist the beneficiaries of the trainees, the clients who are seeking AT, due to the optimal prescription of devices and recommended solutions.

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PREFACE

Acknowledgments

"Optimism is the faith that leads to achievement. Nothing can be done without hope and confidence." –Helen Keller

The quote above resonates through this whole process! While optimism, good faith, hope and confidence are cultivated from within, my support system reignited the fire, strength, and will to complete this journey. I'm forever indebted to my family for their unwavering support for setting the stage for the meaning of success, hard work, and the overwhelming sense of "you can do anything you put your mind to". Mom, you are my inspiration! To Robby for endless hours of support, patience, countless dinners, and welcomed distractions. To my friends for all the runs, coffee trips, wine nights, retail therapy, girls trips, camping, and welcomed distractions. To the trainees of the 2012-2013 RSTCert program, and the whole RSTCe crew, I literally could not have done this without you! To my colleagues in my "other job," not only have you been flexible and understanding, but also provided such amazing guidance, served as reviewers, and statistical consultants! To Dr. Trovato for not only providing supreme academic guidance, but also offering sound emotional support and helping to pave a smooth pathway. To my dissertation committee for their help and support.

Nomenclature

ASAHP-Association of Schools of Allied Health Professions

AT-Assistive technology

ATP-Assistive Technology Professional

CE-Continuing education

CEU-Continuing education unit

H-High

IP-Interprofessionality

IPeP-Interprofessionality e-pedagogy model

IPePD-Interprofessionality e-pedagogy delivery model

IPL-Interprofessional learning

L-Low

M-Medium

MOOC-Massive Open Online Course

PBL-Problem-based learning

RESNA-Rehabilitation Engineering Society of North America

RIPLS-Readiness for Interprofessional Learning Scale

RST-Department of Rehabilitation Science and Technology, University of Pittsburgh

RSTCe-Rehabilitation Science and Technology Continuing Education Program

WHO-World Health Organization

1.0 INTRODUCTION

1.1 SOURCE OF INTEREST

I am interested in the effectiveness of online training in the health sciences, specifically through evaluation of an online assistive technology certificate program in comparison to hybrid training on the same topic. The prior research on and related to my topic of online learning in the health sciences have informed me about the effective methods of the teaching of skills, professional dispositions, and knowledge and best practices in online learning in general (Kolb, 1984; Schon, 1987; USDOE, 2010). Less has been published on health sciences and online learning, especially related to assistive technology. However, the idea of interprofessional learning that is inherent in assistive technology training has also guided my thinking (Casimiro, 2009; Farrell, 2005; WHO report, 2010). The research on collaborative knowledge building leading to a community of practice, especially online, coincides with interprofessional training (Arjava, 2007). Schellens (2007) suggests that online continuing education (especially in an asynchronous online environment) can increase the amount which professionals engage in reflective thinking and practice; this has also influenced my position on online learning and its potential to influence the development of additional skills. These concepts have driven much of my research and remain important components of my conceptual framework.

I came across this general topic at work in the Department of Rehabilitation Science and Technology at the University of Pittsburgh. A few of my colleagues facilitate an online continuing education program that focuses on assistive technology. Some of the competitors that offer continuing education in this same space are companies that infuse commercial bias into their trainings often resulting in inadequate content and inappropriate prescription of devices. My colleagues have based the online program on previous in-person trainings and graduate curriculum in the Department of Rehabilitation Science and Technology. They are interested in validating that these online trainings, especially those in a new certificate program, are based on best practices in terms of pedagogy and delivery to ensure the quality of training is equivalent to what has been traditionally offered in person. My results will demonstrate what portions are effective, what content should be added, and whether more resources are invested in online and/or hybrid training. I will also be able to tell whether certain types of trainees (based on their personal characteristics) excel or struggle more than others, and whether training needs to be customized for those groups as a result. Additionally, since most assistive technology training occurs on a continuing education versus a formal education basis, it is important that continuing education offerings provide foundational knowledge for future trainings and certifications like the Assistive Technology Professional designation. For the busy rehabilitation professional who is most likely to need this training and the mandated continuing education units, it is important the training they receive is of high quality, results in learning outcomes that will truly affect their practice, and improve the extent to which they want to collaborate with others and engage in reflective behaviors. These behaviors are likely to motivate additional learning on the topic and ultimately, increase the quality patient care.

Lastly, the recent buzz and media attention related to online learning through the Massive Open Online Courses (MOOCs), is most certainly interesting and warranted of study. Though this study does not address MOOCs, in particular, the better we can understand the sorts of outcomes associated with solely online learning with limited (if any) contact with an instructor is important. I believe outcomes of this particular case study will be able to inform this general issue. It was recently noted in a *Chronicle of Education* article that online learning with no instructor interaction may not be any more effective than one teaching oneself a concept through a book, or in other words, online learning in this context could be considered a virtual textbook. The difference between taking a course online, individually, with no instructor, may result in a different type of learning—a level of recall knowledge (*about* a particular subject), but not procedural knowledge or knowledge that could be put to use in multiple contexts and make an actual difference. As MOOCs expand across multiple domains including the health sciences and across multiple localities, especially in developing nations, it is especially important to understand this phenomenon.

As mentioned above, practicing professionals and other non-traditional students are the likely recipients of this training, in addition to those from around the world for which online learning can open up many doors. To be able to use online learning in the health sciences, especially related to assistive technology, to make a difference in outcomes in developing countries, it is important to understand the necessary components that make the training effective. Though much of my argument is driven by the idea that in-person and group complements strengthen trainee gains, many in-person activities could be simulated online using problem-based learning components. Therefore, another element of my framework will be problem-based learning (Vernon & Blake, 1993). Vernon and Blake define problem-based

learning as a method of learning (or teaching) that emphasizes 1) the study of clinical cases, either real or hypothetical, 2) small discussion groups, 3) collaborative independent study, 4) hypothetico-deductive reasoning, and 5) a style of faculty direction that concentrates on group process rather than imparting information.

1.2 CONCEPTUAL FRAMEWORK

My conceptual framework is composed of theories related to problem-based learning (Vernon & Blake, 1993), collaborative learning (Vygotsky, 1978), reflective learning (Gibbs, 1988; Schon, 1983), interprofessional learning (Parsell & Bligh, 1999), and a particular spin related to online referred to as Interprofessional ePedagogy (Gordon et al., 2010). The combination of theories that compose my conceptual framework speak to the complexity of what I am studying. In some ways the use of multiple theories are inter-related or dependent on each other.

The use of problem-based learning, or real-life situations and/or within the health sciences, mock clients, to strengthen skills and increase knowledge, was deemed in a meta-analysis to be more effective than traditional methods (Vernon & Blake, 1993). Problem-based learning depends on group interactions and problem solving, and is best achieved in a collaborative learning setting. Vygotsky (1978) theorizes in collaborative learning settings, students are capable of performing at higher intellectual levels than when working individually. Collaborative learning literature also suggests that it may increase reflective behaviors (Johnson & Johnson, 1994). Reflective practice (Schon, 1983) is the capacity to reflect on action so as to engage in a process of continuous learning. Schon also suggested that reflectiveness is one of the defining characteristics of professional practice. Gibbs' (1988) derivation of reflective

learning has been used in the health sciences to guide reflection through structured debriefing, a technique that is used in the program that is being studied here. Finally, interprofessional learning (Parsell & Bligh, 1999), or interactive and group-based education aimed at improving collaborative practice, is informing this study. The greater extent to which trainees engage in interprofessional learning, the more they will be enabled to collaborate with other health professionals post-training (WHO, 2010). The WHO suggests once students understand how to work interprofessionally, they are ready to enter the workplace as a member of the collaborative practice team. It is suggested that better patient care is associated with high levels of interprofessional practice and that interprofessional teams understand how to optimize the skills of their members, share case management, and provide better health services to patients and the community (Farrell, 2005; WHO, 2010).

In order to reach a higher level of interprofessional learning, collaborative learning is required, and the more life-like the training can be through problem-based learning methods, the more authentic the experience. In the context of online learning, the interprofessionality e-pedagogy model demonstrates how both collaborative and reflective learning feed in to the interprofessional learning model (Gordon, Booth, and Bywater, 2010).

1.3 KEY CONCEPTS DEFINED

For the purpose of my study, I am using the *Department of Education's Report of Evidence-Based Practice on Online Learning*'s definition of online learning as learning that takes place partially or entirely over the Internet (p. 9). Other key terms include the context in which I am situating my study related to health sciences and assistive technology. The *Advances in Health*

Science Education journal defines health science education as the study of medicine, nursing, occupational therapy, physiotherapy, nutrition, and related disciplines. Health sciences, though contested, is sometimes referred to as "allied health" in both educational and professional settings. The Association of Schools of Allied Health Professions (ASAHP) defines allied health professionals as "those who are involved with the delivery of health or related services pertaining to the identification, evaluation and prevention of diseases and disorders; dietary and nutrition services; rehabilitation and health systems management, among others. Allied health professionals, to name a few, include dental hygienists, diagnostic medical sonographers, dietitians, medical technologists, occupational therapists, physical therapists, radiographers, respiratory therapists, and speech language pathologists" (ASAHP, 2011).

This study has the most direct relevance to rehabilitation science and professionals, though I will be making inferences based on this sample. A key focus of rehabilitation science is assistive technology. Assistive technology is technology used by individuals with disabilities in order to perform functions that might otherwise be difficult or impossible. Assistive technology can include mobility devices such as walkers and wheelchairs, as well as hardware, software, and peripherals that assist people with disabilities in accessing computers or other information technologies (The National Center on Accessible Information Technology in Education, 2012).

Though previously mentioned above, another important term throughout the study is interprofessional learning. Interprofessional learning is defined as interactive and group-based education aimed at improving collaborative practice (Parsell & Bligh, 1999). The interprofessional learning concept has been around since the 1960s but has become more prevalent in the last fifteen years in literature and research. The driver for this rapid growth is increasing reference to requirements that healthcare graduates are competent regarding

interprofessional collaboration. The interprofessional approach to learning is also supported globally. The World Health Organization (WHO) (2010) recommends the development of 'interprofessional practice', through which health workers from different professional backgrounds work together with patients, families, careers and communities to deliver the highest quality of care.

Throughout this paper, I refer to both “interprofessional” and “collaborative” practice; I will clarify here the significance of each term. “Interprofessional learning,” as I introduced above, is a coined phrase in the health sciences and is used to refer to the process wherein people from two or more professions in healthcare learn together during all or part of their professional training with the objective of cultivating this practice in their work (Parsell & Bligh, 1999). Furthermore, “interprofessionality” is defined as the propensity for an individual to engage in practice where two or more professions work together as a team with a common purpose, commitment, and mutual respect (Freeth et al., 2005). Interprofessionality is becoming a hot topic in healthcare because of the claims related to improving efficiency and patient care; for example, there is a conference devoted to interprofessionality, *All Together Better Health: International Conference on Interprofessional Practice and Education*, now in its seventh year and will be hosted at the University of Pittsburgh (WHO, 2010; ATBH, 2013).

On the other hand, I use the term “collaborative learning” to more broadly speak to the action of working with others to produce or create a product. For the purposes of this paper, I use the Vygotsky (1978) definition of collaborative: a practice aimed at promoting community in the process of “making meaning” and where two or more people learn or attempt to learn something together. Unlike interprofessional learning, collaborative learning can refer to people from the same or different professional disciplines learning together. Additionally,

interprofessional learning has the projected goal of individuals learning to work together post-training and the specific objective of cultivating collective practice for providing client-centered healthcare (Centre for the Advancement of Interprofessional Education, 1997), while I refer to collaborative learning in the more general sense of shared meaning making and problem solving.

1.4 SIGNIFICANCE OF THE PROBLEM

There are 36 million people with disabilities in the United States, and this number is growing with the aging baby boomers. Appropriate assistive technology (AT) can make the difference between whether or not someone is able to remain independently in her home or be able to work, go to school, or complete other activities of daily living. The AT industry is different from those where the consumer does not hold much power in terms of dictating what device he obtains. Using a counter example of smart phones, if an individual ends up with a particular brand or model that does not work or fit his/her needs, the user will return the device or buy another one. Since third-party payers (e.g. insurance, Medicare, the Department of Veterans Affairs) are the primary purchasers of AT, the market is driven by those who are not the primary users of the devices themselves. Therefore, inadequate, cheap equipment often gets on the market and into the hands of the user, sometimes resulting in secondary conditions or abandonment of devices. To escalate the problem, up to a certain classification of device (e.g. power wheelchairs), an individual is able to sell and/or "prescribe" AT without a certification. Unethical companies and individuals are enabled to sell the product that will give them the greatest margin, but may be the worst choice for the consumer. These very companies created their own continuing education courses and deemed them "*X Company* University". These courses are widespread and

rehabilitation professionals who need to maintain their licensure are their primary customers. They infuse commercial bias into this training and do not use evidence-based material. It is therefore possible for rehabilitation professionals to take solely these inadequate courses and remain certified. In essence, my argument here is that somewhat similar to the MOOCs, at best, trainees learn more "about" a subject but not much in terms of being able to apply concepts or gained knowledge beyond definitions of terms, "by the book" processes, and in some cases, what one brand of products offers as solutions. Unlike the MOOCs which in most cases are facilitated by top tier universities including MIT, Stanford, and UC Berkeley, to name a few, these courses are created and distributed by companies that are using their power and resources to market their products, not assist in the development of competent rehabilitation professionals that have the client's best interest in mind.

The RSTCert program was created as a response to this situation addition to the need for more Assistive Technology Professionals (ATP) in the United States. As mentioned above, the ATP certification is needed to prescribe particular AT devices. Additionally, the ATP designation recognizes demonstrated competence in analyzing the needs of consumers with disabilities, assisting in the selection of appropriate assistive technology for the consumer's needs, and providing training in the use of the selected device(s) (RESNA, 2012). In its inaugural year, over three times the capacity applied for the program. This provides further evidence on top of the literature that suggests more continuing education opportunities are needed, especially in the area of AT, and desired by credentialed and non-credentialed persons alike (although only non-credentialed individuals participated in the RSTCert program). Additionally, this surface-level training does not include enough evidence-based content or pedagogy to prepare trainees to sit for the ATP exam.

The program will allow me to conduct a mixed methods study on the overall effectiveness and trainee gains from participating in the program. These results will assist in recommending what components and modalities maximize trainee outcomes in online AT continuing education. I believe it will help both trainees and trainers understand what constitutes quality, and consequently, assist trainees in distinguishing adequate from inadequate training programs by critically reviewing both the content that will be covered and activities in which they will engage. Additionally, trainee behaviors such as exhibited reflective and interprofessional practice will be monitored. I believe this work will help trainers understand how to strengthen these behaviors in trainees. As a result, trainees will not only increase the amount to which they engage in lifelong learning, but also increase the amount they collaborate with other practitioners from different backgrounds. Ultimately, the goal is for more individuals to become ATP certified and online AT education is certainly a mechanism that can assist in proper preparation of trainees when conducted in an appropriate manner. Increasing the number of ATP certified rehabilitation professionals will assist in ensuring proper devices are prescribed to persons with disabilities that will help them to live more independent and fulfilling lives.

1.5 STUDY QUESTIONS

My research questions address aspects of effectiveness in terms of learning outcomes and resultant trainee gains in my sample.

1. Do personal variables predict learning outcomes for online Assistive Technology education?
2. Do learning outcomes differ across online and hybrid groups for Assistive Technology continuing education training?

3. Does AT online CE impact trainees' interprofessionality and reflectiveness?

    A. Do interprofessionality and reflectiveness increase with collaborative online learning (cohort vs. individual learning)?

    B. Do interprofessionality and reflectiveness increase with collaborative hybrid learning (online + in person vs. online only)?

4. What are the most effective online delivery mechanisms for the pedagogy identified in the Interprofessional ePedagogy (IPeP) model?

My research questions are supported by the extensive literature review that I conducted on health sciences education, online learning, and online health sciences training.

2.0 A REVIEW OF THE LITERATURE

Online education has been studied for a long time from many perspectives. The review of the literature outlines the interrelatedness of health sciences education, online education, and health sciences online education. The following three questions guided my review of the literature:

1. What does research say about the teaching of knowledge, skills, and professional dispositions in the health sciences?
2. What does research say about the best practices and standards related to online learning?
3. What does the research tell us about online learning in the health sciences?

2.1 THE TEACHING OF KNOWLEDGE, SKILLS, AND PROFESSIONAL DISPOSITIONS IN THE HEALTH SCIENCES

The Association of Schools of Allied Health Professions (ASAHP) defines allied health professionals as "those who are involved with the delivery of health or related services pertaining to the identification, evaluation and prevention of diseases and disorders; dietary and nutrition services; rehabilitation and health systems management, among others. Allied health professionals, to name a few, include dental hygienists, diagnostic medical sonographers, dietitians, medical technologists, occupational therapists, physical therapists, radiographers,

respiratory therapists, and speech language pathologists" (ASAHP, 2011). My focus in this area was on both pre-professional (graduate) and professional health science education, sometimes referred to as postgraduate or continuing education, or training to enhance skills and knowledge attained for both personal development and career advancement. This broad scope allows for a review of models and frameworks across disciplines and educational level.

There is not one defined or widely accepted model for how knowledge, skills, or dispositions should be taught in health science education. Schon (1987) has suggested there are various forms of knowledge and concludes "applied science and research-based techniques occupy a critically important though limited territory, bounded on several sides by artistry which is an exercise in intelligence, a kind of knowing that is inherent in the practice of professionals" (p. 13). This implied clinical reasoning mandates health professionals to rely on "scientific knowledge of human behavior and body responses in health and illness, the aesthetic perception of significant human experiences, a personal understanding of the uniqueness of self and others, and the ability to make decisions within concrete situations involving particular moral judgments" (Higgs, 2000, p. 27).

The study of such an effort (how this expertise should be transferred to students) is complicated by the multiple disciplines in health science education in addition to the divide between didactic (or declarative) and hands-on or clinical training (i.e. procedural). The two methods of delivery should not be studied in isolation as Anderson (1983) has shown that declarative training results in procedural knowledge. Clinical training is perhaps the most important as it simulates professional practice and encourages experiential learning, but even within clinical training, there is not one model that covers all aspects. The collaborative, problem solving, integrative, multiple mentoring, continuum of supervision, reflective, self-

directed learner, coaching, and interdisciplinary models, along with the mastery pathway framework, are documented clinical training models in the health sciences (Stroschein, 2002). The section that follows describes some of these models in greater detail.

2.1.1 Development and evaluation of pre-professional knowledge, skills, and dispositions

To be able to fully understand practitioners' background and training, it is important to understand the development of their pre-professional knowledge, skills, and dispositions. Dornan (2006) suggests the standard instructional methodology in health science education is to provide students with a solid basic science background first and then transition in to clinical knowledge and experiences. Much of this core knowledge is shared between disciplines. For example, Brown & Greenwood (1999) suggest occupational therapy and physiotherapy share a knowledge base of anatomy, physiology, medical sciences, human growth and development, biomechanics, ergonomics, and kinesiology. However, Nielsen et al. (2011) suggest medical professionals (physicians, specifically) rarely explicitly use basic science knowledge. Custers and Tencate (2011) do not negate the importance of basic science knowledge but found that unless professionals rehearse basic science knowledge in clinical practice, the information will be lost as long-term retention of unrehearsed science knowledge is estimated in the range of 15-20%. This should not undermine the role of core science knowledge, but may overemphasize the need for the interplay of various types of knowledge including clinical, practical, and affective that are used on a daily basis.

In searching literature on the development of knowledge, skills, and dispositions, it is recommended that students work on interdisciplinary teams, place equal emphasis on developing non-technical competencies, and be encouraged to engage in reflective thinking, a finding that is

reiterated in the literature on continuing education. These practices will assist in the development of professional skills and behaviors that will allow them to function independently in a clinical environment. The integrative model has suggested that by incorporating research and clinical practice activities, students result in better skills (Steward, 1996; Bloomer, 1995). Not only should the next generation of students be involved in scientific inquiry, but in theory, by engaging in research activities they could also serve as a bridge between theory and practice and between academic educators and clinicians (Strohschein et al., 2002). Students may reach the next level of professional competency by conducting research on interdisciplinary teams consisting of physical therapists, occupational therapists, assistive technology professionals, and speech therapists. The interdisciplinary model suggests that students' professional development and communication skills develop better in this context compared with similar discipline-specific settings (Cox, 1999). Furthermore, it was perceived that clients benefited from a more comprehensive approach to treatment that resulted from students' improved interdisciplinary insights and understanding. Similarly, the collaborative model (DeClute and Ladyshewsky, 1993) recommends students go through clinical training in pairs to increase dialogue and reflection made possible by peers.

Strohschein (2002) argues that a strong emphasis on technical skills in professional health science education should not overshadow the development of nontechnical skills and dispositions. The development of attitudes and skills for reflection should begin in an academic setting and further be developed in a clinical setting (Strohschein, 2002; Cox, 1999; Shepard & Jensen, 1990). Nontechnical competencies such as communication, collaboration, and reflection are evident in the collaborative, reflective, educator-manger/self-directed learner, and interdisciplinary models (Strohschein, 2002). "We have no need to teach medical students vast

quantities of information which results in memorization when such information can be computer-stored and retrieved in seconds. We do have a need to graduate ethical and compassionate students with high level skills in data analysis and independent critical thinking" (Cavazos, 1984).

This independent critical thinking is often derived from a reflective thinking and/or learning model. Schön's (1987) model of knowing in action explains how the expert or practitioner uses experience and reflection on action to learn and acquire knowledge. According to Schön, experts have a zone of mastery that enables them to solve problems they encounter in their practice. This expertise is unique to each expert and results from a combination of knowledge, skills, attitudes, and clinical experience. Schön's (1987) model contains four phases: surprise (an unexpected event occurs), reflection-in-action (individual formulates different hypotheses), experiment (search for additional information), and reflection-on-action (re-examine the surprise and clinical approaches taken). Sobral (2000) found that reflective thinking could be developed and demonstrated students' reflection in learning scores increased after participating in activities that fostered this skill. Mann (2009) suggests that reflection can assist learners to connect and integrate new learning to existing knowledge and skills, including integrating the affective aspects of their learning. Clinically, this may be very important as many aspects of the professional role are experienced and learned. This is where both reflection-in-action and reflection-on-action can be demonstrated. Learners should be encouraged to seek input to validate their own judgments. Though to date the idea that reflection enhances competence is still unknown, reflection has potential to enhance learning, and ultimately, practice (Mann, 2009).

2.1.2 Educator's role

While it is of utmost importance to consider how skills develop for individuals, it is imperative to consider the role others play in this process. Higgs (1993) developed the Educator-Manager/Self-Directed Learner framework to describe the relationship that occurs between teacher and student. Instead of teacher, Higgs' framework suggests that an effective clinical educator's role should be a dynamic facilitation of the student's readiness for a particular task, resulting in a higher level of self-directed learning. As self-directed learning occurs, more opportunities for co-management emerge which results in students taking greater responsibility of their learning. Similarly, the "coaching model" calls for the supervisor to also take a role as a facilitator (Hagler & McFarlane, 1991). Five coaching roles include educator, coach, sponsor, counselor, and confronter; the first three roles are for those working with students who are progressing normally towards professional competence while the latter two are appropriate for those working with students who are struggling with becoming an independent, creative, and self-supervising learner. This focused approach of allowing students to develop and refine their skills in a supportive environment helps establish a sense of professional accountability, especially for students who lack in this competency area.

Formal educators and clinical professionals are not the only "teachers" involved in this process. For example, Nolinske's (1995) multiple mentoring model suggests that many individuals play an integral role in developing clinical skills, professional attitudes, and identities. A mentoring relationship is an interactive relationship between mentor and protégé in order to provide information, role-modeling, wisdom, and emotional support. Peer mentors are equally important in this process, though no one individual is responsible for all necessary components. The team approach maximizes the learning outcomes of the trainee as well as

strengthen skills and awareness of the mentors. The mentor matching process can occur naturally among students, peers, and professionals, and can also be arranged by clinical or academic faculty. Involvement with more clinicians and students during fieldwork, students could develop a diversity of relationships, experience a range of perspectives and approaches, identify appropriate role models, and benefit from the unique strengths and interests of a number of individuals (Strohschein et al., 2002).

2.1.3 Enhancement of skills through continuing education

After pre-professional training and certification, it is imperative that professionals engage in continuing education. As mentioned in the significance suggestions of this overview, not one size fits all in terms of quality or content. It is important to understand what how skills are enhanced through continuing education and what is well documented in the literature. In terms of pedagogy, the reflective model is generally applied to the development of skills for professionals in continuing education settings. Moon (1999) describes reflection as ‘‘a form of mental processing with a purpose and/or anticipated outcome that is applied to relatively complex or unstructured ideas for which there is not an obvious solution’’ (p. 23). Schon (1983) introduced the concept of the ‘‘reflective practitioner’’ as one who uses reflection as a tool for revisiting experience both to learn from it and for the framing of complex problems of professional practice. Most models of reflective practice stem from the need to learn a task based on encountering a challenging situation. There are two areas that have been explored in reflective practice: the iterative and vertical dimensions (Mann et al. 2009). Theories that are iterative in nature involve reflection occurring by experience resulting in a new understanding and this impacting future experiences (Boud, Keogh and Walker, 1985; Schon; 1983). The

vertical dimension relates to the depth and quality of reflective thinking and was explored by Dewey (1933), Hatton and Smith (1995), Mezirow (1991), and Moon (1999). Upon surveying literature related to reflective practice and health science education, Mann et al. (2009) also reviewed whether or not current practitioners engage in reflective practice. In both the medical and nursing professions, reflective practice was in place.

For professional or continuing education, the aforementioned Schön's (1987) model of knowing in action describes the processes an expert or practitioner acquires new knowledge. After completing the phases of 1) surprise, 2) reflection in action, 3) reflection on action, the practitioner's acquisition of knowledge moves in to the zone of mastery, or the stage 4) knowing in action. The reflection processes that occur in Schön's model often motivate the practitioner to partake in new continuing education activities.

When used as a model to direct continuing education activities, Borduas et al. (2001) determined that practitioners' learning significantly increased through prompts to reflect in and on action through discussions with experts and access to other resources. Schön's (1987) "knowing in action" model often results in practitioners acknowledging their own personal gaps in knowledge and motivating a more self-directed method of learning. Self-directed learning is defined as a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes (Knowles, 1975). This change in a critical attitude can lead to development of expertise and impact on clinical decisions leading to better care. The more self-directed learning is practiced, the more natural this technique becomes for acquiring new evidence-based information.

2.2 BEST PRACTICES IN ONLINE LEARNING

Since the mid-1970s, communication technologies have altered how educators interact with curriculum and students in the classroom (Harasim, 1995). The term "online education" is intended as generic, referring not to a specific educational level or pedagogy. There is a need for further investigation in this area and to better understand what has been researched, as the Department of Education (DOE, 2010) suggests the field lacks a coherent body of linked studies that systematically test theory-based approaches in different contexts.

2.2.1 Evidenced based practices in online learning

Previous meta-analyses have determined that there is no statistical difference between the effectiveness of stand alone in person vs. online delivery of education. For example, in the meta-analysis performed by the Department of Education (2010), researchers did not find significant differences when comparing a purely online condition with face-to-face instruction. This signifies that instruction conducted entirely online is as effective as classroom instruction but not better (i.e. no statistical significance was found across multiple studies). An important issue to keep in mind in reviewing these findings is that many studies did not attempt to control for factors such as curriculum materials, aspects of pedagogy, and learning time in the treatment and control conditions. The results should therefore be interpreted with caution; observed advantage for blended learning conditions is not necessarily rooted in the media used and may reflect differences in content, pedagogy and learning time. The sections that follow look at various factors to consider how to increase the effectiveness of online learning.

As opposed to solely looking at whether or not one modality is preferred and more effective, researchers have looked at whether or not online learning can enhance certain components of instruction (i.e. enhancement of learning material through blended methods vs. replacement of one modality for another). For example, online learning is perceived to not only assist in creating a community of learners (Bransford, Brown & Cocking 1999; Riel & Polin 2004; Schwen & Hara 2004; Vrasidas & Glass 2004) but also increase self-reflective learning when conducted asynchronously (Harlen & Doubler 2004; Hiltz & Goldman 2005; Jaffee et al. 2006).

In terms of effectiveness, other factors to consider are the type of learning experience and whether the learning is achieved in a synchronous or asynchronous manner. For example, the learning experience may include didactic (expository) learning, active learning, or interactive learning. Online technology can support any three of these areas via digital devices that transmit knowledge, online drills through which a learner engages, or inquiry-based collaborative interaction where instructors are co-learners and serve as facilitators (Harasim, 1995; DOE, 2010). Interactive learning, perhaps the best fit for health sciences education, stresses a flexible combination of independent and group learning activities (Choi, 2005). One of the widely accepted benefits of online learning is its flexible nature. Some of what makes it flexible is due to being able to offer a self-directed approach that allows learners to access content on-demand or asynchronously. Asynchronous learning allows students to contribute at their convenience mechanisms such as e-mail, threaded discussion boards, and blogs. Synchronous learning signifies using technologies (e.g., webcasting, chat rooms, desktop audio/video technology) to approximate face-to-face teaching strategies such as delivering lectures and holding meetings with groups of students. Expository, active, and interactive learning experiences may have

synchronous and/or asynchronous capacities that may either substitute or enhance face-to-face instruction.

Another dimension to consider is whether the learning is blended or online. Overall, when comparing blended vs. pure online learning, studies do not provide a basis for choosing online versus blended instructional conditions (Hiltz, 2005; Cavus, 2007). Blended learning allows the learner's experience to be enhanced by online activities, but still requires some sort of in-person interaction. Pure online learning requires all classroom exchanges and activities to be hosted on a web platform. In terms of type of learner experience (expository, active, or interactive), a few preliminary studies have found results that suggest that when learners have more control of the content via active or interactive styles, they perform better academically (Cavus et al., 2007; Dinov, Sanchez & Christou, 2008; Gao & Lehman, 2003; Zhang, 2005).

Regardless of type of learning experience, blended or online conditions, or a/synchronous conditions, activities and the way experience is guided can alter learning outcomes. In terms of guiding the experience, a few studies suggest prompts and activities that encourage self-reflection, self-regulation, and self-monitoring improve online learning outcomes (Bixler, 2008; Chang, 2007; Cook, 2005). An instructor or other adult moderator does not always improve learning, but one study that compared peer vs. instructor moderated resulted in higher scores for the latter (Zhang, 2004). However, regardless of mechanism, studies that investigated the presence of scripts to guide interactions among groups did not appear to improve learning outcomes (Choi, Land & Turgeon, 2005; Hron et al., 2000; Ryan, 2007). Several studies' focus is not on the replacement of face-to-face instruction with online learning, but the strategies that enable student success through the supplementation or enhancement of online learning activities and the technology that supports it. Schellens et al. (2007) conducted a study to investigate the

impact of learning in asynchronous discussion groups on students' levels of knowledge construction. A design-based approach enabled the comparison of two successive cohorts of students and results indicated that a large part of the overall variability in students' level of knowledge construction can be attributed to the discussion assignment. More intensive and active individual participation in the discussion groups and adopting a positive attitude towards the learning environment also positively related to a higher level of student knowledge construction. Task characteristics and the differences between the consecutive discussion themes significantly affected levels of knowledge construction, although further analysis revealed that these differences largely disappeared after correcting for task complexity. Comparisons between both cohorts revealed that the introduction of student roles led to significantly higher levels of knowledge construction.

In summary, there are multiple ways to look at online learning studies: whether the course (or class or training) has been conducted synchronously or asynchronously, was blended or purely online, and whether it was expository, active, or interactive in terms of user experience. Depending on the combination of these variables and population, there are mixed results for what is effective, though there is evidence to support asynchronous delivery (due to logistics and research that suggests this delivery can support self-reflective thinking), with blended conditions (online learning is more of a tool to support, supplement, and enhance, rather than replace learning environment), and interactive learning (where students can facilitate their own learning).

2.2.2 Standards in online learning

Though there is not a standard or regulated document for online learning in undergraduate, graduate, or continuing education, there are several good sources. *Essentials of Online Course*

Design: A Standards-Based Guide (2011) draws from a number of resources including Chickering's (1987) "Seven Principles for Good Practice in Undergraduate Education," several resources on universal design and accessibility, and the underlying principles as detailed by Quality Matters (QM), a faculty-centered, peer review process group that certifies the quality of online and blended courses. *Essentials* offers standards related to learning outcomes, ease of communication, pedagogical and organizational design, visual design, engaged learning, collaboration and community, assessment, feedback, evaluation and grading, and ease of access.

Another source worth noting, though not necessarily broken down by standards, is the aforementioned report by the Department of Education (2010). It is the most comprehensive and current information related to undergraduate, graduate, and continuing online education research. It is worth consulting each of these works (i.e. *National Standards for Quality Online Courses, Essentials of Online Course Design: A Standards-Based Guide,* and the DOE report) in developing online courses. Each contains valuable information related to how the course can be designed, how students can engage in learning material, and how coursework can be evaluated.

2.3 ONLINE LEARNING IN THE HEALTH SCIENCES

While the previous literature review sections reviewed research related to effective practices in the teaching of knowledge, skills, and professional dispositions in health sciences and online education in general, it is important to survey the research related to online education practices within the health science domain. The studies reviewed included undergraduate through postgraduate students.

Studies reveal mixed results when comparing online and face-to-face instruction in the health sciences (Beeckman et al., 2008; Campbell, et al., 2008; Cook et al., 2005). While online learning was more effective for some populations, it was not for all, even within the same study. For example, Beeckman et al. (2008) examined whether an e-learning program is able to increase the pressure ulcer classification skills of qualified nurses and nursing students. After an intervention comparing qualified nurses and nursing students, these skills improved significantly in both groups but were different among types of participants. While the nursing students achieved better results when using the e-learning program, there was no difference between the learning methods among the qualified (credentialed) nurses. Similarly, Campbell et al. (2008) conducted a quasi-experimental study to determine the effectiveness of online learning in nursing education but did find significant effects across groups. However, it is important to note that the sample was homogeneous (all students). Campbell et al. assessed whether participation in face-to-face discussion seminars or online asynchronous discussion groups had different effects on educational attainment in a web-based course. Ignoring confounding variables, students choosing online discussions had significantly higher assignment grades than students choosing face-to-face discussions. Among online discussion students, assignment grade was significantly correlated with the numbers of discussion messages read and posted among face-to-face discussion students. This study demonstrated that a research methods course can be delivered to postgraduate healthcare students at least as successfully by an entirely online method as by a blended method in which students accessing web-based teaching material attend face-to-face seminar discussions. Increased online activity was associated with higher assignment grades.

It is also important to consider type of pedagogy used in online education. Bernard et al. (2004) suggest problem-based learning which medical education literature (e.g., Colliver, 1999),

represents as a useful mechanism for engaging students, teaching problem solving, and developing collaborative working skills, might be linked to collaborative learning in online learning environments. Increasing the amount of problem-based learning in courses may increase the effectiveness of this modality overall.

2.3.1 Interprofessional training

Much of the health science online education research focuses on the development of and effective strategies for individual programs or disciplines. However, interprofessional training, or interactive and group-based education aimed at improving collaborative practice, also may benefit from online learning. Research has been conducted on the proliferation of social networking as a way to engage in interprofessional training that results in effective communities of practice and better patient care. King et al. (2009) suggest that students in an educationally structured social networking environment can be guided to join learning communities quickly and access course materials and created a theoretical framework to describe the processes. More research and implementation work is required to effectively develop interprofessional health sciences communities in a combined face-to-face and on-line social networking context.

Similarly, Casimiro et al. (2009) suggests interactions between those with different academic backgrounds as well as complementary areas of practice, are instrumental in constructing common and individual meanings of teamwork. Offering interprofessional education online can help with scheduling logistics, allowing students to learn with and from each other, and promoting reflection and critical thinking through asynchronous components. E-learning programs developed by Hall and Casimiro (2007) used patient narratives to eliminate profession-specific jargon to foster the development of the determinants of collaboration

including willingness to collaborate, trust, respect, and effective communication skills. Casimiro et al.'s framework, W(e)Learn, supports collaborative online and blended learning. The ''(e)'' suggests that web technologies can potentially bridge approaches that integrate a strong focus on both collaboration and effective learning experiences. For example, e-learning modalities can be used to maintain contact between established teams of students when, for example, clinical placements dictate that they cannot meet face-to-face (Farrell, 2005).

2.3.2 Online learning related to assistive technology (AT)

As I focus on this investigation on AT, I turn next to literature specific to AT online education and how it is tied to interprofessional learning. The assistive technology field embodies interprofessional training. The AT prescription process is by nature multidisciplinary and should include involvement and empowerment of the user as a decision maker (Reed et al., 1995), thus resulting in better client care as recommended by interprofessional training. The post-professional credential, the Assistive Technology Professional designation, is held by occupational and physical therapists, medical doctors, speech language pathologists, audiologists, rehabilitation engineers, and rehabilitation technologists in addition to others who would play a role in prescribing, creating, or evaluating AT (RESNA, 2009). Therefore, AT education offers an opportunity to engage in interprofessional training. There are approximately 55 programs in 27 states conducting AT training for formal credit, which includes graduate or undergraduate credit or degrees, continuing education units (CEUs), and/or AT credential (Jans & Scherer, 2006). Half of these programs offered distance learning though less than 20% reported that students could complete more than 80% of the course work through e-learning mechanisms.

Sax (2002) suggests distance learning methods can be effective for teaching practicing professionals, especially when they include personalized attention to individual learning needs of the students. Jans and Scherer (2006) suggest that distance learning methods must include the opportunity for students to personally interact with AT devices, whether in a classroom, internship, or work setting. Crawford et al. (2010) surveyed physiotherapy clinical education coordinators about remote, particularly international in this case, internship opportunities and challenges. The majority of respondents (83%) reported that PT students were required to be supervised by an on-site physical therapist. Other supervisory models reported were "virtual" supervision online by a physical therapist or university faculty member and supervision by an on-site health care professional from another discipline (e.g. nurse or physician). Similarly, Maciel (2009) and Bollela (2009) described effective remote clinical internship tutoring and management through the e-learning client Moodle. Wunschel (2009) illustrated the effectiveness of an 'Inmedea-Simulator', a web-based virtual hospital environment integrating the complete orthopedic curriculum. A script was composed for each patient, which listed personal characteristics, including complaints, symptoms, social status, hobbies, etc., as well as the frequency and dates of clinical visits. Students who completed the patient case studies highly rated the experience. These options may also be feasible for AT training in remote locations, suggesting that the future of internships and simulations may be found online.

In both in-person and online contexts for both the assistive technology field and beyond, clinicians have noted a shortage of relevant CE programming (Rappolt & Tassone, 2002). Strategies are needed to make more efficient use of available educational programming. Friedland et al. (2000) demonstrated how repackaging of an advanced entry-level rehabilitation course into a format accessible as CE increased the availability of new knowledge to practicing

clinicians. Knowing that research activities, or familiarity with research methodologies and incorporating evidence based practices increases quality of care, and that interprofessional education may also increase quality of care, learning opportunities resulting in these outcomes should be encouraged. Stucki (2007) suggests most clinicians, do not have the possibility of, or sufficient interest in, taking 1 or 2 years out of their clinical work to obtain additional training related to research or other disciplines that may result in a Masters' degree. However, many clinicians across professions and disciplines may be able to commit themselves to a certificate program of 6–9 weeks duration. To meet the needs of these participants, programs generally need to be provided in blocks of maximum 2 weeks, spread over 2 years and include a reasonable amount of e-learning (distance learning) and self-learning credits. Therefore, feasibility of technological media for continuing rehabilitation education including telehealth and web-based courseware, should be examined.

2.4 SUMMARY OF REVIEW OF LITERATURE

I reviewed several aspects of general pedagogy for health sciences education and its implications related to online learning. There is not one defined or widely accepted model for how knowledge, skills, or dispositions should be taught in health science education (e.g. Kolb, 1984; Schön, 1987). Research has shown that declarative training results in procedural or clinical training (Anderson, 1983). Clinical training is perhaps the most important as it simulates professional practice and encourages experiential learning, but even within clinical training, there is not one model that covers all aspects. The collaborative, problem solving, integrative, multiple mentoring, continuum of supervision, reflective, self-directed learner, coaching, and

interdisciplinary models, along with the mastery pathway framework, are documented clinical training models in the health sciences (Stroschein, 2002).

For adequate development of knowledge, skills, and dispositions in the health sciences, it is recommended that students work on interdisciplinary teams, place equal emphasis on developing non-technical competencies, and be encouraged to engage in reflective thinking (Cox, 1999). Research also suggests that students' professional development and communication skills develop better when working on interdisciplinary teams compared with similar discipline-specific settings. This is especially true when engaging in research activities, which can not only enhance students' skills, but also serve as a bridge between theory and practice and between academic educators and clinicians (Stroschein, 2002).

It is also important to consider the role of the educator. Effective practices for educators or "learning facilitators" include encouraging self-directed and reflective learning, especially in continuing education (Borduras, 2002; Mann, 2009). Also, multiple mentor relationships including students, peers, and professionals can also be arranged by clinical or academic faculty to increase the extent to which knowledge, skills, and professional disposition learning outcomes are achieved (Nolinske, 1995). When evaluating the mastery of skills, frameworks should be used that guide, monitor, and evaluate clinical competence (DeClute & Ladyshewsky, 1993). Such models include cognitive, manual, and affective components that rate students on a continuum between maximum supervision needed and proficient independence (Oldmeadow, 1996).

In both health sciences education and beyond, there is a need for further inquiry related to online education. A U.S. Department of Education (2010) meta-analysis suggests the field lacks a coherent body of linked studies that systematically test theory-based approaches in different

contexts. In further review of the studies contained in the meta-analysis, it seems most researchers did not attempt to control for differences among curriculum materials, aspects of pedagogy, and learning time in the treatment and control conditions (e.g. Beile & Boote, 2002; Bixler, 2008; Cavus, 2007; Zhang, 2005). Despite this assumed lack of rigid research, online learning is perceived to not only assist in creating a community of learners, but also increase self-reflective learning when conducted asynchronously (Hiltz, 2005). Research suggests blends of online and face-to-face instruction, on average, have stronger learning outcomes than face-to-face instruction alone. Increasing active learning and collaborative knowledge building activities may enhance the effectiveness of online learning (Greenhow & Belbas, 2007; Muukonen, 2009). Additionally, online learning activities that promote self-efficacy are recommended (Beile & Boote, 2002).

Studies reveal mixed results when comparing online and face-to-face instruction in the health sciences (Beeckman et al., 2008; Campbell, et al., 2008; Cook et al., 2005). While online learning was more effective for some populations, it was not for all, even within the same study. More research should be conducted that compares online instruction to face-to-face instruction based on external board exams or other similar reliable and valid measures that provide a stronger standard of comparison.

Lastly, both in-person and online interprofessional training is encouraged in the health sciences as it can improve patient care (Farrell, 2005). Offering interprofessional education online can help with scheduling logistics, allowing students to learn with and from each other, and promoting reflection and critical thinking through asynchronous components (Casimiro, 2009). Assistive technology education offers both pre- and professional opportunities to engage in interprofessional training online, though there are very few programs that can be completed

entirely online. Virtual clients and e-learning platforms such as Moodle can help to facilitate remote internships in these cases (Maciel, 2009). Clinicians have also noted a shortage of relevant CE programming (Rappolt, 2002). To facilitate change in clinicians' behavior and clients' outcomes, organizations should foster professional development activities and efforts within the organization itself to promote the adoption of evidence-based practices.

3.0 METHODOLOGY

3.1 PROTOCOL

This study compared and contrasted different modalities for learning AT concepts online. The first modality I was interested in includes an online-only program consisting of video modules on AT and case studies that participants completed independently. The second modality was a hybrid program consisting of online video modules, case studies, and in-person activities that participants completed collaboratively. Specifically, I looked at the learning outcomes and perceptions of trainees in the health sciences related to status (position, education, and experience levels), delivery mode (online, hybrid), setting (individual or group), and pedagogical features (collaborative and reflective learning practices). I planned to use these findings to describe the extent to which online assistive technology training results in a higher level of interprofessionality and reflective behaviors, the fit of the Interprofessionality e-Pedagogy (IPeP) model to assistive technology (AT) training online, and recommendations for delivery mechanisms to match pedagogy in the IPeP model. Currently, the IPeP model solely focuses on appropriate pedagogy derived from adult and constructivist learning theories but does not include the accompanying technological mechanisms that will maximize content delivery and associated learning outcomes. This study required a mixed methods approach due to the complex nature of assessing learning outcomes and perceptions. It is common to assess declarative knowledge in

the health sciences through quantitative pre and post tests. A previously validated interprofessionality readiness scale and reflective questionnaire, also quantitative measures, are required to assess the effect of AT training online on these constructs. It is also critical to assess both learning outcomes and perceptions of trainees through qualitative measures to ensure multiple viewpoints are considered and incorporated. It is dually common to assess learning outcomes in the health sciences via observation of a trainee's interactions with a mock client to assess procedural knowledge. Additionally, to ensure the trainees' voices are heard, it is important to capture outcomes and perceptions in their own words, and not just aggregated results from a questionnaire or scale. Therefore, questionnaires, scales, observations, and journal entries were completed to assess both individual and group differences through a constructivist lens. My study questions for this sample were:

1. Do personal variables predict learning outcomes for online Assistive Technology education?

2. Do learning outcomes differ across online and hybrid groups for Assistive Technology continuing education training?

3. Does AT online CE impact trainees' interprofessionality and reflectiveness?

    A. Do interprofessionality and reflectiveness increase with collaborative online learning (cohort vs. individual learning)?

    B. Do interprofessionality and reflectiveness increase with collaborative hybrid learning (online + in person vs. online only)?

4. What are the most effective online delivery mechanisms for the pedagogy identified in the Interprofessional ePedagogy (IPeP) model?

The study included a convenience sample composed of two groups from the University of Pittsburgh School of Health and Rehabilitation Sciences (trainees in Rehabilitation Science and Technology Continuing Education programs). The content focus in each of the trainings was assistive technology. The core areas of assistive technology knowledge consist of service delivery, funding procedures, wheelchair seating and cushions, human-assistive technology interfaces (e.g. assistive technology models of adoption), visual sensory aids, hearing sensory aids, cognitive augmentation aids, alternative and augmentative communication devices, mobility devices, transportation, environmental aids for daily living, assistive technology in the context of the classroom, and assistive technology in the context of work (or worksite modifications) (Cook & Polgar, 2008). The trainings covered the various areas of assistive technology. The online group (Group A) completed all trainings independently (modules and case studies) and there was no involvement of the instructor, with the exception of the pre-recorded modules on AT topics. The hybrid group (Group B) also watched all modules independently, however group activities were required for each topic. The instructor was involved in monitoring and grading these activities in addition to hosting a monthly recitation for all trainees. The recitation was held online one night per month and included case studies and roundtable discussions. The hybrid component of the training was an in-person hands-on session held at the end of the program that covered a portion of the topics, with an emphasis on the service delivery aspects of assistive technology. Group work was an essential part of the in-person session. Each group worked with a client with unique disabilities to assess their needs, develop an intervention strategy, implement the intervention, and evaluate the intervention, following the core areas on the Rehabilitation Engineering Society of North America's ATP Readiness Self-Rating questionnaire.

The online group, from here referred to as Group A, includes 385 clinicians who completed an online course focusing on assistive technology prior to this study through the University of Pittsburgh Rehabilitation Science and Technology Continuing Education program. The participants ranged from less than one year to over twenty years of experience in the rehabilitation (most specifically in the sub-area of AT) field, in expertise from beginners to advanced level, and 94% were therapists (see full descriptive statistics in Table 13). The specialties of the personnel include but are not limited to wheeled seating and mobility, computer access, cognitive devices, and sensory aids. I collected demographics (see Appendix A) and pre and post scores from a previously validated true/false content assessment from all participants. I chose to include this group because they completed a pure online training individually, in contrast to the other group who completed a group and hybrid training. Group A was broken down in to a sub-group and representative sample, Group A1, in order to match as a control for the hybrid group (Group B). I identified 28 individuals for Group A1 by matching participants from Group A with those in Group B based on personal characteristics that I deemed had significant relationships with learning outcomes through my first research question. I collected additional metrics from Group A1, through a database that ran an automatic script and contacted the individuals requesting their participation in the study (see approved IRB determination in Appendix B). Forty-eight participants out of 385 responded to the request. The users entered their IDs on each additional metric to match their responses together.

Group B completed their training and assessments through the course of this study. Group B was composed of 28 participants completing an online/in-person (hybrid) certificate program in assistive technology, also through the University of Pittsburgh Rehabilitation Science and Technology Continuing Education program. The participants ranged from less than one year

to over twenty years of experience in the rehabilitation (most specifically in the sub-area of AT) field, in expertise from beginners to advanced level, and 69% were therapists (see full descriptive statistics in Table 13). The specialties of the personnel include but are not limited to wheelchair seating and mobility, computer access, cognitive devices, and sensory aids, mirroring those of Group A and the focus areas of the course. This group completed identical content to the course completed by Group A in the first phase of the study and additional content related to other assistive technologies. I also broke down Group B in to a sub-group and representative sample composed of 8 participants, Group B1, for more in-depth qualitative analysis. I chose four archetypes based on group demographics (e.g. two participants representing each "type" of trainee by factors such as education level and experience). Further information about the rationale for the selection of these individuals will be included in the qualitative results section.

All participants were asked if they would like to participate in the study and completed the informed consent process. The study, with the exception of personal observations, was anonymous as participants' names were replaced with user IDs. A total of N=413 for the study, though not all participants or their resultant data was used in each facet of the study. Based on a thorough literature review and professional experiences, I assert the following propositions that laid the groundwork for my study: a) health sciences education is generally most effective when combining collaborative learning, reflective learning, and problem based learning pedagogies; b) online instruction is generally more effective when linked to pedagogy and appropriate delivery mechanisms to assist in solely "learning about" a topic to achieving mastery of procedural content; c) interprofessionality results in higher learning outcomes, engagement in collaborative and reflective practice, lifelong learning, and ultimately, as a piece for future work but not to measured in this study, higher patient outcomes; d) the Interprofessionality ePedagogy (IPeP)

model (Gordon, Booth, and Bywater, 2010) contains the integral components for the development of new interprofessional and professional knowledge. Therefore, my hypotheses and resultant beliefs and suggested implications were as follows:

1. Experience, education level, and other characteristics predict performance on recall exam.

2. Learning outcomes differ for online and hybrid AT continuing education. The inclusion of a problem-based hands-on session will increase learning outcomes. This suggests group-based learning and some opportunities for hands-on experiences should be emphasized in the development of assistive technology continuing education.

3. Trainees' interprofessionality and reflective behaviors will increase when conducted in a cohort. This increase will be more apparent after the hands-on session. This is important to note as a) Interprofessional learning impacts rehabilitation professionals' propensity to collaborate with those from different backgrounds and positively impacts patient care and b) Reflective behaviors result in the development of autonomous, qualified, and self-directed professionals. These assertions suggest that online AT continuing education should be designed with the goal of increasing both interprofessional and reflective behaviors in mind.

4. Building from Gordon et al.'s (2010) Interprofessional ePedagogy (IPeP) model, I will be able to make recommendations for technology and delivery to accompany the pedagogy, thus expanding to an IPePD(delivery) model to encourage online assistive technology instructors (and associated health science fields instructors) to develop modules with both appropriate pedagogy and delivery mechanisms in mind.

3.2 A RATIONALE FOR MIXED METHODS RESEARCH

Constructivists believe that knowledge is socially constructed and multiple views are present (Guba and Lincoln, 1985). Johnson et al. (2007) suggest "qualitative dominant mixed methods research is the type of mixed research in which one relies on a qualitative, constructivist-poststructuralist-critical view of the research process, while concurrently recognizing that the addition of quantitative data and approaches are likely to benefit most research projects" (p. 124). The research methods in an investigation must fit the research problem or question. Johnson and Onwuegbuzie (2004) suggest mixed methods as the third research paradigm (in addition to qualitative and quantitative) in educational research. Problems most suitable for mixed methods are those in which the quantitative approach or the qualitative approach, by itself, is inadequate to develop multiple perspectives and a complete understanding about a research problem or question. For example, quantitative outcome measures may be comprehensible using qualitative data. Alternatively, qualitative exploration may usefully occur prior to development of an adequate instrument for measurement. Greene et al. (1989) suggest there are five major purposes or rationales for conducting mixed methods research: a) triangulation, b) complementarity, c) initiation, d) development, and e) expansion. By including qualitative research in this study to complement the quantitative measures, I believed I would be better suited to understand complex phenomena, hard-to-measure constructs, and interactions. Based on Greene's rationales, I was most interested in b) complementarity, or the enhancement and illustration of results from one method with results from the other method, and e) expansion, or seeking to expand the breadth and range of research by using different methods for different inquiry components.

I followed the mixed methods research process model as defined by Johnson and Onwuegbuzie (2004): 1) determine the research question, 2) determine whether a mixed design is appropriate, 3) select the mixed-method or mixed-model research design, 4) collect the data, 5) analyze the data, 6) interpret the data, 7) legitimate the data, and 8) draw conclusions and write the final report. My qualitative methods consisted of content analysis through development of a unique coding scheme. My quantitative methods consisted of paired and independent sample t-tests, fisher-exact tests, and ordinary least squares (OLS) regression.

3.3 DATA COLLECTION

As mentioned above, I analyzed data on two separate groups: a group taking a pure online course on assistive technology and a group taking a hybrid course on assistive technology. While Group A already completed the training and pre and post questionnaires, 48 individuals from that cohort completed additional questionnaires after the course to match Group B. From this set, I selected 28 participants for data analysis and further involvement in the study, forming Group A1, based on a manual matching technique on participant characteristics (derived from a demographics survey that both groups completed). There were some limitations with this group including a time lag between training and analysis. Additionally, I only had access to a post-questionnaire on interprofessionality and ATP readiness with Group A1 because they already completed their training.

Group B was comprised of professionals enrolled in a longer-term hybrid certificate program. There were 28 participants in the group and therefore, all were asked to participate in the study. I collected questionnaires, participant journals, and observed participants in discussion

groups and other open access forums. Tables 6 and 7 in section 3.6 display the data collection metrics, purpose for each metric tied to the research questions, sample, and method of analysis, in addition to a timeline.

3.3.1 Questionnaires

There were four validated questionnaires used in this study, in addition to a demographics survey. The demographics survey collected descriptive statistics on all participants (see Appendix A). I first analyzed these statistics by Group A only to determine whether personal variables predict learning outcomes for AT online education. The demographics survey also allowed for a purposeful sampling of 28 participants to serve as matched controls for Group B.

The first questionnaire was a Rehabilitation Science and Technology Continuing Education (RSTCe) pre and post-test content assessment developed for the RSTCe program that has been taken by more than 600 individuals. The questionnaire contains 40 true/false questions. This questionnaire helped me determine if personal variables predict learning outcomes for online assistive technology education (question 1) and whether learning outcomes differ across online and hybrid groups (question 2).

The second questionnaire was the Readiness for Interprofessional Learning Scale (RIPLS) developed by Parsell and Bligh (1999) (see Appendix C). The scale explores differences in trainees' perception and attitudes towards multi-professional learning, with the conception that interactive and group-based education increases potential for collaborative practice. Group A only completed the "post" questionnaire but Group B took the questionnaire before the online portion, after the online portion, and after the in-person portion. This questionnaire helped me determine if AT online continuing education impacts trainees'

interprofessionality, and whether other differences exist related to those who have learned together online, and also whether differences exist between online and hybrid delivery mechanisms.

The third was the RESNA ATP Readiness Self-Rating questionnaire (see Appendix D). This allowed participants in both groups to rate their skills and knowledge related to preparation for the assistive technology professional (ATP) credentialing exam. Group A only completed the "post" questionnaire but Group B took the questionnaire before the online portion, after the online portion, and after the in-person portion. This questionnaire helped me determine if AT online continuing education impacts trainees' learning outcomes, and whether other differences exist related to those who have learned together online, and also whether differences exist between online and hybrid delivery mechanisms.

The fourth was Kember's Reflective Questionnaire (2000) (see Appendix E), which was used to assess Group B participants' reflective behaviors before and after the course. This assisted in answering question 3 related to whether the training increases participants' reflectiveness.

3.3.2 Observations

There were two main observation opportunities involving participants from Group B: discussion forums (both online and in-person) and journal entries. Each observation opportunity assisted me in confirming my results from my previously described data collection methods for each of my research questions in that they provided evidence of both learning and other gains related to interprofessionality and reflection.

Two types of discussion forums took place. One was online, an average of one time per month, which provided trainees an opportunity to discuss that month's content in the program through a voice and text chat forum. The second was an in-person forum at the hands-on workshop. In each type of session, trainees interacted with experienced clinicians who hold the Assistive Technology Professional (ATP) designation and assisted me with observations. Though all sessions were designed using problem-based learning, the in-person session, at minimum, included an exercise for the trainees to interact with a mock client. A pilot exercise and assessment were conducted with other clinicians for reliability purposes prior to the study. A designated ATP clinician and I observed a random sampling of trainees at both the online and in-person stage to identify gains across the program.

Journal entries were required of all participants in Group B. However, I selected four archetypes based on the results of question 1 and analysis of Group A. From there, I selected 2 participants that fit each archetype, forming Group B1. These trainees' journal entries were analyzed four times over the course of the program to assess both individual gains and group differences. Journal entry prompts contained aspects relevant to learned content, interprofessionality, and reflectiveness.

3.4 RELIABILITY AND VALIDITY

It is important to note that I have triangulated, or used or used multiple data sources in my study to produce understanding. Following Denzin (1978), I have used two types of triangulation, methods triangulation (different data collection methods) and triangulation of sources within the same methods by collecting data at different points of time and also using different subjects.

3.4.1 Qualitative data

3.4.1.1 Internal validity

Internal validity, or the extent to which scientific observations and measurements are authentic representation of some reality (LeCompte & Goetz, 1982), was insured through the reflection of myself as a researcher. Internal validity is affected by the quality of the qualitative research design. In accordance with McMillan and Schumacher's (1997) recommendations to enhance internal validity, I obtained literal statements of participants and quotations verbatim from documents, conducted "member checking" where I checked informally with participants for accuracy during data collection, and maintained a field log (dates, times, people, and activities for all data) resulting in a high level of audibility by recording my data management techniques, codes, categories, and decision-rules as a "decision trail".

3.4.1.2 External validity

External validity, or the degree to which representation of some reality may be compared legitimately across groups (LeCompte & Goetz, 1982), was ensured through a detailed account of field experiences, including description of key stakeholders (myself, certificate program personnel, funding agency, certificate and previous CE program participants). Describing a phenomenon in sufficient detail allows one to evaluate the extent to which the conclusions drawn are transferable to other times, settings, situations, and people (Geertz, 1973).

I also utilized Maxwell's (1992) Validity Typology to describe the measures I took to ensure the study's validity. Maxwell's Validity Typology includes descriptive, interpretive, theoretical, generalizability, and evaluative validity. To ensure descriptive validity, I checked the factual accuracy of participants' statements. After all of the qualitative data was aggregated

in Dedoose, I sampled 16 passages (2/participant) and found the corresponding passage in the Coursesites archives. All participants' journal entries are archived in the Coursesites portal by date. I matched the timepoint and statement by participant for each of the 16 passages. 100% of the passages were accurately coded, meaning each participant's statement matched what was originally said. Interpretive validity was ensured by identifying what objects, events, and behaviors meant to the participants. I sent each participant the two statements I identified above and asked them to confirm what they meant to convey with the statement. I compared these responses with the associated codes that I assigned to the statement. No discrepancies were identified in the process. I ensured theoretical validity by applying the concepts to the phenomena under investigation. I developed a codebook for each of the components of the theoretical framework and defined the levels for each concept (low, medium, and high). This codebook was reviewed by two other University of Pittsburgh PhD students, who had no connection to the present study, but who were also trained in qualitative methods. The students identified 3 and 5 points, respectively that needed to be clarified based on the operative definitions of each concept. The feedback was incorporated and the same students reviewed the codebook again and identified no issues. The final codebook is displayed in Tables 1-3 below.

Table 1. General umbrella concepts/codes

Code	Interprofessional Learning
Brief Definition	Interactive and group-based education aimed at improving collaborative practice
Full Definition	Interactive and group-based education aimed at improving collaborative practice, as occasions when two or more professionals learn with, from and about each other to improve collaboration and the quality of care
When to Use	Apply this code to all references to working together with the other students or groups; these individuals or groups

	May be referred to as other clinicians/professionals, and also other professionals outside of the class (co-workers, etc). May also use words like team and collaborator.
Example	"The materials also helped me to think about how I will want to work within a team concept to be sure that the clients' wishes and needs are met in the best way possible going forward."

Table 2. Reflective learning

Code	Reflective Learning
Brief Definition	When learning is linked to professional experiences and practices are changed as a result.
Full Definition	Learning starts on the basis of tacit knowledge; a practitioner usually connects with their feelings, emotions and prior experiences to attend to the situation directly. Includes reflection-on-action, the idea that after the experience a practitioner analyzes their reaction to the situation and explores the reasons around, and the consequences of, their actions.
When to Use	Apply this code when student links course material to professional practice, when they talk about the change in professional practice as a result of course material/activities.
Example	"I think in whatever setting you are an Occupational Therapist, you are required to be nearly constantly looking at alternative ways to practice because each patient/client's needs are so different and this is one of the strengths of OTs. I frequently reflect on ways I have provided patient care and strive to do my best to meet each person's needs. Some of the things I am learning about in this course, I do not do in my daily practice, however this course has made me look at the ways I complete wheelchair evaluations/justifications."

Table 3. Course content/learning outcomes

Code	***Course Content/Learning Outcomes***
Brief Definition	The particular knowledge, skill or behavior that a student is expected to exhibit after a period of study.
Full Definition	The particular knowledge, skill or behavior that a student is expected to exhibit after a period of study. A learning outcome sets out what a learner is expected to know, understand and be able to do as the result of a process of learning.
When to Use	Apply this code when learning outcomes are mentioned in passages. This includes when a student highlights
When not to Use	When a student only suggests a desire to learn a particular topic, but not does not reference when they learned it, or comparing their previous knowledge with their current knowledge.
Example	"I have little if any experience with some of the material especially with cognitive AT and augmentative technology. I have been able to utilize aspects of the seating and position and learned a lot from the disability modules. I have a better understanding of what is needed and how to help our clients be more comfortable and supported while using their equipment. I still have so much to learn. I do not have a clinical background. I've been on the technical and electronics end for the last ten years or so."

Table 4. Operative definitions of content sub-codes

Content	
Knowledge	the fact or condition of being aware of something
Skill	the ability to use one's knowledge effectively and readily in execution or performance
Behavior	the manner of conducting oneself/resuming habitual inclinations or tendencies that are common to professional field

Table 5. Definitions of ratings (low, medium, high)

Source	L	M	H
Others **(interprofessionality)**	Uses a negative word (e.g. no, never) when referring to working/learning with others.	Uses word like beginning, continue, still (something along a continuum) when referring to working/learning with others.	Indicates a stronger desire to work/learn with others and other statements that indicate a high value placed on this concept.
Course content ***Knowledge***	Uses a negative word (e.g. no, never) when referring to understanding of concepts.	Notes some level of mastery of content but remains somewhere in the middle of the continuum, or still at recall level.	Demonstrates concepts beyond memorization. Linkages across concepts.
Skills	Uses a negative word (e.g. no, never) when referring to a course topic and executing knowledge.	Notes some level of mastery of skills but remains somewhere in the middle of the continuum, or less confident in performance or execution.	Executes and performs key concepts, demonstrating a mastery of concepts beyond memorization/recall to procedural.
Behaviors	Does not resume or notes a lack of habitual inclinations or tendencies that are common to professional field.	Notes some professional tendencies but remains somewhere in the middle of the continuum.	Resumes habitual inclinations or tendencies that are common to professional field.
Self **(reflection)**	Uses a negative word (e.g. no, never) when referring to reflecting on material learned or a change in practice based on material learned.	Uses word like beginning, continue, still (something along a continuum) when reflecting on learned material, discuss the process of thought/reflection in	Indicates a stronger desire to reflect on material learned, discuss active change in practice based on material learned.

		practice. In some cases mentions either reflection or change in practice, but not both.	

I ensured generalizability by extending the findings to other persons, times, or settings than those directly studied here. Guba and Lincoln (1985) also suggest external validity can be described through the degree of transferability and applicability in other contexts. The findings in this study have applicability in other fields and throughout the scope of online education. As described in the background and literature review, the emergence of MOOCs across the country (over 80 universities and 26 fields identified in the Coursera portal alone) confirms this as a contemporarily relevant and emerging topic in online education. This phenomenon is drawing attention to online education and its resultant quality. The modular format of the cert program is congruent with the standard MOOC experience. Based on this parallel structure, the findings from this study may be generalized across multiple fields. I ensured evaluative validity by applying an evaluative framework rather than a descriptive, interpretive, or explanatory framework.

3.4.1.3 Internal reliability

Internal reliability is determined by the extent other researchers would match previously generated constructs with data in the same way as the original researcher (LeCompte & Goetz, 1982). Internal reliability was ensured in the background literature search. Both interprofessionality and reflection are phenomena that have been applied across other settings in online learning in the health sciences, as seen in both Gordon et al., 2010 and Mann, 2009.

3.4.1.4 External reliability

External reliability is determined by the extent independent researchers discover the same phenomena or generate the same constructs in the same or similar settings (LeCompte & Goetz, 1982). I utilized two of the strategies identified by LeCompte and Goetz to reduce threats to internal reliability including mechanical recording of data and using multiple researchers. The data was collected automatically from archived journals and analyzed in Dedoose. Multiple researchers also analyzed the data. The same sample of 16 passages was coded by the same two researchers mentioned above. The inter-rater reliability between each researcher and me was .78 and .74 for an average of 76% agreement.

3.4.2 Quantitative data

I ensured quantitative validity, or the degree to which an instrument measures what it is supposed to measure, and consequently, permits appropriate interpretation of scores, by using previously validated questionnaires and assessments. I ensured quantitative reliability, or the degree to which a test consistently measures what it is designed to measure, by using instruments that were already assessed for their reliability.

3.5 DATA ANALYSIS

Related to question 1, “Do personal variables predict learning outcomes for online Assistive Technology education?” quantitative methods and data analyses were used to assess the differences across multiple variables within group A. Paired-sample t-tests were conducted on

scores on the RSTCe pre-test to compare each group's knowledge before and after the course, followed by an Ordinary Least Squares Regression. Variables included knowledge, job type, years of experience, and expertise level prior to course enrollment. STATA 13.0 was used for all quantitative data analyses.

Related to question 2, "Do learning outcomes differ across online and hybrid groups for Assistive Technology continuing education training?" Independent and paired-sample t-tests (Group A1 and Group B) were conducted for the RSTCe pre-test and RESNA ATP Readiness scores. Ordinary least squares regression was conducted if differences were identified. Additionally, both qualitative and quantitative content analyses were conducted on observations and journal entries to assess clinical and procedural knowledge. Dedoose (LLC, Los Angeles, dedoose.com), a cross-platform application for analyzing text, video, and spreadsheet data for qualitative, quantitative, and mixed methods research was used for content analysis. The software interface allows users or teams to effectively analyze qualitative and mixed methods research data from various research approaches. I used Dedoose for content analysis and the first and second cycle coding (Saldaña, 2009) method. Saldaña (2009) suggests the portion of data to be coded during first cycle coding processes can range in magnitude from a single word to a full sentence to an entire page of text to a stream of moving images. In second cycle coding processes, the portions coded can be the same units, longer passages of text, and/or a reconfiguration of the codes previously developed.

Related to question 3, "Does AT online CE impact trainees' interprofessionality & reflectiveness?" quantitative and qualitative methods and data analyses were used to assess the differences between and across groups. Independent and paired sample t-tests followed by regressions (where differences exist) were conducted on scores on the Readiness for

Interprofessional Learning (RIPLS) and Reflective questionnaires to compare trainees' level of interprofessionality after the course (and Group B's pre and post scores). As Group A1 already completed the training, only their post-tests were included in the analysis. Additionally, discussion forums and journal entries were analyzed via Dedoose and first and second cycle coding.

Related to question 4, "What are the most effective online delivery mechanisms for the pedagogy identified in the Interprofessional ePedagogy (IPeP) model?", quantitative and qualitative methods and data analyses were used to assess the differences within Group B. Data included observations and questionnaire results related to trainees' learning outcomes and opinions. Results from questions 1-3 were also used to inform question 4. The data from observations were coded to make a recommendation for online tools that were most effective at facilitating activities in the Interprofessionality e-Pedagogy model. This method complements Johnson & Onwuegbuzie's (2004) step number 7, or legitimating my data based on analysis and interpretation.

3.6 SUMMARY OF METHODOLOGY

The mixed methods approach through a constructivist lens allowed multiple perspectives to be represented while empirically representing group differences through quantitative statistical measures. Tables 6 and 7 below present a summary of tool, purpose, groups involved, number of participants, data analysis, and timeline for each facet of the study. These methods allowed me to report between and across group differences for delivery modality (online or hybrid), setting (group or in-person training), and online delivery mechanism (type of online tool). I was also

able to report whether AT online education impacts trainees' interprofessional and reflective behaviors, and the format through which the most profound differences occur (i.e. online/hybrid and individual/group). I was also able to recommend whether assistive technology online learning is supported by the Interprofessional e-Pedagogy model and the particular delivery mechanisms that best facilitate interprofessional learning outcomes.

Table 6. Metrics summary

Tool	**Purpose**	**Research Question**	**# of Participants**	**Analysis**
Baseline questionnaire	Collect descriptive statistics on all participants	1	413	Summary statistics; graphs
RESNA ATP Readiness	Compare each group's content awareness self-assessment	2	56	Independent-samples and paired t-tests on subscales and overall score; Fisher-exact tests on individual items; OLS regression on subscales and overall score
Content assessment	Compare each groups' AT knowledge after the course (and Group B's level pre/post)	2	413	Independent-samples and paired t-tests; OLS regression on overall score
Readiness for Interprofessional Learning (RIPLS)	Compare each group's level of interprofessionality after the course (and Group B's level pre/post)	3A, 3B	56	Independent-samples and paired t-tests on overall score; Fisher-exact tests on individual items
Reflective questionnaire	Assess current clinical competence to achieve job goals and reflective practice	3A, 3B	56	Independent-samples and paired t-tests on subscale and overall score; Fisher-exact tests on individual items
Trainees' journals and messages from discussion forum	Self-assessment related to learned content, collaborative, and reflective practice	All	8	First/second-cycle coding (Saldaña, 2009)

Table 7. Timeline

Tool	**0-Oct 2012 (pre-program)**	**1-Jan 2013 (mid-program)**	**3-Apr 2013 (after online portion)**	**4-May 2013 (after in-person workshop)**	**5-June 2013 (1 month after completion)**
Baseline questionnaire	A B				
Readiness for Interprofessional Learning (RIPLS)	B		B	A1 B	
RESNA ATP Readiness	B		B	A1 B	
Content assessment	B		B	A B	
Trainees' journals	B1	B1	B1	B1	
Discussion forum	B	B	B	B	
Reflective Questionnaire	A1 B				A1 B

4.0 RESULTS

4.1 QUALITATIVE RESULTS

As described above in the methods section, I was only able to obtain qualitative data from Group B since Group A (and subsequently, Group A1) did not complete journal entries. From Group B, I created Group B1, a representative sample of 8 individuals (out of 28, total) comprised of 4 therapists and 4 non-therapists; 5 with more years of experience (over 10) and 3 with less years of experience (less than 10); and 5 intermediate and 3 beginner participants in terms of their expertise. Among this group were 4 different archetypes (2 of each kind) that I used for sampling including: 2 VA therapists, 2 non-VA therapists, 2 suppliers, and 2 individuals who were new to the field (1 an engineer, the other previously in business). Reflective journal entries were collected for all participants as a required assignment in August (baseline as a part of the program application), October, January, April, and May.

4.1.1 Expected findings

Related to Research Question 1, I hypothesized that characteristics including participants' job type (e.g., whether or not they are a therapist), level of expertise in assistive technology (AT), and years of experience were related to gains on learning outcomes, and as a result, would see some variation in how participants' excerpts were rated and would be able to draw some

conclusions based on overall trends. In terms of research question 2, I expected to see that Group B would make gains in learning outcomes from the online to the in-person workshop, and the journal entries would reflect this change. I would not be able to identify differences in learning outcomes as a result of collaboration (related to research question 2), since only Group B's responses were coded and analyzed and Group A was used as a control group for this aspect.

Related to my third research question, I also expected to see gains in the areas of interprofessionality, or interactive and group-based education aimed at improving collaborative practice, and reflectiveness for the hybrid group. Gains in these areas speak to additional trainee outcomes that may affect their capacity to sustain content knowledge from the training long-term, address AT problems, work in interprofessional teams, and engage in lifelong learning. The higher a trainee's reflectiveness and interprofessionality, by definition and according to previous research, the more likely they are to seek additional training, collaborate well with others, and provide better patient care (Schon, 1983; Parsell & Bligh, 1999; Farrell, 2005).

4.1.2 Results from coding

Qualitative results are presented below, beginning with frequency tables for each code and rating (low, medium, high) at each pre-selected timepoint (August, October, January, April, and May) in tables 8-12. In accordance with Saldaña's (2009) first and second cycle coding method, I preliminarily developed the coding structure and iteratively defined the definitions of the rating scale. I first coded all entries from the timepoints listed above, and during second cycle coding processes, coded the same units and/or a reconfigured the code ratings that I previously developed.

In August, October, and January, the majority of the excerpts across all constructs (interprofessionality, learning outcomes, and reflectiveness) were coded as either “low” or “medium”. In April and May there were no “low” codes and more “high” codes than “medium” codes. April, or at the conclusion of the online course, demonstrates the largest number of high codes at 70%. May, or after the in-person workshop, demonstrates the second largest number of high codes at 64%. Examples are provided in Table 24 in Appendix F to demonstrate how responses were coded and from which timepoint it was extracted.

Table 8. August

Source	**L**	**M**	**H**
Others (interprofessionality)	0	5	3
Course content (understanding)			
Knowledge	6	5	3
Skills	6	8	4
Behaviors	1	7	4
Self (reflection)	1	8	4
Total	14	33	18

Table 9. October

Source	L	M	H
Others (interprofessionality)	0	3	0
Course content (understanding)			
Knowledge	9	6	1
Skills	4	4	0
Behaviors	3	2	0
Self (reflection)	2	7	0
Total	18	22	1

Table 10. January

Source	L	M	H
Others (interprofessionality)	0	10	0
Course content (understanding)			
Knowledge	5	9	0
Skills	6	8	0
Behaviors	2	7	1
Self (reflection)	1	17	4
Total	14	51	5

Table 11. April

Source	L	M	H
Others (interprofessionality)	0	1	11
Course content (understanding)			
Knowledge	0	6	4
Skills	0	4	4
Behaviors	0	1	11
Self (reflection)	0	6	12
Total	0	18	42

Table 12. May

Source	L	M	H
Others (interprofessionality)	0	0	7
Course content (understanding)			
Knowledge	0	3	4
Skills	0	4	4
Behaviors	0	2	4
Self (reflection)	0	7	10
Total	0	16	29

I also analyzed the qualitative data individually by participant. In table 25 (see Appendix G), responses were tabulated to identify growth patterns per participant. Five out of eight

participants demonstrated an increase from low or medium to high in the latter two months of the program. Two of the three participants who did not demonstrate an increase to "high" codes in the latter two months of the program were both new to the field (less than 1 year of experience). This finding did not surprise me because being that new to the field it would be common for trainees to be unsure about some course content and their professional practice.

4.1.3 Qualitative Results Summary

4.1.3.1 Research question 1: Do personal variables predict learning outcomes for online Assistive Technology education?

There were 4 different archetypes chosen for this analysis: "VA therapists", "non-VA therapists", "suppliers", and "new to the field". Most trainees followed the same pattern of more low codes at the beginning of course and more high codes at the end of the course, indicating that in this case the personal variables that were chosen for the archetype did not serve as predictors for learning outcomes, with the exception of years of experience. The two participants who were "new to the field" did not have an overall increase to high codes at the end of the course. However, the following passages demonstrate that for this coding scheme and analysis, both suppliers and therapists had gains at the end of the course. This suggests with perhaps the exception of years of experience, regardless of job type, participants' comments were more highly ranked at the end of the course.

Supplier pre-skills M, knowledge M, reflect M

"I am very interested in furthering my career by becoming an ATP. I have been working as a wheelchair technician for the past eleven years and would like to build on that experience. I am currently taking RESNA preparation courses online through The MED Group. The more in

depth training provided through the University of Pittsburgh would provide me the opportunity to fulfill my goal."

Supplier post online-skills M, knowledge M, reflect H

"As far as gaps in knowledge I'm still learning, and I never really had the opportunity to do any of this kind of work except for the last year or so. I always work with someone when it comes to positioning and that's a good thing because the last thing I want to do is make someone's situation worse because of a mistake I made due to lack of knowledge. I really enjoyed this. I found it all very interesting and very informative. It has given me the framework and tools that I need to take the exam."

Therapist pre-knowledge L, reflect L

"My reaction was one of nervousness after finishing the lecture; I was surprised at just how much information was provided, and that was just the instructors skimming the surface! It made me think that I have quite a bit of studying to do, and that I have quite a bit of reading to do on my own with the Hussey and Cook book."

Therapist post online-reflect H, behavior H, inter H

"I think the class has taught me that there are very different many ways to approach a problem/many solutions for people with challenges/disabilities and just knowing how to get to those resources/who to ask professionally is very important. I often reflect on whether or not I could have improved what I did during a session with a client, and I think this class has helped me figure out concrete ways in which I can assist patients to reach their goals towards independence."

These results may have important implications in ensuring that participants with fewer years of experience are afforded opportunities for hands-on practice that may encourage them to

discuss and further realize the gains they have made in knowledge and skills. Optional remediation at the beginning of the course to level the playing field for participants with fewer years of experience may also be helpful.

4.1.3.2 Research question 2: Do learning outcomes differ across online and hybrid groups for Assistive Technology continuing education training?

70% of the codes were rated as high at the conclusion of the online course, where 64% of the codes were rated as high at the conclusion of the in-person workshop. In this coding scheme and analysis, there does not seem to be a difference across online and hybrid groups. However, the richness of several of the participants' comments reflected the gains they made after the hybrid portion of the course, especially in terms of synthesizing the content from the online course:

May-Participant 6-Skills-high, knowl-high, reflect-high

"I am not sure about alternative ways of thinking or doing my job but this course has provided me with a wealth of knowledge far greater than when I entered this class last year. My work to this point has been affected from the course itself in a way that I do think about some of the concepts taught to me throughout the year. The deep dive was a greater help for we were able to see and use the AT devices that were presented to us in the class."

May-Participant 3-Reflect-high, inter-high

"As a result of the deep dive, I loved the team work aspect. I do not find myself utilizing my peers and coworkers the way I have during the deep dive. The online course was very informative but to actually see the products and devices and to recommend them and actually see them work was 2nd to none. The online course sort of gave us a heads up of what we were gonna see in the deep dive. It definately prepared me personally to feel somewhat comfortable at the deep dive."

May-Participant 6-Skills-med, knowl-med, reflect-high

"The deep dive definitely required me to use the concepts taught throughout the online course. I had to refer to information that I had learned from the online classes to be able to complete the activities for the deep dive. Given my limited experience in the field, without the online classes some of the areas of the deep dive would've been quite difficult for me to understand. But with the background of the classes, I was able to see how a lot of the information applied in a real world setting."

4.1.3.3 Research question 3: Does AT online CE impact trainees' interprofessionality and reflectiveness?

a. Do interprofessionality and reflectiveness increase with collaborative online learning (cohort vs. individual learning)?

Qualitative data was not collected from Group A, therefore question 3.a. will be answered in the quantitative results section because analyzing the collaborative effect of the training is dependent upon Group B's comparison with the control group (Group A).

b. Do interprofessionality and reflectiveness increase with collaborative hybrid learning (online + in person vs. online only)?

Interprofessionality

92% of trainees' comments were rated as high at the conclusion of the online course, where 100% of trainees' comments were rated as high at the conclusion of the in-person workshop. Therefore, interprofessionality appears to increase after the online program and again slightly after the online + in person portion. The following comments demonstrate a participant's gain in interprofessionality between the online and in-person workshop.

April-Participant 5-Interprofessional med, knowl-med, skills-med

"The course did make me think about the topics presented; however not on a daily basis as I don't work in a facility where I have a lot of patient with specialized needs for driving, vision, hearing, etc. The most common thing that I prescribe is custom manual and electric w/c; usually for the patient with diabetic neuropathy or general decline in functional mobility (no high level SCI or ALS). At time I felt that I was quite unknowledgeable about the equipment that was available/most of the people that I was paired with in my group had much more experience than I did, and therefore, when we started doing group assignments, I didn't really have to think that much as before I even had a chance to get the wheels turning, someone would already have jumped in and answered the questions. I don't believe that this is due to not cooperating at all, but truly because everyone had a lot more knowledge than I did."

May-Participant 5-Interprofessional high, knowl-high, skills-high

"In hindsight I am really glad that we had all the classes previous to the deep dive as I needed that background information. At times I was not quite sure why we were getting so much information, however I feel that everything made so much more sense to me once I got to Deep Dive. Having little to no experience with AT, I think I struggled with some of the concepts throughout the on-line section, however once we got to Deep Dive I was really able to understand everything. I really enjoyed Deep Dive and liked the interaction with the patients, getting to use the equipment, and getting to work with all the other professionals that all seemed like we had been working together for quite some time! It was great to work and learn from the different professionals that were on my team, definitely to a different extent than just working together online. It made me appreciate what the folks from different backgrounds brought to the team."

Reflectiveness

67% of trainees' comments were rated as high at the conclusion of the online course, where 58% of trainees' comments were rated as high at the conclusion of the in-person workshop. Below demonstrates a participant's increase in reflectiveness from the beginning (prior to the start) to the end of the course (first in April, and again in May), but overall, according to this coding scheme and analysis, the in-person workshop does not appear to increase participants' reflectiveness.

August-Participant 2-Reflect medium

"I would like to continue working in an acute care setting, possibly progressing to a manager level with the hopes of continuing with wheelchair evals in an outpatient setting. I would also like to possibly start a wheelchair clinic at the current hospital that I am in."

Apr-Participant 2-Reflect medium

"I think in whatever setting you are an Occupational Therapist, you are required to be nearly constantly looking at alternative ways to practice because each patient/client's needs are so different and this is one of the strengths of OTs. I frequently reflect on ways I have provided patient care and strive to do my best to meet each person's needs. Some of the things I am learning about in this course, I do not do in my daily practice, however this course has made me look at the ways I complete wheelchair evaluations/justifications."

May-Participant 2-Reflect high

"The deep dive required my to understand the concepts taught by the lecturers and think back to the material that I had learned in the online modules. I also find myself reflecting daily at work on how to improve my practice. I do think that watching/listening to the modules prior

to attending the deep dive was of great benefit to my learning/trialing of the items at the deep dive."

4.1.3.4 Research question 4: What are the most effective online delivery mechanisms for the pedagogy identified in the Interprofessional ePedagogy (IPeP) model.

This question will be addressed in the discussion section as it requires analysis of the findings from questions 1-3 and a mix of qualitative and quantitative results.

In terms of qualitative results overall, the overall themes of learning outcomes, interprofessionality, and reflectiveness were very apparent in journal entries across participants and phases (online and in-person), and also at interim points (October and January). However, I found it difficult to identify differences among trainees and archetypes except for overall gains, with most participants having "high" codes at the end of the training. Perhaps the coding scheme may require additional reliability and validity assessments to accurately assess trainee gains. The rating scale of low, medium, and high may also require additional investigation. As a result, I may find clearer trends among the gains according to participant characteristics.

4.2 QUANTITATIVE RESULTS

4.2.1 Expected findings

Related to Research Question 1, I hypothesize that characteristics including participants' background knowledge, job type (e.g., whether or not they are a therapist), level of expertise in

assistive technology (AT), and years of experience are related to their performance on the post-treatment content assessment. The relationship between the scores and individual characteristics tells me whether the characteristics help to explain variation in scores. I hypothesized in my second research question that learning outcomes differ across online and hybrid groups for continuing education in assistive technology. I predicted that collaborative learning also impacted online training outcomes.

Controlling for the significant covariates that I identified from my first research question, I expected to see greater learning outcomes from the hybrid group due both to the collaborative learning aspects in addition to the opportunities for authentic hands-on activities that provide greater relevance to practice. Related to my third research question, I also expected to see gains in the areas of interprofessionality and reflectiveness for the hybrid group. The learning outcomes evidenced by the content assessment may only be a snapshot into the participants' capacity, or even more narrowly, their recall memory, at this time while the gains in the other areas may project their capacity for critical reflection, problem solving, and their ability to obtain additional knowledge when necessary to serve as a competent, well-informed contributor of the AT team they work with in their own professional setting.

4.2.2 Descriptive Statistics

I measured learning outcomes by individuals' scores on two instruments: the content assessment questionnaire and the RESNA ATP Readiness questionnaire. The first metric, the content assessment, is more of an objective measure while the latter relies on self-report. While the content assessment measures knowledge via true/false questions, the RESNA ATP Readiness questionnaire asks participants to gauge their competency or ability to perform in several

domains (subscales) on a 1-4 scale. The tool is designed to help the learner document strengths in a specific practice area; identify gaps in knowledge and skills for a specific practice area; identify professional growth opportunities; link current skills and abilities to critical job skills and performance plans; assess learning needs prior to re-entering the workforce after a prolonged absence from practice; assess learning needs prior to transitioning from one area of practice to another; and form the framework for a professional development plan. Subscales include assessing needs, developing intervention strategies, implementing the intervention strategies, and evaluating the interventions. The overall competency score measures the participants' readiness to sit for the RESNA ATP exam, which results in the ATP certification.

Table 13 presents descriptive statistics for Group A (online only), Group A1 (a subset of Group A, online only), Group B (hybrid: online and in-person collaborative training), and Group B1 (a subset of Group B, online only), respectively. The content assessment is based on a true/false questionnaire, composed of 40 items. Scores are on a 0-100 scale in terms of percentage correct; in this study scores range in value from .40-1.0. Expertise level of the participants is a categorical variable with categories of beginner, intermediate, and advanced. Experience is a categorical variable representing bands of years beginning with less than 1 through more than 21 years. The percentage of therapists (vs. non-therapists) in the groups are also included in the table. The table illustrates that the groups are not equivalent in terms of the share of therapists; Group B and B1 have fewer therapists than Group A and A1, a limitation of the study. This may affect the analysis because the within Group B comparison results may apply more to therapists than non-therapists. However, these statistics reveal that there are not substantial differences among the groups in terms of prescores (background knowledge), expertise level, or years of experience, suggesting that the groups can be compared to test the

role of particular aspects of the treatment (online vs. hybrid; collaborative vs. independent learning).

Table 13. Descriptive Statistics

	Group A	Group A1	Group B	Group B1
Content assessment prescore	.78 (.09)	.78 (.05)	.77 (.05)	.76 (.05)
Content assessment online course postscore	.86 (.09)	.82 (.13)	.80 (.06)	.76 (.05)
Content assessment in-person workshop postscore	N/A	N/A	.80 (.07)	.82 (.03)
Beginner Level	.39	.46	.25	.37
Intermediate Level	.54	.46	.61	.63
Advanced Level	.07	.07	.14	.00
Less than 1 year	.11	.04	.04	.13
1-5 years	.20	.25	.29	.13
6-10 years	.16	.18	.11	.13
11-15 years	.18	.21	.25	.39
15-20 years	.13	.07	.14	.13
21+ years	.22	.25	.18	.13
Therapist	.94 (.24)	.96 (.19)	.69 (.48)	.50 (.54)
N	385	28	28	8

Notes: Each cell reports the variable mean, standard deviation (in parentheses).

Quantitative results for research questions 1-3 are analyzed below.

4.2.3 Research Question 1: Do individual characteristics predict learning outcomes for online Assistive Technology education?

For this analysis, I used the content assessment scores before and after the online course. I conducted an OLS regression of Group A's content assessment postscore on prescore after completing the online training to identify predictors for learning outcomes for online AT education. I used Group A alone for this analysis because of its larger sample size (N=385). To better understand outcomes, I found it helpful to first understand predictors for prescores. If

particular characteristics are predictors for prescores, it helps me understand whether particular groups of trainees (e.g. those with more or less experience) on average, have more knowledge at baseline. As both the level and experience are categorical variables, I ran all regression models with the indicators to allow for more flexible parameterization.

- *Do Group A participants' (those who learn individually online) expertise level, job type, and years of experience predict their content assessment pre-scores?*

Table 14 demonstrates that the higher the participants' self-rated knowledge level and years of experience, the better their pre-intervention performance on the content assessment, on average. For example, holding all other variables constant, I identified that advanced participants scored, on average, approximately 2/3 standard deviation higher than beginner participants. In addition, participants with 11 or more years of experience perform nearly one standard deviation better than their counterparts with no experience. Therefore, based on the content assessment prescore, more experienced participants are substantially more knowledgeable at baseline. This result is in line with my hypothesis for the first research question, that there is a relationship among these variables. I expected to find that participants with a higher expertise level and more years of experience are better equipped with both knowledge and skills compared to trainees with less expertise and fewer years of experience at baseline.

Table 14. Summary of OLS Regression for Variables Predicting Prescores

Variables	Coefficient
Level	
Intermediate	.02**
	(.01)
Advanced	.07***
	(.02)
Therapist	.00
	(.02)
Experience	
1-5 years	.04**
	(.02)
6-10 years	.05**
	(.02)
11-15 years	.08***
	(.02)
16-20 years	.09***
	(.02)
21+ years	.07***
	(.02)
Intercept	.70
	(.02)
R^2	.17
Number of Observations	385

Notes: Each cell reports the variable mean, standard error (in parentheses). $p < .10$~, $p < .05$*, $p < .01$**, $p < .001$***

After I conducted the regression for the predictors of prescore, I conducted a regression on postscore using prescore as another one of the covariates to identify the relationship among participants' characteristics and their content assessment postscore.

- *Do Group A participants' prescore, expertise level, job type (therapist vs. other), and years of experience predict their postscore on the content assessment?*

Table 15 demonstrates there is a significant relationship between pre- and postscore. For every unit difference in prescore, I predict a positive .42 unit difference in postscore, holding all other variables constant. Controlling for baseline knowledge (prescore), I predict intermediate

participants will receive a -.02 lower postscore than beginners, while participants with over 21 years of experience are predicted to receive a .03 higher postscore compared to those with less than one year of experience. I also predict therapists will receive a .03 higher postscore compared to non-therapists.

Table 15. Summary of OLS Regression for Variables Predicting Postscores when Controlling for Prescore (baseline knowledge), Level, Job Type, and Experience

Variables	Coefficient
Prescore	.42***
	(.06)
Level	
Intermediate	-.02*
	(.01)
Advanced	-.03
	(.02)
Therapist	.03~
	(.02)
Experience	
1-5 years	.01
	(.02)
6-10 years	.01
	(.02)
11-15 years	.03
	(.02)
16-20 years	-.00
	(.02)
21+ years	.03~
	(.02)
Intercept	.50
	(.05)
R^2	.17
Number of Observations	385

Notes: Each cell reports the variable mean, standard error (in parentheses). $p < .10$~, $p < .05$**, $p < .01$***, $p < .001$****

This suggests that participants with a self-rated lower level, more years of experience, and therapists (vs. non-therapists) are predicted to score higher on the posttest, controlling for pretest

performance. I did not expect participants at a lower expertise level to score higher on the posttest, but the rest of the results do not contradict my hypotheses.

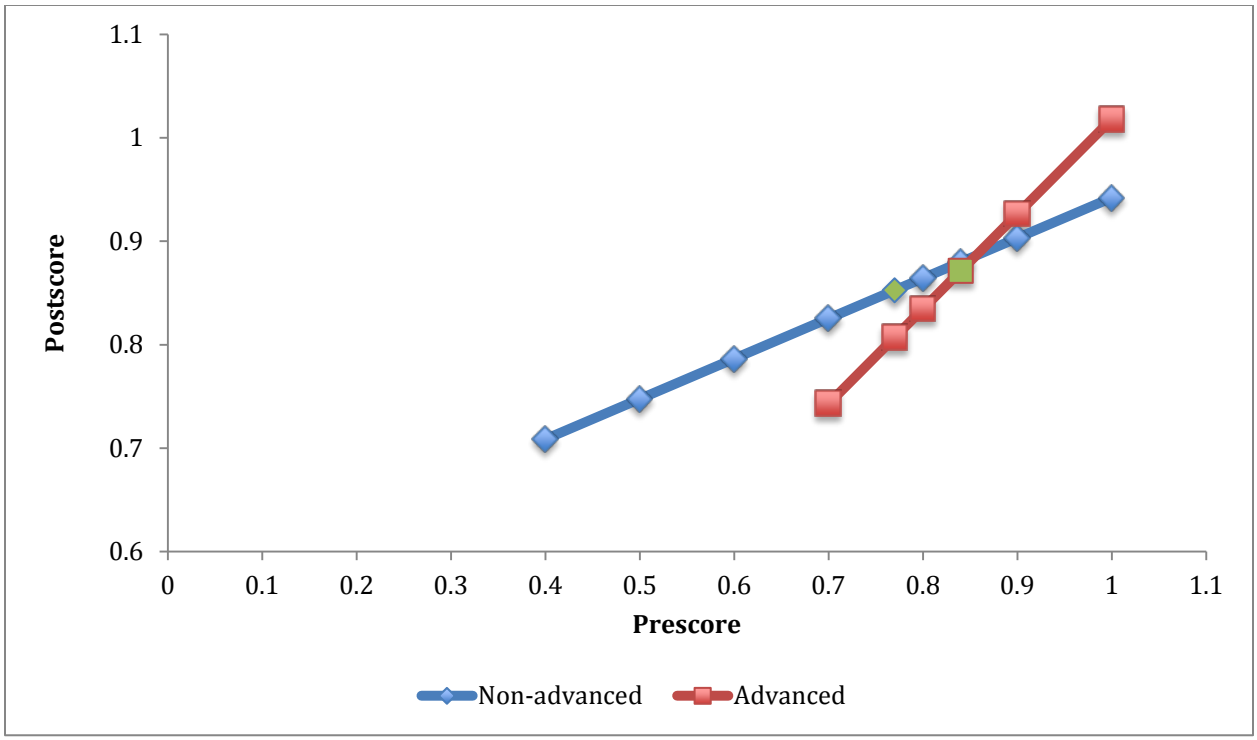
I removed the covariates (i.e. experience) that were not significant, acknowledging that there does not seem to be a relationship between years of experience and postscore. I created two interaction variables for prescore and intermediate status and prescore and advanced status to investigate whether the relationship between prescore and postscore depends on expertise level. I found it was interesting to investigate this relationship because controlling for prescore (baseline knowledge), I wanted to see if there was a relationship between expertise level and the change between prescore and postscore. Table 16 demonstrates the advanced level and the interaction between prescore and advanced status were significant predictors. The regression model in Table 16 below suggests that the relationship between postscore and prescore depends on level interaction. One hypothesis is that those who are less advanced may be less disposed to preconceived ideas than advanced participants, recall and use more of the material learned in the course (vs. their experience) for their test responses, and score higher on the posttest (which is aligned closely with the course material) as a result.

Table 16. Summary of OLS Regression for Variables Predicting Postscores when Controlling for Prescore (baseline knowledge), Level, and Prescore and Level Interaction terms

Variables	Coefficient
Prescore	.40****
	(.09)
Level	
Intermediate	-.03
	(.09)
Advanced	-.45**
	(.23)
Therapist	.03*
Prescore x Intermediate	.02
	(.11)
Prescore x Advanced	.51*
	(.27)
Intercept	.52
	(.06)
R^2	.16
Number of Observations	385

Notes: Each cell reports the variable mean, standard error (in parentheses). $p < .10$*, $p < .05$**, $p < .01$***, $p < .001$****

Figure 1 displays a graphical representation of the relationship between postscore and prescore for advanced and non-advanced participants at the time of prescore. The figure illustrates that though non-advanced participants score lower on the pretest, on average, they score higher on the posttest than advanced participants, as demonstrated by the green dots in the figure. The figure illustrates that for a given prescore, the novice participants outscore the advanced participants on average. However, the model also suggests that all trainees on average make steady gains on the posttest according to the positive slopes, though this model suggests advanced participants at a lesser rate than beginner and intermediate participants.



Note: Model displayed for the average value of therapist (94% of the sample are therapists as shown in Table 12 descriptives). The green dots represent the average prescores.

Figure 1. Relationship between postscore and prescore for non-advanced and advanced participants

4.2.4 Research Question 2: Do learning outcomes differ across online and hybrid groups for Assistive Technology continuing education training?

Prescores and post-treatment scores were calculated for both Group A1 (online) and B (hybrid) on the content assessment, as it was a standard assessment used for the training. Because the online group completed the program before this research study began, they did not complete a pre-RESNA ATP Readiness questionnaire. After the research study started, they were asked to complete post questionnaires. However, the hybrid group completed both the pre and post RESNA ATP Readiness questionnaires because their program began after the research study

started. Twenty-eight participants were matched by prescore, level, job, and experience out of a sample of Group A participants who responded to the research study request and completed the additional questionnaires (48 out of the original 385). Though this is a low response rate, as demonstrated in Table 13, the characteristics that I am able to observe to do not differ between Groups A and A1 even though A1 represents the individuals who responded to the questionnaire.

- *Do the groups have significantly different prescores on the content assessment?*

I used a matching procedure to balance the sample on baseline covariates. I manually sorted the prescore, level, job, and experience covariates in order from low to high for Group B. As mentioned above, a sample of Group A participants (48) responded to the research study request and completed additional questionnaires. I also sorted this sample's characteristics in the same order (prescore, level, job, and experience). From this 48, I selected 28 by matching on the covariates.

Table 17 illustrates the success of my matching and demonstrates that online and hybrid groups did not have significantly different prescores prior to the training on the content assessment. This suggests that coming in to the training, one group did not know significantly more information as measured by the content assessment, nor have a different expertise level or experience level. This confirms that the matching worked well to balance the baseline covariates that I observed. Therefore, based on this assumption, the online and hybrid groups can be analyzed comparatively to identify differences between the two programs. In other words, because I balanced my sample on observable covariates, I am making an assumption that the groups are similar on characteristics that I cannot observe as well. This may not be the case with regards to trainees' propensity to participate in the two types of training. Therefore, a limitation of the study may be that participants in Group A may be more receptive to individual training and Group B, more receptive to collaborative training. Therefore, this may be a strong predictor

in why they chose one training over the other. For example, this may make it more challenging to identify whether collaborative training on average, especially with the limited sample size, has an impact on participants' learning outcomes. Future studies that use random assignment may be able to better investigate the role of collaboration.

Table 17. Groups A1 and B Comparison

Variables	Group A1	Group B	t-stat
Prescore	.78	.77	.55
	(.05)	(.05)	
Level	1.61	1.89	-1.69
	(.63)	(.63)	
Experience	3.79	3.71	.17
	(1.62)	(1.56)	
Number of Observations	56	56	

Notes: Each cell reports the variable mean, standard error (in parentheses). p < .10~, p < .05**, p < .01***, p < .001****

Prior to comparing Groups A1 and Group B, I tested whether Group A1 and Group B made gains individually on the online course. I also tested whether Group B made gains between the end of the online course and after the in-person workshop.

- *Does the online group have significantly different postscores than prescores on the content assessment after completing the online portion of the course?*

I utilized a paired t-test to examine Group A1's prescore and postscore differences. Table 18 demonstrates Group A1 had significantly higher postscores than prescores. This suggests that the independent online training is effective at increasing knowledge measured by the content assessment.

- *Does the hybrid group have significantly different postscores than prescores on the content assessment and the RESNA ATP Readiness questionnaire after completing the online portion of the course?*

I conducted a paired t-test on Group B's content assessment and RESNA ATP Readiness questionnaire after the online course. Table 18 illustrates Group B scored significantly higher on the content assessment and all four constructs measured by the RESNA ATP Readiness questionnaire, suggesting that after the online portion of the course, Group B believes they can more accurately assess needs, develop intervention strategies, and confidently implement and evaluate the interventions. This illustrates that the collaborative online training is effective at increasing knowledge measured by both the content assessment and RESNA ATP Readiness questionnaire.

Table 18. Group B Pre/Post on Content Assessment and RESNA ATP Readiness

Variables	Group A1 Pre	Group A1 Post-Online	t-stat	Group B Pre	Group B Post-Online	t-stat
Content Assessment	.78 (.01)	.82 (.03)	1.89~	.77 (.05)	.80 (.06)	3.91***
Assessment of Need	N/A	3.19 (.81)	N/A	3.23 (.70)	3.41 (.76)	1.67~
Intervention Strategies	N/A	2.49 (.80)	N/A	2.31 (.13)	2.75 (.15)	4.87***
Implementation of Intervention	N/A	2.78 (.97)	N/A	2.85 (.82)	3.39 (.72)	4.49***
Evaluation of Intervention	N/A	2.73 (1.06)	N/A	2.58 (.65)	3.39 (.80)	6.18***
Number of Observations	28	28		28	28	

Notes: Each cell reports the variable mean, standard error (in parentheses). $p < .10$~, $p < .05$*, $p < .01$**, $p < .001$***

- *Does Group B have significantly different postscores on the content assessment and RESNA ATP Readiness questionnaire after completing the in-person workshop?*

The post-online score for Group B only explains a portion of the trainees' learning outcomes. I was interested in seeing the effect of the in-person workshop (what makes Group B's training classified as "hybrid"), so after completing this portion of the course, Group B took

the post-test again. Table 19 displays that Group B's post score after the in-person workshop was significantly different from the post-online score (nearly one-half of a standard deviation higher), and one standard deviation higher than the prescore on the content assessment. Group B's scores on the RESNA ATP Readiness questionnaire were also significantly different on intervention strategies and evaluation of intervention.

Scores did not significantly differ for assessment of need and the implementation of intervention subscales. Though scores increased slightly for assessment of need, I expected to see a significant difference on this construct because during a considerable portion of the in-person workshop, participants spend one-on-one time interviewing clients about the benefits and shortcomings of their current assistive technology. The only activities under assessment of need that were not covered in the in-person workshop were related to reviewing current records and plans (medical, educational, and vocational), assessing the client's environment, and presenting the findings to the client (though they did present their client case to the instructors and group). Adding these activities in the future may be helpful and may result in a difference in scores. It makes sense that I did not see a difference in implementation of intervention because unlike intervention strategies and evaluation of intervention, the participants did not have an opportunity to prepare, order, monitor, and train the client on the equipment. Adding these activities in the future will also be helpful for the trainees.

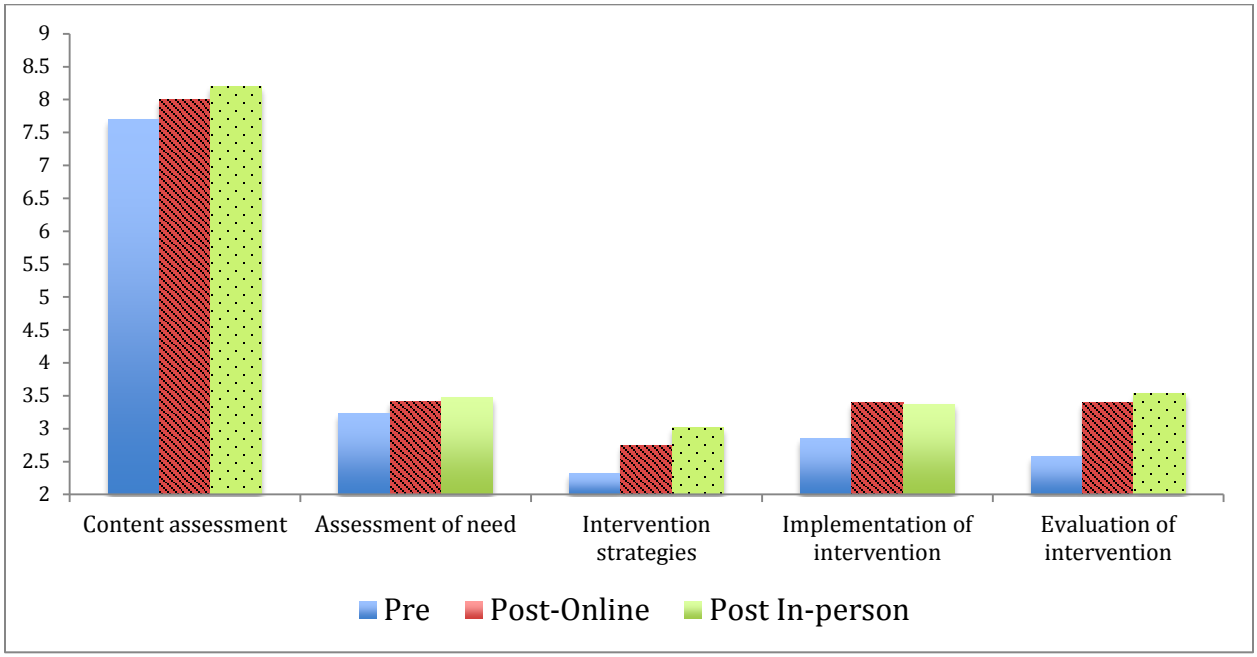
These findings are important to note because it indicates that the in-person workshop did impact Group B's learning outcomes and that the collaborative hybrid training is effective at increasing the trainees' competencies in the areas in which the activities were focused. Figure 2 presents learning outcomes constructs for before, after the online portion, and after the in-person portion of the training to demonstrate that with the exception of the implementation of

intervention subscale, trainees' scores increased after each stage of the course, but were the highest after the in-person workshop.

Table 19. Group B Pre/Post on Content Assessment and RESNA ATP Readiness

Variables	Post-Online	Post-In person	t-stat
Content Assessment	.80	.82	1.78~
	(.06)	(.01)	
Assessment of Need	3.41	3.47	.08
	(.76)	(.72)	
Intervention Strategies	2.75	3.01	3.63**
	(.15)	(.84)	
Implementation of Intervention	3.39	3.37	-.01
	(.72)	(.76)	
Evaluation of Intervention	3.39	3.54	1.97*
	(.80)	(.72)	
Number of Observations	28	28	

Notes: Each cell reports the variable mean, standard error (in parentheses). $p < .10$~, $p < .05$*, $p < .01$**, $p < .001$***



Notes: Means are presented. All constructs except for "content assessment" are on a 1-4 scale. The content assessment is a percentage. The line overlay pattern demonstrates a significant difference ($p < .10$) after the online portion; the dot overlay pattern demonstrates a significant difference ($p < .10$) after the in-person workshop. 'Pre' is the left bar, 'post-online' is the middle bar, and 'post in-person' is the right bar.

Figure 2. Group B learning outcomes constructs for before, after the online portion, and after the in-person portion of the training

A difference between Group A1 and B's online training is whether the training was completed independently (Group A1) or collaboratively (Group B). The next two items investigate whether collaborative learning affects outcomes in this training.

- *Does collaborative learning lead to larger improvements in scores on the content assessment?*

I compared Group A1 and B's content assessment by calculating differences between individuals' postscore and prescore performance and conducting an independent samples t-test after the online portion of the training to determine whether collaboration impacted scores. There was not a significant difference in score improvement, $t(27) = .58$, $p > .05$. Because Group

A1's training was completed independently and Group B's training collaboratively, in this setting evidence suggests that the role of collaboration does not impact a change in postscores on the content assessment.

This result came as a surprise because of my hypothesis that collaborative activities played a role in creating a sense of community that would benefit participants' overall knowledge. It may be that collaboration itself was not beneficial in developing the content knowledge that was evaluated by the assessment. The online individual training group (A1) may have spent more time studying the modules and books because there was no requirement of group work, while the online collaborative group (B) split their time between individual work, which ultimately may have allowed them to score higher on the test as demonstrated by these results, and group activities. I conjecture however, based on other results, that the group activities may have played a stronger role in developing other constructs, such as participants' self-awareness and beliefs related to competencies of AT skills (demonstrated by the RESNA ATP Readiness, interprofessionality, and reflectiveness questionnaires), that may reconcile the minimal consequence of a lower content assessment score. It is also important to note the practical significance of the increase in the participants' scores; both groups raised their scores, on average, to over 80%. The next question dives deeper into another assessment of the difference between the groups' learning outcomes.

- *Does collaborative learning lead to larger improvements in scores on the RESNA ATP Readiness questionnaire?*

While the content assessment demonstrated no significant difference among groups, I analyzed the groups' postscores on the RESNA ATP Readiness questionnaire as another measurement of learning outcomes. Significant differences may suggest that the instruments measure different

types of learning outcomes and/or that the role of collaboration has more of an effect on participants' perceptions of their abilities related to assessing clients' needs, developing intervention strategies, implementing the intervention strategies, and evaluating the interventions.

Group A1 and B have significantly different scores on the "implementation of intervention," $t(52) = 2.67$, $p < .01$ and "evaluation of intervention," $t(52) = 2.6$, $p < .01$ constructs measured in the RESNA ATP Readiness questionnaire after the online portion of the course. I conducted OLS regressions on "implementation and intervention" and "evaluation of intervention" subscores to identify significant differences between groups and also investigate the relationships among the subscores and covariates. The implementation and intervention treatment, previous knowledge, level (advanced), and experience variables were significantly different. Table 20 demonstrates that Group B scored higher on the implementation of intervention subscale. Substantively, on average, participants in Group B scored 2/3 of a standard deviation higher than participants in Group A1 on the "implementation and intervention" subscore, holding all else constant. Participants in the advanced level and with over 21 years of experience scored higher on the subscale (.84 and 2.32, respectively), compared to beginners and those with less than 1 year of experience.

Table 20. Summary of OLS Regression for Variables Predicting Implementation and Intervention and Evaluation of Intervention Subscores when Controlling for Prescore (baseline knowledge), Level, Job, and Experience

Variables	Implementation & Intervention	Evaluation of Intervention
Group B	.62**	.81***
	(.21)	(.23)
Prescore	4.01~	5.33*
	(2.13)	(2.29)
Level		
Intermediate	.32	.17
	(.24)	(.26)
Advanced	.84*	.69*
	(.36)	(.39)
Job	-.05	.34
	(.28)	(.30)
Experience		
1-5 years	2.03***	2.08***
	(.54)	(.58)
6-10 years	2.07***	2.25***
	(.57)	(.61)
11-15 years	1.49**	1.51*
	(.57)	(.62)
16-20 years	1.70**	1.92**
	(.60)	(.65)
21+ years	2.32***	2.36***
	(.56)	(.61)
Constant	-2.42	-3.87
	(1.80)	(1.93)
R^2	.52	.54
# of Observations	54	54

Notes: Each cell reports the variable mean, standard error (in parentheses). $p < .10$~, $p < .05$*, $p < .01$**, $p < .001$***

Similarly, the evaluation of intervention treatment, previous knowledge, expertise level (advanced), and experience variables were significantly different. Table 20 demonstrates that Group B scored higher on the evaluation of intervention subscale. On average, participants in Group B scored nearly one standard deviation higher than participants in Group A1 on the "evaluation of intervention" subscale, holding all else constant. Participants with a higher expertise level (advanced) and experience level (over 21 years of experience) scored .66 and 2.36

higher on the subscale, respectively, compared to beginners and those with less than 1 year of experience.

There was no significant difference on the "assessment of need" or "intervention strategies" subscale. Interestingly, assessment of need was also not significant between Group B's post-online and post-in-person workshops. This may suggest that no aspects of the course (both online, whether collaborative or not, and in-person) impacted the "assessment of need" construct. A significant difference exists on these constructs for Group B after the online course, suggesting they increase for that group. However, not having prescores on this measure for Group A1 prevents me from making a conclusion in this area related to the effect of collaboration, because it is possible that Group A1 makes similar gains from before and after the online course.

These results suggest that the two assessments (content and RESNA ATP Readiness) provide conflicting evidence for the difference in learning outcomes between hybrid and online groups. However, the results from the RESNA ATP Readiness questionnaire do suggest the role of collaboration may impact participants' view of performing well on the exam and of their AT skills in the implementation of intervention and evaluation of intervention areas. Though Group B improved on all four constructs, they only differ from Group A1 on two of the constructs after the online course. It is difficult to make conclusions without knowing whether Group A1 made similar gains. In the event Group B was significantly different on all four constructs, and the fact that the groups were not significantly different on the covariates, I could make a stronger claim that collaboration impacted the learning outcomes measured by the RESNA ATP Readiness questionnaire. In contrast, on the basis of these same claims, I conjecture that collaboration impacted participants' competencies of implementing and evaluating interventions.

4.2.5 Research Question 3: Does online continuing education in assistive technology impact trainees' interprofessionality and reflectiveness?

4.2.5.1 Research Question 3a: Do interprofessionality and reflectiveness increase with collaborative online learning (cohort vs. individual learning)?

Interprofessionality

I conducted t-tests between Group A1 who completed the course individually and Group B who completed the course collaboratively in a cohort. A limitation is that I did not conduct a baseline questionnaire for Group A1. However, when I compared both groups after the course, the difference in the overall interprofessionality scores were nearly significant, $t(53) = 1.52$, $p = .13$. This suggests after the course, Group B may value practicing communication and other professional skills with those from differing professions to some extent over Group A1, though the minimal difference may not be practically meaningful. I conducted Fisher-exact tests on the 19 individual items that make up the interprofessionality questionnaire. I identified statistically significant differences ($p < .05$) on participants' belief that shared learning will help them to understand their own professional limitations. I investigated if additional covariates were meaningful in explaining variation and none were explanatory. Because only one individual item was significant out of 19, this does not hold much weight because I may expect one to be significant by chance. Therefore, it seems that collaborative learning in an online setting may not have much of an impact on trainees' level of interprofessionality. This finding may also be an instance that is a result of the limitation described in section 1.1.4, that participants' propensity to participate in one training over the other may reflect their interest

and/or aptitude in individual vs. collaborative training, therefore presenting a challenge to identify differences in this study utilizing a convenience sample.

Reflectiveness

T-tests were conducted between Group A1 and Group B. Group A1 scored significantly higher on the habitual action subscale. I conducted Fisher-exact tests on 16 individual items and identified significant differences ($p < .05$). I discovered significant differences (Group B scoring higher) on the way participants' perceived themselves as professionals and their intent to reflect on whether their practice could be improved. Similar to the findings related to interprofessionality, in addition to both groups demonstrating significantly higher scores, I am unable to conclude whether collaboration affects reflectiveness for this online training program.

4.2.5.2 Research Question 3b: Do interprofessionality and reflectiveness increase with collaborative hybrid learning (online + in person vs. online only)?

Interprofessionality

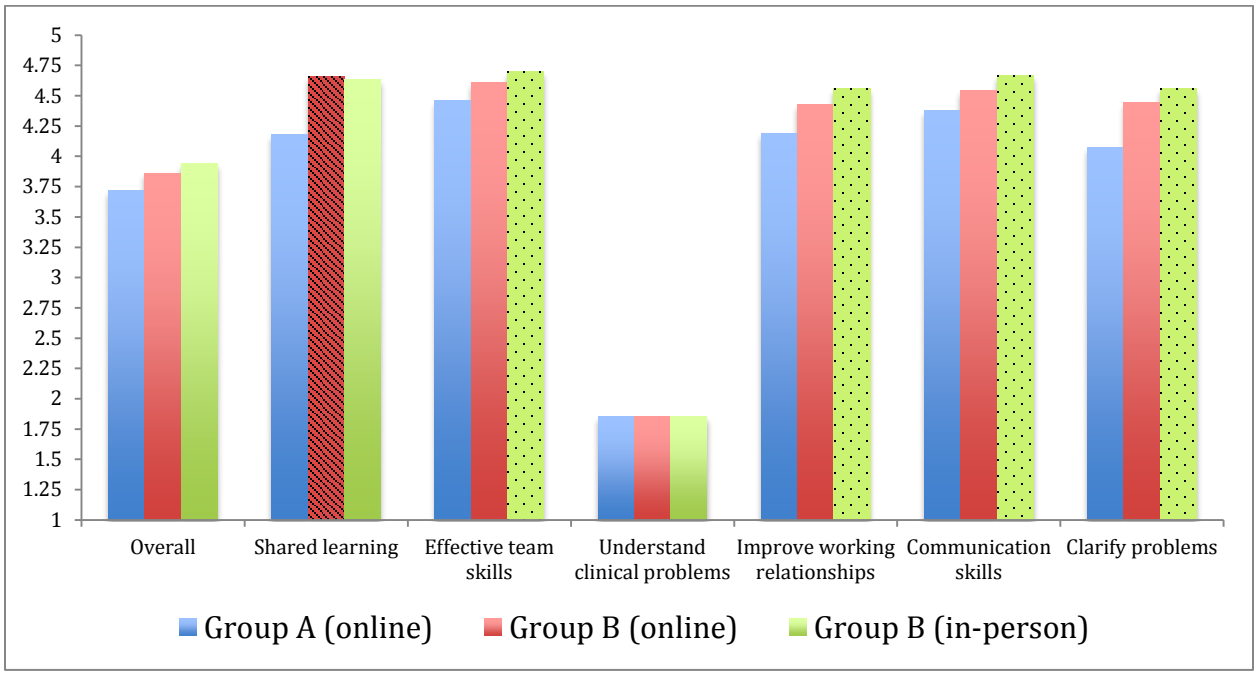
I conducted paired t-tests and Fisher Exact tests on Group B's interprofessionality questionnaires after the online course. I conducted paired t-tests on overall interprofessionality scores, and did not identify significant differences. I also conducted Fisher-exact tests on individual items and found significant differences ($p < .1$) on participants' belief that shared learning will help them to understand their own professional limitations and that learning with other professionals make them a more effective member of the health care team. Items contrary to the benefits of interprofessionality were also not significant, including viewing learning with

other professionals as “a waste of time” and that it is not necessary for healthcare students to learn together. In other words, participants view learning with other professionals to be valuable.

Again, after the in-person course, I conducted paired t-tests on Group B’s overall interprofessionality scores and were not found to be significant. I again conducted Fisher-exact tests on individual items; 8 out of 19 were found to be significant (all $p < .05$). I identified the significant effect of interprofessional learning on participants’ ability to improve working relationships, communicate better with patients and other professionals, think positively about other health and social care professionals, clarify the nature of patients’ or clients’ problems, and become a better team worker. I also found a significant difference in participants’ willingness to work on small group projects with other healthcare professionals and their belief that for small-group learning to work, professionals need to respect and trust each other. The sentiments related to small-group work were not significant after the online course, suggesting that the in-person workshop may have changed participants’ appreciation for these activities. Hybrid collaborative learning in AT may therefore have more of an effect on participants’ interprofessionality compared to online collaborative learning in AT as demonstrated by the increase in several constructs.

Figure 3 below details the postscores for Group A and Group B after the online course, and also Group B after the in-person course for select interprofessionality constructs. It is interesting to note that across all groups, there was no significant difference in “understanding clinical problems,” which in the interprofessionality construct suggests that after the course, individuals do not rely on their peers or differing backgrounds to understand clinical problems. In future studies it would be interesting to investigate to what degree and under what circumstances participants rely on their peers to assess needs and develop, implement, and

evaluate interventions. In other words this future study could look more at the integration of the various constructs including both the RESNA ATP Readiness and interprofessionality questionnaires.



Notes: Means are presented for all postscores. All constructs are on a 1-4 scale. The line overlay pattern demonstrates a significant difference between Group A and Group B; the dot overlay pattern demonstrates a significant difference between Group B's post-online and post-in-person scores. 'Pre' is the left bar, 'post-online' is the middle bar, and 'post in-person' is the right bar.

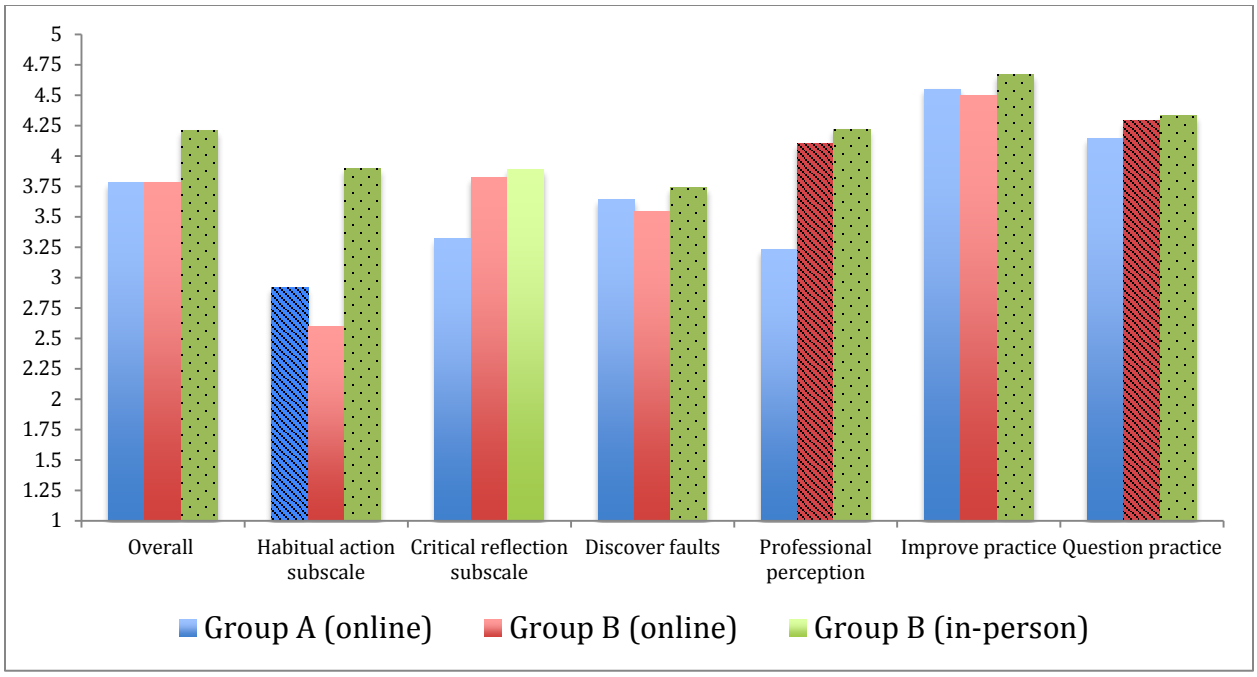
Figure 3. Postscores for Group A and Group B after the online course, and also Group B after the in-person course for select interprofessionality constructs

Reflectiveness

After the online course, I conducted paired t-tests on Group B's overall reflectiveness scores and sub-scale scores. No significant difference was found for the overall score. A significant difference was identified for the critical reflection subscale, $t(27) = 2.44$, $p < .05$. I

conducted Fisher exact tests on individual items and 4 items out of 16 were significant (all $p <$ .01). I found differences on participants' affinity to reflect on their actions and consider alternative practices and re-appraise experiences so they can learn from them and ultimately improve their practice. Both of these constructs fall in the "reflection" subscale, suggesting the collaborative online course may impact both reflection and critical reflection.

Again, after the in-person course,I conducted paired t-tests to compare Group B's reflectiveness overall and sub-scales. The overall reflectiveness scores were significantly different, $t(26) = 5.16$, $p <.01$. Additionally, the habitual action subscale score was significantly different, $t(26) = 5.48$, $p <.01$. I conducted Fisher exact tests on individual items and 11 items out of 16 were significant ($p < .05$). Several of the items referred to the course itself including participants' beliefs that the course requires them to understand concepts taught by the lecturer, understand the content itself, and continually think about the material they are being taught. The remaining items focused on participants' practice including questioning the way others do something and offering alternate solutions, reflecting on their own actions to improve what they did, and re-appraising experiences so they can learn from them and ultimately improve their practice. Additionally, my results suggest that as a result of this course, participants changed the way they looked at themselves in addition to changing their "normal way of doing things". Hybrid collaborative learning in AT may therefore have more of an effect on participants' reflectiveness compared to online collaborative learning in AT as demonstrated by the increase in several constructs that cross all four subscales. Figure 4 below details the postscores for Group A and Group B after the online course, and also Group B after the in-person course for select reflectiveness constructs.



Notes: Means are presented for all postscores. All constructs are on a 1-4 scale. The line overlay pattern demonstrates a significant difference between Group A and Group B; the dot overlay pattern demonstrates a significant difference between Group B's post-online and post-in-person scores. 'Pre' is the left bar, 'post-online' is the middle bar, and 'post in-person' is the right bar.

Figure 4. Postscores for Group A and Group B after the online course, and also Group B after the in-person course for select reflectiveness constructs

4.2.6 Quantitative Results Summary:

I first investigated whether personal variables predict learning outcomes for online continuing education in assistive technology. Group A demonstrates by holding all other variables constant, previous knowledge (prescore) and job predict postscore on the content assessment. Those with higher prescores and those who worked as therapists (vs. non-therapists) are predicted to score higher on the content assessment. Further exploring the categorical covariates, the relationship between postscore and prescore also depends on level interactions. Participants with a self-

reported “advanced level” make lower gains from the course in comparison to beginner and intermediate participants. This might be because they score higher on the pretest than beginner and intermediate participants, and are also more biased towards their previously conceived ideas about AT. Beginner and intermediate participants may answer the questions solely based on their experience in the training while advanced participants may reflect on their professional experience that may not be “by the book”. However, on average, all groups do make advances in the course from pretest to posttest. A takeaway might be to consider what additional material or activities can be provided for advanced participants to help them question their practices and reconsider alternate ideas.

Second, using the significant covariates I identified in my first analysis, I examined whether learning outcomes differ across online and hybrid groups for continuing education in assistive technology. Some evidence suggests that learning outcomes differ across online and hybrid groups for AT continuing education training; however, results differed based on the questionnaire used. While both groups (Group A1 as online only and Group B as hybrid) see significant gains from the course independently, when comparing difference scores after the online course, no significant difference exists between Group A1 and Group B on the content assessment. This may suggest the collaborative aspects of Group B’s online training did not have an effect. However, learning outcomes measured by the RESNA ATP Readiness questionnaire differed significantly between groups. When holding all else constant, participants in Group B scored significantly higher than Group A1 on two of the competency areas, implementation of intervention and evaluation of intervention. This may suggest that the collaborative aspects of Group B’s training demonstrate an effect on participants’ readiness to sit for the ATP exam, at least in the implementation of intervention and evaluation of intervention

areas. I identified no significant differences in the areas of assessment of need and intervention strategies, suggesting collaboration may not affect these areas. With regards to assessment of need, I believe activities that may impact this area may be underrepresented in both the online and in-person portions of the training and an area I recommend to emphasize in future trainings.

After Group B's in-person workshop, learning outcomes increased again. Significantly higher scores were identified on both the content assessment and RESNA ATP Readiness questionnaire in comparison to Group B's scores after the online course. As mentioned above, activities related to "assessment of need" may have been underrepresented in both the online and in-person workshop because I identified no significant differences in this construct between the individual and collaborative online groups and between the hybrid group's online and in-person portions. Since participants in Group B made gains after both the online and again after the in-person workshop, as opposed to seeing no additional gains after the in-person workshop, I conjecture that the in-person workshop does increase learning outcomes. In other words, the hybrid training does provide an additional impact in both content assessment and readiness to take the ATP exam, in contrast to participants' competency after completing the online portion.

Lastly, I explored whether online continuing education in assistive technology impacted trainees' interprofessionality and reflectiveness. I examined the effect of both collaborative online (cohort vs. individual) and hybrid (online + in-person vs. online) learning. First, I found that there might be slight differences in interprofessionality postscores for those who engaged in collaborative online learning. Those who learned in a cohort (Group B) ranked higher on communication skills and a willingness to learn with others in comparison to those who completed the training individually (Group A1). Reflectiveness, does not appear to increase with collaborative learning. Trainees from Groups A1 and B did not have significantly different

scores on the overall reflectiveness score, though Group B did score significantly higher on some of the individual items. In both instances, this might be a result of the limitation described in section 1.1.4, that participants' propensity to participate in one training over the other may reflect their interest and/or aptitude in individual vs. collaborative training, therefore presenting a challenge to identify differences in this study utilizing a convenience sample.

Second, I discovered that both interprofessionality and reflectiveness increase with collaborative online and hybrid learning. Interprofessionality first significantly increases after Group B's online portion (on 2 individual items) and more after Group B's in-person workshop (on 8 individual items). Similarly, Group B's reflectiveness increases after the online portion (on 4 individual items) and again after the in-person workshop (on 11 individual items). Additionally, after the online portion, the critical reflectiveness subscale significantly increased, and after the in-person portion, the overall reflectiveness score and habitual action subscale significantly increased. Therefore, when considering Group B's gains, my results suggest both the online and in-person trainings seem to have more of an effect on reflectiveness than interprofessionality where overall significant differences were identified vs. solely within individual items.

The key significance of these findings is that participants, on average, after both the collaborative online and in-person portion of the course demonstrate an increase in both their interprofessionality and reflectiveness. Gains in these areas may affect trainees' capacity to sustain content knowledge from the training long-term, address AT problems, work in interprofessional teams, and engage in lifelong learning. The addition of the in-person workshop results in an overall significant increase in the reflectiveness scale (covering all areas of habitual

action, understanding, reflection, and critical reflection) and participants' appreciation for small-group work, which exemplifies interprofessionality.

5.0 DISCUSSION

5.1 SUMMARY

The purpose of this study was to discover whether learning outcomes, interprofessionality, and reflectiveness are affected by type of assistive technology (AT) continuing education (CE) program. I investigated online, hybrid (online + in-person), individual, and collaborative programs. I also investigated predictors of success; I suspected an individual's self-reported level (beginner, intermediate, and advanced), job type (rehabilitation therapist vs. non-therapist (manufacturer, researcher, technology supplier)), and years of experience (six bands of years from less than 1 year to over 21 years) to have a relationship with learning outcomes, interprofessionality, and reflectiveness.

Assistive technology continuing education programs are contemporarily significant because of 1) the legislation and Medicare policies that require licensed professionals (Assistive Technology Professionals (ATP)) to prescribe complex rehabilitation devices (Rehabilitation Act Amendments, 1995, 1998; Centers for Medicare and Medicaid Services, 2008); 2) the multiple types of learners that engage requiring balanced education that can support and benefit high school through doctoral level trainees (RESNA, 2013); and 3) the industry-sponsored education programs in rehabilitation that raise concerns about the level of bias and quality of the training (Weber, 2001). With regards to number one, there has been a historical documented shortage of

licensed professionals to provide complex rehabilitation devices, suggesting that there is a need for more programs and to increase the number of trainees in the United States (Clarkson University and Good Shepherd, 2004; Langton, Coker, & Smith, 1989; Ohio Rehabilitation Services Commission, 1990; Rowley, Mitchell, & Weber, 1997; Winters, 1995). Programs that are more flexible in nature (e.g. online and/or asynchronous components) may be able to support this need (Campbell, 2008).

The second point raises an interesting concern that individuals, regardless of education, knowledge, or experience level need to benefit from the training. The exam and resultant certification permits individuals of multiple levels through a sliding education/experience scale to become licensed. Therefore, common students may be a technology supplier or salesman with a high school degree and five years of experience and a Doctor of Physical Therapy with a few years of clinical experience who is more of a novice in the field. Pre-professional training in assistive technology also varies greatly, even within disciplines (Bausch, 2012). Developing training that is sensitive to the needs of the various participants, while still benefiting advanced trainees may be a challenge.

Lastly, industry-sponsored programs host AT training courses that result in Continuing Education Units (CEUs), the same credits that are provided by accredited universities that boast evidence-based practice, contribute original scholarship, and produce hundreds of graduates at both the undergraduate and graduate level with the skills, experience, and knowledge provided by quality training and mentorship from experts in the field. In other words, training that solely educates on industry's newest advances, neglecting research and foundational content, may be remiss in providing fundamental information that not only better prepares trainees for licensure, but also prepares students with critical thinking skills to address novel challenges in the future.

In continuing education, ultimately, it is up to the individual clinician to decide what educational settings seem appropriate, the degree to which given information is affected by bias, and what information to discount altogether (Standaert, 2009). Interprofessionality, or the ability to learn from and work with others in complementary disciplines, and reflectiveness, or the ability to recognize what one does not know in practice, and obtain competence in that area as a result, may be two constructs that when developed can assist professionals in addressing novel challenges in the future.

To investigate learning outcomes, interprofessionality, and reflectiveness in the context of AT CE, I assessed two programs: a self-paced individual online training program and a group-based hybrid (online + in-person) training program. The first program (self-paced individual), took place over one-year, the second program, over 8 months. In contrast to the first program, the second program had both interprofessional group and individual activities, and monthly recitations where material was further discussed with expert instructors of the subject matter. Additionally, the program had an in-person component where the trainees engaged in case studies with real model clients. Based on the preliminary review of literature and available data from the first program, I developed the following research questions:

1. Do personal variables predict learning outcomes for online Assistive Technology education?
2. Do learning outcomes differ across online and hybrid groups for Assistive Technology continuing education training?
3. Does AT online CE impact trainees' interprofessionality and reflectiveness?
    A. Do interprofessionality and reflectiveness increase with collaborative online learning (cohort vs. individual learning)?

B. Do interprofessionality and reflectiveness increase with collaborative hybrid learning (online + in person vs. online only)?

4. What are the most effective online delivery mechanisms for the pedagogy identified in the Interprofessional ePedagogy (IPeP) model?

From the two programs, I developed four groups: Group A encompassing 385 individuals from the individual online training; Group A1, a 28-participant subset of Group A matched on characteristics from Group B; Group B, 28 individuals from the collaborative hybrid training; and Group B1, a representative sample of archetypes (therapist, VA therapist, supplier, and new to the field) from the collaborative hybrid training program. Due to its size, I used Group A to investigate learning outcomes and their relationship to the covariates of interest (expertise level, job, and years of experience). Groups A1 and B were used for independent sample comparisons to evaluate the role of online vs. hybrid and individual vs. collaborative training. Group B1 allowed me to evaluate the richness of qualitative responses before the training, after the online portion, and ultimately after the in-person component of the training.

Learning outcomes, interprofessionality, and reflectiveness were the three areas I assessed via questionnaires and journal entries. In terms of learning outcomes, I assessed knowledge, skills, and behavior. Knowledge was assessed through a content assessment, in addition to journal entries. Skills were assessed through a self-report instrument, the RESNA ATP Readiness questionnaire, and journal entries. Behaviors were solely assessed through the journal entries. Interprofessionality and reflectiveness were both assessed through self-report instruments, the Readiness for Interprofessional Learning Survey and Kember's Reflective Thinking Questionnaire respectively, and journal entries.

Group A completed the content assessment before and after the course. Group A1 completed the content assessment before and after the course, and only completed the RESNA ATP Readiness Questionnaire, Readiness for Interprofessional Learning Survey, and Reflective Thinking Questionnaire after the course. Groups B and B1 completed the same assessments before and after the course in addition to journal entries. In supplement, Groups B and B1 also completed all assessments after the in-person course. In other words, Groups B and B1 had two sets of post assessments, first after the online portion, and again after the in-person portion.

I made comparisons both between and within groups. For the content assessment, I assessed all groups to determine differences before and after the online course, and for Groups B and B1, after the in-person portion of the course. I statistically analyzed Groups A and A1 via paired t-tests and ordinary least squares. After determining there were no statistical differences between Groups A1 and B on the covariates (knowledge, level, job, and experience), I conducted independent samples t-tests on the content assessment results. Group B's learning outcomes were analyzed both qualitatively and quantitatively. Similar to Group A1, Group B's content assessment results were analyzed through paired t-tests before and after the online course, and again after the in-person course. Also, a coding structure was developed to reflect three levels on each of the aspects of learning outcomes (behavior, knowledge, and skills), along with an accompanying definition for each. Responses from before the course, during, after the online portion, and after the in-person portion were coded and analyzed via frequency and richness of response.

For the RESNA ATP Readiness, Readiness for Interprofessional Learning, and Reflective Thinking questionnaire, I followed the same pattern as above, however only used the postscores for between groups (Groups A1 and B) comparisons, again based on the assumption that the

groups were not significantly different on the covariates. For Group B, however, I again conducted paired t-tests on overall and sub-scores, and Fisher-exact tests on the individual items at both the pre/post (before and after the online course) and the post/post2 (before and after the in-person workshop) junctures. Similar to the learning outcomes assessment, I developed a coding structure to reflect three levels of both interprofessional learning and reflectiveness. Responses from before the course, during, after the online portion, and after the in-person portion were coded and analyzed via frequency and richness of response.

5.2 SUMMARIZING AND REPORTING KEY RESULTS

5.2.1 Qualitative and quantitative results comparison

There appears to be agreement between qualitative and quantitative results on two major constructs (interprofessionality and reflectiveness) as demonstrated in Table 21 below. Qualitative and quantitative results differ on the learning outcomes constructs. Namely, for Q1, it was difficult to isolate differences among archetypes that were pre-defined having certain predictive characteristics, while that was shown in the quantitative measures. For Q2, though the frequency of the coded passages did not demonstrate gains after the in-person workshop (in comparison to the online portion), the richness of the responses challenged and mirrored the quantitative results.

Table 21. Results agreement

Question	Qualitative	Quantitative	Agreement
Q1	Not one specific archetype seemed to predict higher learning outcomes. However, those with fewer years of experience demonstrated more "low" than "high" codes.	Previous knowledge and job predict learning outcomes, dependent on level.	No
Q2	More content codes were rated "high" at the conclusion of the online course than at the conclusion of the in-person workshop. Richness of data and quality of response changed, however, suggesting participants' gains after the in-person workshop.	Learning outcomes were not significantly different on the content assessment between the two online groups, but significant differences were identified after the hybrid portion for Group B. Learning outcomes also significantly increased after the hybrid portion of the course on the RESNA ATP Readiness on two of the constructs.	Mixed
Q3a	N/A	Those who have engaged in collaborative learning (hybrid group) have significantly higher ratings on a few interprofessionality constructs. Online and hybrid groups did not differ on reflectiveness constructs.	N/A
Q3b	More interprofessionality codes were rated "high" at the conclusion of the in-person course than at the conclusion of the online portion. More reflectiveness codes were rated "high" at the conclusion of the in-person course than at the conclusion of the online portion.	Significant differences were identified on 11% of the interprofessionality constructs after the online portion of the course and 42% after the in-person workshop. Significant differences were identified on reflectiveness after the online portion (critical reflection subscale) and in-person workshop (overall score & habitual action subscale).	Yes

5.2.2 Commenting on key results

My hypotheses are listed below. I fail to reject the null hypotheses in each, based on the qualitative, quantitative, and in some cases, both, results.

1. Experience, education level, and other variables predict performance on recall exam.

This study suggests that participants with a self-rated lower level, more years of experience, and therapists (vs. non-therapists) are predicted to score higher on the posttest. Implications here suggest that prior to coming in to the course, those with fewer years of experience, especially those who are non-clinical, may need to do foundational coursework.

2. Learning outcomes differ for online and hybrid AT continuing education. The inclusion of problem-based hands-on session will increase learning outcomes. This suggests group-based learning and some opportunities for hands-on experiences should be emphasized in the development of assistive technology continuing education.

This is congruent with the literature on both online and in-person training in rehabilitation (Bernard, 2004; Colliver, 1999; Stroschein, 2002). Learning outcomes increased after both online and in-person trainings for Group B. The overall content assessment score did not differ between Group A1 and B after the online course, however, constructs on the RESNA ATP Readiness did differ. This suggests participants' recall did not differ between individual and collaborative learning, but did when looking at participants' self-report of skills. The two areas where Group B demonstrated gains over Group A were on "implementation and intervention" and "evaluation of intervention". This may suggest that the collaborative aspects of Group B's training demonstrate an effect on participants' readiness to sit for the ATP exam, in addition to their competence related to the two areas that refer to reviewing the implementation plan with

both the consumer and AT team members, fitting the technology to the user, training the consumer and their caregivers, and adjustments. Group-based learning would be beneficial with regards to these two areas to both be mentored by more seasoned professionals and learn complementary perspectives. Hands-on instruction would be especially beneficial for fitting technology to real clients, training the consumer on the technology, and personalizing or making adjustments to the devices. Participants suggest via journal entries after the hands-on workshop that they feel more confident after having opportunities to "test drive" equipment on real clients. Therefore, where hands-on activities are not possible, instructors should make an effort to simulate this experience, either through Second Life as reported in (Sabus, 2011) or fieldwork as reported in (Bausch, 2012).

3. Trainees' interprofessionality and reflective behaviors will increase when conducted in a cohort. This increase will be more apparent after the hands-on session. This is important to note as a) Interprofessional learning impacts rehabilitation professionals' propensity to collaborate with those from different backgrounds and positively impacts patient care and b) Reflective behaviors result in the development of autonomous, qualified, and self-directed professionals. These assertions suggest that online AT continuing education should be designed with the goal of increasing both interprofessional and reflective behaviors in mind.

Trainees' interprofessionality increased slightly in the areas of communication skills and a willingness to learn with others in comparison to those who completed the training individually. There is weaker evidence to suggest that collaborative learning plays a role in increasing reflectiveness, though the collaborative group also demonstrated some gains in this area, in particular on discovering faults in preconceived ideas about AT, changing the way they

view themselves as a professional, and reflecting on actions to see whether improvement could be made.

Both interprofessional learning and reflectiveness increase after both online and in-person training. After the online portion, interprofessionality increased slightly on two items, "shared learning will help me to understand my own professional limitations" and "learning with other students/professionals will make me a more effective member of a health and social care team" and on eight items after the in-person course. "Shared learning…" was again significant after the in-person course.

After the online portion, the critical reflectiveness subscale significantly increased, and after the in-person portion, the overall reflectiveness score and habitual action subscale significantly increased. There is evidence that suggests reflective thinking increases in asynchronous learning environments (e.g. Schellens, 2007), so the increase identified here in my study is congruent with that finding. However, in this study, for action to become habitual, significant increases are only identified after gaining hands-on experience. This again suggests the need for instructors to make an effort to simulate this experience.

4. Building from Gordon et al.'s (2010) Interprofessional ePedagogy (IPeP) model, I will be able to make recommendations for technology and delivery to accompany the pedagogy, thus expanding to an IPePD(delivery) model to encourage online assistive technology instructors (and associated health science fields instructors) to develop modules with both appropriate pedagogy and delivery mechanisms in mind.

First, deconstructing the model and describing the processes allows us to understand how all of the pieces fit together. Starting from the bottom on the IPeP model, logistics and learner autonomy promote authenticity, collaboration/interaction, and adult/constructivist learning

theories. Authenticity supports patient (I prefer the term "client") in the classroom activities and enables relevance to practice. At the same level, collaboration creates communities of practice and the constructivist pedagogy enables active/student-centered learning. The communities of practice are ultimately what create new IP knowledge that informs professional knowledge, and vice versa.

Related to assistive technology, one can imagine a scenario where a new smartphone application can assist in addressing both a client's alternative/augmentative communication needs and also cognitive behavioral issues. Therefore, when prescribing this application, a speech therapist and psychologist may work together to implement the treatment plan, learning from each other's client-based experiences, professional languages and behaviors, and practices that may produce a more effective collaborative, rather than unilateral, solution or duplicative services or products. This scenario conveys how learning and working together produces new interprofessional knowledge. The new interprofessional knowledge, or dual purpose of this device and treatment, may then permeate the professional knowledge base. Individuals from the various professional communities contribute back to this knowledge through a mix of training, previous experience, and research, and the interprofessional knowledge grows, and the cycle perpetuates.

My results in this study (displayed in Table 22) suggest that the following online delivery mechanisms help the training program and learners meet their desired outcomes including achieving authenticity and relevance, collaboration among trainees, constructivist and reflective learning capacity, communities of practice, active and student-centered learning, and new interprofessional and professional knowledge. I recommend facilitating this type of training where the instructor is not the cornerstone to the learning. The students not only construct

knowledge, but also support others' learning through interprofessional activities. The student is also encouraged to become the advocate of his/her own learning and claim autonomy over his/her mastery of the subject.

Table 22. Proposed IPePD Model

Training program/learner inputs	**Outcomes (supports, enables, or creates)**	**Online delivery mechanisms**
Learner autonomy	Authenticity, collaboration/interaction, constructivist learning, *reflective learning*	*Journal reflection/assessment; recorded "talking head" modules*
Authenticity	Relevance/transferability to practice	*Case study videos accompanied by collaborative document editing of client assessment form and insurance justification; simulations*
Collaboration/Interaction	Communities of practice	*Discussion board and blogs*
Adult/constructivist learning theories	Active/student-centered learning	*Discussion board and blogs*
Communities of practice	New IP and professional knowledge	*Multidisciplinary interactive/animated best practice guides*

Notes: Items in italics were added based on this study's findings.

5.2.3 Recommendations for instructors and learners

Based on the key results described in section 5.2.2, I developed the following recommendations for instructors and learners to optimize learning outcomes, level of reflectiveness, and level of interprofessionality as a result of training.

5.2.3.1 Instructors' perspective

- Trainers should promote learner autonomy and reflectiveness through journal reflections and "talking head" modules that require submission of follow-up questions for comprehension.

- Journal prompts may ask trainees to reflect on some or all of the following based on the stage of the course:
    - Based on the "x content" module, what were your reactions to the material?
    - Reflecting on this experience, what do you perceive as gaps in your knowledge and skills?
    - Based on these gaps, what aspects of the course will help you improve your practice?
    - Does this course require you to understand the concepts taught by lecturers? Do you have to continually think about the material you are being taught to complete assignments and activities?
    - In general, do you consider alternative ways of doing something in your day-to-day practice? Do you often reflect on whether you could have improved what you did? Has this course affected these reflection practices?
    - As a result of this course have you changed the way you look at yourself as a professional? Did it change some of your firmly held ideas? As a result, have you changed anything about your everyday practice? During this course, please describe any instance where you may have discovered faults that you previously believed to be right or gaps in your knowledge.
- Trainers should promote authenticity and relevance to practice through case studies (either videos or real clients), client assessment documentation activities, and simulations when hands-on and in-person activities are not available.
    - The case studies (pre-recorded videos may be used when a live option is not available) should present clients' symptoms and/or disability and condition, current

assistive technology use, gaps in function or barriers to participation in desired activities.

  - The client assessment documentation activities should consist of trainees completing a generic assessment form (see Appendix H) for their client's needs to help the trainees understand how to both assess and document needs and obtain funding for AT.

- Trainers should promote collaboration through developing a sound community of practice through the use of discussion boards and blogs.
- Trainers should generate a logic model to evaluate your program where you include your course activities, tasks, and pre-defined metrics of learner achievement and greater outcomes (e.g. number of trainees that obtain ATP certification). Iteratively assess and design both your program and logic model in order to meet your desired outputs and outcomes.

5.2.3.2 Learners' perspective

- Trainees' years of experience and expertise level may affect their preparation for and resultant gains in the AT course or program. Trainees with less experience or beginners may want to partake in foundational coursework in anatomy and physiology or basics of assistive technology. Individuals who are more experienced or advanced may want to engage in additional activities outside of the course or program to increase their competency; this may include but not be limited to:
  - an internship or shadowing experience in a less-familiar area of AT;
  - critiques of journal articles investigating the effectiveness of AT devices and practices;

    - and/or preparing a unique lesson for their peers based on course material that challenges their previous practice.
- AT learning outcomes are composed of knowledge, skills, and behaviors. A program should be developed with the intent to enhance all three areas.
    - To develop trainees' knowledge, course materials should compose original and scholarly textbooks (e.g. Cook & Polgar, 2008), peer-reviewed journals, and RESNA position papers and best practice guides.
    - Trainees should have opportunities to develop skills through hands-on activities; when unavailable in an online course, the course should offer case studies and simulations.
    - Learners should engage in opportunities to practice professional behaviors, or resume habitual tendencies that are common to professional field. Learners can achieve this by engaging in group discussion and activities with other trainees.
- AT trainees should strive to become reflective learners and practitioners. Trainees should recognize gaps in their practice and obtain additional training as a result. While engaging in an AT course, trainees should question their (and their teammates') practice based on what they are learning, and offer suggestions on how to optimize client-centered AT solutions in the future.
- AT trainees should maximize the opportunity to engage in group activities to practice communication skills, learn from each other's different academic backgrounds and professional experiences, and practice making decisions as a part of an AT team.

5.2.4 Key contributions of the study

A key contribution of this study is how to evaluate blended CE programs in AT. While the above figure and table recommend components and delivery mechanisms for an online or blended program that promotes interprofessionality, they both lack an assessment mechanism that includes activities, tasks, and outputs. Because my study focuses on blended CE programs in AT specifically, the assessment mechanism I can most confidently propose is a logic model related to that topic. My assessment has demonstrated that qualitative and quantitative data provide complementary information about learning outcomes, interprofessionality, and reflectiveness. The benefit of the mixed methods study provides a full picture of trainee gains and differences. Acknowledging that learning outcomes, especially within a short-term period, may not predict long-term gains, it is important to consider additional competencies such as interprofessionality and reflectiveness. A trainee's development in these two areas may support his/her tendency to collaborate with other professionals that may provide additional insight to the team or the client issue and also lifelong learning for continued development of skills.

Based on the significant covariates and gains in the areas of learning outcomes, interprofessionality, and reflectiveness, I developed the proposed logic model in Table 23 to reflect my results and coding structure on how to evaluate blended CE programs in AT. Items in italics are adaptations for when collaborative and/or hands-on learning is not an option. The logic model above should assess an individual's performance in addition to a group of trainees.

Table 23. Logic model

Objectives	Inputs	Activities	Tasks	Outputs	Outcomes
Increase trainees' learning outcomes Knowledge Skills Behaviors	Level, job, experience of trainees Individual vs. collaborative learning Authenticity of training Autonomy of learners	As needed based on inputs, complete foundational training through additional modules "Talking head" modules in 10 core AT areas in accordance with the RESNA ATP Readiness questionnaire Assignments that reflect "assessment of need", "development of intervention strategies", "implementation of intervention strategies", and "evaluation of intervention" Hands-on workshop	Assign participants individual and group assignments through discussion board/blog that require competency in each of the 10 module areas Practice all 4 aspects of the AT prescription process Mock-client activities (intake interview, AT selection, and AT modifications) *Mock-client can be simulated through virtual reality or pre-recorded video with feedback from instructor*	Pre/post competency score on content assessment (can be averaged for group) Pre/post competency score on RESNA ATP Readiness exam (can be averaged for group) # of hours trained # of individuals trained (for group assessment only)	Increase trainees' AT knowledge, skills, and professional behavior to have the foundational tools to assess, develop, implement, and evaluate AT solutions.
Increase trainees'	Level, job, experience	Case study assignments	Assign participants to	Pre/post competency	Increase trainees'

interprofessionality	of trainees Individual vs. collaborative learning Authenticity of training Autonomy of learners	Hands-on workshop	interprofessional groups In groups, via collaborative editing, discussion boards, and blogs, complete intake assessment and insurance justification letter *Upon completion of activity have trainee obtain peer review of professional from alternate discipline*	score on RIPLS questionnaire (can be averaged for group) # of interprofessional activities completed	willingness and opportunities to learn with, and ultimately collaborate with professionals from complementary disciplines Communities of practice
Increase trainees' reflectiveness	Level, job, experience of trainees Individual vs. collaborative learning Authenticity of training Autonomy of learners	Reflection journals Hands-on workshop	Provide reflection prompts (pre, mid, post) that ask questions regarding understanding of topics, considering alternative ways and/or improving of practice, perception of professional identity, and discovering faults in current practice	Pre/post competency score on Reflectiveness questionnaire (can be averaged for group) Coding of journal entries Frequency of codes (can be tallied and averaged for group) # of reflective activities completed	Increase trainees' affinity to acknowledge what they do not know and obtain additional training to support better patient outcomes

5.2.5 Stating limitations of the study

First, Group A1 did not complete the content pretest, nor the pre-questionnaire on ATP readiness, interprofessionality, or reflectiveness. Therefore, any measure comparing Groups A and B are purely cross-sectional. There is an additional limitation with regards to the RESNA ATP Readiness, Interprofessionality, and Reflectiveness questionnaires due to a time lag between when the training occurred and when they were contacted retrospectively to complete the questionnaires.

Second, both sets of participants (Group A and Group B) exhibited selection bias for their respective programs. Participants may prefer independent online learning vs. collaborative hybrid learning due to personal perspective, experience, or other time commitments. The converse is true for those in Group B. Additionally, "matching errors" may occur as not all participants were perfectly matched on the covariates.

Third, my role in the RSTCert program and Department of Rehabilitation Science and Technology may also exhibit a bias over the results. While I had no interaction with participants in Group A, I did interact with participants in Group B. Group A participants received a message from an "honest broker" while Group B participants were aware of my coordination role in addition to using information collected within the context of the course for my dissertation.

Forth, the amount of treatment through Group B trainees' additional hours spent in the in-person workshop is also not equivalent to Group A, nor did I have a control group within Group B that spent the same amount of time learning online. In other words, if participants in Group A also participated in an in-person workshop, I may be able to draw some insights about the role of independent vs. collaborative online learning that preceded the "hybrid" portion of the training.

Likewise, if participants in Group B were provided with the option of the same number of additional hours of training online, I would then be able to compare those who completed additional hours online with those who spent additional hours in the in-person workshop. Therefore, those who spent additional hours online may also perform better on the content assessments, similar to the participant gains I identified after the in-person workshop. The interprofessionality and reflectiveness scores may also increase in a similar manner with additional online training. Therefore, it is unclear if the gains are due to additional training hours or to the in-person, hands-on aspects of the in-person workshop.

Lastly, similar to other studies of this nature, the following general limitations, including but not limited to: the narrow scope of the study, the study's small sample size, the fact that only one case was studied, and the self-report nature of many of the questionnaires may elicit responses that differ from how participants actually respond are also worth noting and may limit the generalizability of my findings.

5.2.6 Making recommendations for future research

I recommend conducting an experimental study where both groups receive an equivalent amount of instruction through the various delivery mechanisms. The online group instruction time could be monitored to include additional sessions to equal the amount of time the hybrid group was in the in-person workshop. To truly test the role of collaboration, it would be interesting to facilitate a purely online cohort with two dimensions: one group completed all individual activities and the other, all collaborative activities. In this research design, all groups would have pre-post assessments. This would also be an opportunity to investigate the integration of

learning outcomes, reflectiveness, and ATP readiness through the evaluation of logic model. I also recommend the main researcher not maintain a dual role with the programs of interest.

Additionally, it would be interesting to investigate whether similar results are identified across multiple areas of study within the health sciences. Though these findings have potential to impact any field if broadened appropriately, if a similar study was conducted across other related health science continuing education training programs (e.g. clinical rehabilitation counseling, prosthetics and orthotics, and gerontology), the ability to generalize across other disciplines would be better received.

Lastly, it would be interesting to conduct the study in (or with participants from) developing countries including India and Mexico. The equivalent of one cohort (~30 students) are enrolled in or have already completed a training similar to Group B. Therefore, on an individual basis I can confidently claim that trainees did not have issues with the adoption of the training or completing the activities. At least two interesting dimensions need to be considered for developing country work: 1) delivery mechanisms related to low bandwidth in remote areas and 2) content validation due to the availability of complex technology. The overall assessment and prescription practices are foundational, but how this information is applied may differ by context or environment. In other words, validating pedagogy, delivery mechanism, and content may assist in appropriate dissemination of information to extend assistive technology best practices to promote independence of individuals with disabilities worldwide.

APPENDIX A

DEMOGRAPHICS/BASELINE QUESTIONNAIRE

Expertise level:

- Beginner
- Intermediate
- Advanced

Position:

- Consumer
- Rehab therapist
- Researcher
- Manufacturer
- Supplier

Years of experience:

- Less than 1 year
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21+ years

APPENDIX B

IRB APPROVAL

Recruitment Script-Group A

The purpose of this research study is to assess the overall effectiveness and trainee gains from participating in the RSTCe online programs. For that reason, we will be administering three questionnaires with previous trainees via Wufoo, an online survey tool. There are minimal risks associated with this project, as a risk of breach of confidentiality exists, however, this will be minimized by providing participants with codes for the questionnaires instead of using names (through an independent broker), and all data will be stored on a secure server. Results will only be shared with members of research team. Each questionnaire should take no longer than 15 minutes. Participants who complete all 3 questionnaires will receive a free coupon for one webinar (.1 CEU). Your participation is voluntary, you are free to notify members of the research team at any point if you change your mind. This study is being conducted by Mary Goldberg, who can be reached at 412-822-3693, if you have any questions.

Recruitment Script-Group B

The purpose of this research study is to assess the overall effectiveness and trainee gains from participating in the RSTCe online programs. For that reason, we are requesting the use of

questionnaires, journal responses, and discussion board responses that are collected in the context of the course for this research analysis. There are minimal risks associated with this project, as a risk of breach of confidentiality exists, however, this will be minimized by storing all data on a secure server. Results will only be shared with members of research team. Your participation is voluntary, you are free to notify members of the research team at any point if you change your mind. The items collected for this study will have no impact on your performance in the course and you may opt-out with no penalty. This study is being conducted by Mary Goldberg, who can be reached at 412-822-3693, if you have any questions.

University of Pittsburgh ***Institutional Review Board***

Memorandum

To: Mary Goldberg, M.Ed
From: Sue Beers, PhD , Vice Chair
Date: 10/3/2012
IRB#: PRO12090406
Subject: Comparative Effectiveness of Online Assistive Technology Training

The above-referenced project has been reviewed by the Institutional Review Board. Based on the information provided, this project meets all the necessary criteria for an exemption, and is hereby designated as "exempt" under section

45 CFR 46.101(b)(1)
.

This study is supported by the following federal grant application: H129E100001 Rehabilitatio Technology Long-Term Training Grant*f*

Please note the following information:

- If any modifications are made to this project, use the "**Send Comments to IRB Staff**" process from the project workspace to request a review to ensure it continues to meet the exempt category.
- Upon completion of your project, be sure to finalize the project by submitting a "**Study Completed**" report from the project workspace.

Please be advised that your research study may be audited periodically by the University of Pittsburgh Research Conduct and Compliance Office.

APPENDIX C

READINESS FOR INTERPROFESSIONAL LEARNING SCALE (RIPLS)

Readiness for Interprofessional Learning Scale (RIPLS) Questionnaire

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The purpose of this questionnaire is to examine the attitude of health and social care students and professionals towards interprofessional learning.

Your name: (develop your own 'personal code' by using the following formula):

First 3 letters from your first name: ☐ ☐ ☐ **Last 3 letters** from your last name: ☐ ☐ ☐

Year of birth: 19 ☐☐ **Your discipline**: _____ **Gender**: ☐M ☐F

Have you completed the RIPLS questionnaire before? ☐ Yes ☐ No

If you answered yes to the previous question please indicate how long ago you last completed the questionnaire:

☐ 1 – 3 months ☐ 3 – 6 months ☐ 6 – 12 months

☐ 1 – 2 years ☐ 2-3 years ☐ 3+ years

Have you had previous experience of interprofessional teaching? ☐ Yes ☐ No

If you answered yes to the previous question please give a very brief statement of what this IPE teaching was and any impact it may have had.

_____

_____

_____

_

Please complete the following questionnaire.

		Strongly agree	**Agree**	**Undecided**	**Disagree**	**Strongly disagree**
.	Learning with other students / professionals will make					

	me a more effective member of a health and social care team					
.	Patients would ultimately benefit if health and social care students / professionals worked together					
.	Shared learning with other health and social care students students / professionals will increase my ability to understand clinical problems					
.	Communications skills should be learned with other health and social care students students / professionals					
.	Team-working skills are vital for all health and social care students students / professionals to learn					
.	Shared learning will help me to understand my own professional limitations					
	Learning between health					

.	and social care students students before qualification and for professionals after qualification would improve working relationships after qualification / collaborative practice.					
		Strongly agree	**Agree**	**Undecided**	**Disagree**	**Strongly disagree**
.	Shared learning will help me think positively about other health and social care professionals					
.	For small-group learning to work, students / professionals need to respect and trust each other					
0.	I don't want to waste time learning with other health and social care students / professionals					
1.	It is not necessary for undergraduate / postgraduate					

	health and social care students / professionals to learn together					
2.	Clinical problem solving can only be learnt effectively with students / professionals from my own school / organisation					
3.	Shared learning with other health and social care professionals will help me to communicate better with patients and other professionals					
4.	I would welcome the opportunity to work on small group projects with other health and social care students / professionals					
5.	I would welcome the opportunity to share some generic lectures, tutorials or workshops with other health and social care students / professionals					
6.	Shared learning and practice will help me clarify the					

	nature of patients' or clients' problems					
7.	Shared learning before and after qualification will help me become a better team worker					
8.	I am not sure what my professional role will be / is					
9.	I have to acquire much more knowledge and skill than other students / professionals in my own faculty / organisation					

If you have any further comments regarding interprofessional education please enter them in the box below

APPENDIX D

RESNA ATP READINESS QUESTIONNAIRE

This tool contains the validated tasks and skills to provide competent seating and mobility services, as identified by the RESNA Professional Standards Board (PSB) 2008 ATP job analysis study. It is intended to help you assess your readiness for the exam and is recommended for use with other resources in preparation for the exam.

Results of this self-assessment are for your professional use only and in no way impact your current certification status or guarantee the results of your performance on the exam.
You can use the results of this assessment to:

- Document strengths in a specific practice area;
- Identify gaps in knowledge and skills for a specific practice area;
- Identify professional growth opportunities;
- Link current skills and abilities to critical job skills and performance plans;
- Assess learning needs prior to re-entering the workforce after a prolonged absence from practice;
- Assess learning needs prior to transitioning from one area of practice to another;
- Form the framework for a professional development plan.

I. ASSESSMENT OF NEED	No Experience	Participate or Assist	Under Supervision	Proficient
Interview the consumer, family, and caregivers to determine needs and expectations				
Review relevant records and plans (e.g., medical, educational, and vocational)				
Assess environmental factors (e.g., physical, social, personal assistance and support in the environment) pertaining to the use of the assistive technology				
Assess consumer's functional abilities and limitations				
Relate abilities and functional limitations to the use of specific assistive technology				
Assess consumer's possible future needs				
Assist the consumer in clarifying and prioritizing goals/needs				
Assess the effectiveness of prior and existing technology				
Refer consumer to other professionals, as needed				
Present findings to consumer in an accessible and appropriate format				

II. DEVELOPMENT OF INTERVENTION STRATEGIES - ACTION PLAN	No Experience	Participate or Assist	Under Supervision	Proficient
Define potential intervention strategies/services (technology vs. non-technology) (MACRO, e.g. what general type of technology is appropriate or what features are appropriate)				
Identify, simulate, and try product(s) that matches technology features given goals, functional abilities, personal preferences, environmental factors, and applicable standards and determine the appropriateness of commercial vs. custom solutions(MICRO, e.g., what specific products or features are appropriate) for				
1. Seating and Mobility				
2. AAC				
3. Cognitive Aids				
4. Computer Access				
5. EADL				
6. Sensory				
7. Recreation				
8. Environmental modification				
9. Accessible Transportation (public and private)				
10. Technology for learning disabilities				
Identify training and support needs				
Identify issues of integration within the environment				
Seek and integrate consumer feedback throughout process and use observation as feedback (Take into account using non-verbal cues from consumers who have difficulty communicating.)				
Identify measurable outcomes to monitor progress toward achieving stated goals				
Assist consumers in making final selections by explaining pros and cons of different solutions, including issues such as the life-expectancy of the technology and availability of funding sources (Trade-offs)				
Participate in the alignment of services for an individual (coordination of care across environments)				
Document and justify recommended intervention				
III. IMPLEMENTATION OF INTERVENTION	No Experience	Participate or Assist	Under Supervision	Proficient
Review and confirm the implementation plan with consumer and team members				
Initiate and monitor the order process				
Check out product for safety implications and				

verify function, performance and quality				
Prepare, install, fit and adjust the technology to end-user requirements				
Provide information on device care, warranty and scheduled maintenance				
Train consumer and others (e.g., family, care providers, educators) in device operation and set up (proper positioning)				
Train consumer and others (e.g., family, care providers, educators) in adjustment (programming)				
Train consumer and others (e.g., family, care providers, educators) in troubleshooting				
Train consumer and others in functional use in typical environments				
Make adjustments or modifications in technology, as needed				
Document implementation process and progress				

IV. EVALUATION OF INTERVENTION	No Experience	Participate or Assist	Under Supervision	Proficient
Measure and document outcomes (both qualitative and quantitative) and reassess as necessary				
Address repair issues as needed as part of the follow up process				

V. PROFESSIONAL CONDUCT	No Experience	Participate or Assist	Under Supervision	Proficient
Operate within RESNA's Code of Ethics and Standards of Practice				

APPENDIX E

REFLECTIVENESS QUESTIONNAIRE

Development of a Questionnaire to Measure the Level of Reflective Thinking

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DAVID KEMBER & DORIS Y. P. LEUNG WITH ALICE JONES,
ALICE YUEN LOKE, JAN MCKAY, KIT SINCLAIR, HARRISON TSE,
CELIA WEBB, FRANCES KAM YUET WONG, MARIAN WONG &
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Hong Kong Polytechnic University, Hung Hom, Kowloon,
Hong Kong

Please fill in the appropriate circle to indicate your level of agreement with statement s about your actions and thinking in this course.

A—definitely agree

B—agree with reservation

C—only to be used if a definite answer is not possible

D—disagree with reservation

E—definitely disagree

Habitual Action

1. When I am working on some activities , I can do them without thinking about what I am doing.

5. In this course we do things so many times that I started doing them without thinking about it.

9. As long as I can remember handout material for examinations , I do not have to think too much.

13. If I follow what the lecturer says, I do not have to think too much on this course.

Understanding

2. This course requires us to understand concept s taught by the lecturer .

6. To pass this course you need to understand the content .

10. I need to understand the material taught by the teacher in order to perform practical tasks.

14. In this course you have to continually think about the material you are being taught.

Reflection

3. I sometimes question the way others do something and try to think of a better way.
7. I like to think over what I have been doing and consider alternative ways of doing it.
11. I often reflect on my actions to see whether I could have improved on what I did.
15. I often re-appraise my experience so I can learn from it and improve for my next performance .

Critical Reflection

4. As a result of this course I have changed the way I look at myself.
8. This course has challenged some of my firmly held ideas.
12. As a result of this course I have changed my normal way of doing things.
16. During this course I discovered faults in what I had previously believed to be right.

Reprinted with permission from Dr. David Kember, Educational Development Centre, The Hong Kong Polytechnic University.

TEHE Ref.: R144a

Kember *et al.* (2000) Development of a questionnaire to measure the level of reflective thinking. *Assessment & Evaluation in Higher Education, 25* (4), 381-395.

APPENDIX F

TABLE 24

Table 24. Example Excerpts for Each Code/Rating

(Key: 8-Aug-Red; 10-Oct-Orange; 1-Jan-Green; 4-Apr-Blue; 5-May-Purple)

Source	L	M	H
Others (interprofessionality)	N/A	The references in speech and vision AT will assist with my cotreatments with other therapists. Knowledge of laws will improve my recommendations for accessibility modifications. 10: 4:5694	As a result of the deep dive, i loved the team work aspect. I do not find myself utilizing my peers and coworkers the way i have during the deep dive. The online course was very informative but to actually see the products and devices and to recommend them and actually see them work was 2nd to none . The online course sort of gave us a heads up of what we were gonna see in the deep dive. it definately prepared me personally to feel somewhat

			comfortable at the deep dive. 5:6:1191
Course content (understanding)			
Knowledge	I have a basic knowledge of w/c's, however I would say that I am very new to AT, so most areas are areas that I need covered. I do feel very weak in computer access, AAC and legislation. 10:5:4926	It has changed my professional outlook because it has provided me with a large amount of new material that has been applicable to my practice. Some things are complicated and difficult to understand, but they have opened my eyes to how much technology has changed. Gaps in my knowledge include Environmental controls, CAT and the vast amount of computer access technology; scanning, direct scanning. Also, all the software that is available for computer access, speaking and writing are things I ahd never been exposed to. 1:7: 565	I beleive my work experience of 25 years will be highly contributory. Also, working at the WPSBC will provide many great cases of patients who have many assistive technology needs. 8:7:1370

Skills	Being that I do not have any experience in the AT field, I don't really have a past or current practice to compare my new knowledge with. I did want to say that I am learning a lot, and am looking forward to coming to the lab to get some hands on experience. Once I get a bit of that going, I will feel confident in my abilities because I have been given a great knowledge base to start with. As I said before the instructors have been extremely knowledgable, and my group members have also been helpful. I admit that starting the class was a bit intimidating because I had no prior knowledge or experience base, but the course has done a great job of providing me with	As for the gaps in my knowledge. There are plenty, i have been doing seating and positioning for a number of years and have primarily been used for that skill set. I really need to learn diseases and the problems that can occur from these diseases along with basic prognosis of the individuals that are afflicted with them. 10:6:3082	I am constantly thinking of new ways to assist Veterans to improve in function and efficiency in self care. When I see equipment that meets a need, I am happy to have that information so I can learn how to apply it to Veteran use. After the Deep dive, and getting to use the equipment I feel more confident and am more likely to reflect on and trial the equipment. I would have benefitted from more time with the wheelchair and seating, Aug comm. Devices and trials with a greater variety of ECUs, I would have liked to see a demo of how the Aug comm. Devices are programmed for ECU access and which devices can perform which

	the information I will need to be proficient and productive in the AT field. I think that everyone that I have met involved with the course is doing an excellent job. 1:1:891		functions. 5:4:532
Behaviors	I am new to this field and don't set in stone ideas yet. Consequently this course has not changed my habits. However, it has exposed me to many different subjects and professionals. I think it has helped to broadened my experience. 1:0:274	This question is difficult for me to answer because I am not in day-to-day practice. However the course has given me an outline to follow once I am practicing in the field, and the certain types of products and situations I should be aware of when dealing with a patient with a particular disability. 4:1:868	I have not really changed the way I look at myself as a professional. I do feel that I have experienced other viewpoints different then my own, or other therapists I work with normally. I feel more connected to the AT and rehab field as well. I definititely feel I am lacking in documentation and funding, and I am unsure I ever want to get too involved in that area. 5:0:954
Self (reflection)	My reactions to the material is WOW! There is a lot that i do and do	As a result of this course, i cannot say it has changed the way i look at	The deep dive required my to understand the concepts taught by

	not know from the material that i have watched so far.It is a definate eye opener and i look forward to learning as i go. Honestly i havent a clue about the questions. I am not sure what questions to write for my questions. Please do not think i am avoiding these but i am not sure what is needed here. 10:6:2701	myself as a professional but it is helping me to become more professional at my position. My ideas in this field are not set in stone, although there is always the go to or the reliable piece of equipment, i can honestly say most of the individuals i see are on a as needed basis in recommending equipment. There are a lot of gaps in my knowledge because i do not use most of what is being taught and lectured in my everyday job as of yet. This course is probably the most informative in the AT field that i have encountered. I look forward to the rest of the course. 1:6:684	the lecturers and think back to the material that I had learned in the online modules. I do think that watching/listening to the modules prior to attending the deep dive was of great benefit to my learning/trialing of the items at the deep dive. 5:2:0

APPENDIX G

TABLE 25

Table 25. Codes by participant

ID: 7	*Rating*	*Low*					*Medium*					*High*				
Alfery	*Timepoint*	*A*	*O*	*J*	*A*	*M*	*A*	*O*	*J*	*A*	*M*	*A*	*O*	*J*	*A*	*M*
	Course content (understanding?)															
	Knowledge	2	1	0	0	0	2	1	2	0	1	1	0	0	1	0
	Skills	2	1	0	0	0	2	1	1	0	1	1	0	0	0	0
	Behaviors	0	0	0	0	0	2	1	1	0	0	1	0	0	1	0
	Others (interprofessionality)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Self (reflection)	0	0	0	0	0	3	2	2	0	2	0	0	1	2	1
	Total	4	2	0	0	0	9	5	6	0	4	3	0	1	4	1
ID: 4	*Rating*	*Low*					*Medium*					*High*				
Bandy	*Timepoint*	*A*	*O*	*J*	*A*	*M*	*A*	*O*	*J*	*A*	*M*	*A*	*O*	*J*	*A*	*M*
	Course content (understanding?)															
	Knowledge	0	0	0	0	0	1	2	3	1	0	4	1	0	0	1
	Skills	0	0	0	0	0	2	1	1	0	1	4	0	0	0	1
	Behaviors	0	0	0	0	0	0	0	0	0	0	3	0	0	1	1
	Others (interprofessionality)	0	0	0	0	0	1	1	2	0	0	2	0	0	2	1
	Self (reflection)	0	0	0	0	0	1	0	2	0	1	2	0	1	2	2
	Total	0	0	0	0	0	5	4	8	1	2	15	1	1	5	6

ID: 6	Rating	Low					Medium					High				
Beers	Timepoint	A	O	J	A	M	A	O	J	A	M	A	O	J	A	M
	Course content (understanding?)															
	Knowledge	0	1	2	0	0	3	1	1	0	0	0	0	0	1	1
	Skills	0	0	2	0	0	3	1	1	0	0	1	0	0	1	1
	Behaviors	0	0	0	0	0	3	0	2	0	0	0	0	0	2	0
	Others (interprofessionality)	0	0	0	0	0	2	1	1	0	0	0	0	0	1	2
	Self (reflection)	0	1	0	0	0	2		3	0	0	0	0	0	2	2
	Total	0	2	4	0	0	13	3	8	0	0	1	0	0	7	6

ID: 0	Rating	Low					Medium					High				
Burkhart	Timepoint	A	O	J	A	M	A	O	J	A	M	A	O	J	A	M
	Course content (understanding?)															
	Knowledge	2	1	0	0	0	0	0	0	2	0	1	0	0	0	0
	Skills	1	0	0	0	0	2	0	1	0	0	0	0	0	0	0
	Behaviors	0	0	1	0	0	2	2	0	0	1	1	0	0	2	0
	Others (interprofessionality)	0	0	0	0	0	2	1	1	0	0	2	0	0	2	1
	Self (reflection)	0	0	1	0	0	2	1	1	3	2	1	0	1	0	1
	Total	3	1	2	0	0	8	4	3	5	3	5	0	1	4	2

ID: 2	*Rating*	*Low*					*Medium*					*High*				
Kring	*Timepoint*	*A*	*O*	*J*	*A*	*M*	*A*	*O*	*J*	*A*	*M*	*A*	*O*	*J*	*A*	*M*
	Course content (understanding?)															
	Knowledge	1	1	0	0	0	0	1	1	0	0	0	0	0	1	1
	Skills	1	1	1	0	0	2	1	1	0	0	0	0	0	1	1
	Behaviors	0	0	0	0	0	1		1	0	0	0	0	1	2	1
	Others (interprofessionality)	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1
	Self (reflection)	1	0	0	0	0	2	1	2	0	1	0	0	1	2	0
	Total	3	2	1	0	0	5	3	6	0	1	0	0	2	7	4
ID: 1	*Rating*	*Low*					*Medium*					*High*				
Miller	*Timepoint*	*A*	*O*	*J*	*A*	*M*	*A*	*O*	*J*	*A*	*M*	*A*	*O*	*J*	*A*	*M*
	Course content (understanding?)															
	Knowledge	1	2	3	0	0	0	0	0	2	1	0	0	0	0	0
	Skills	1	2	3	0	0	1	0	0	1	1	0	0	0	0	0
	Behaviors	0	3	2	0	0	2	0	2	1	1	3	0	0	0	0
	Others (interprofessionality)	0	0	0	0	0	1	0	3	0	0	0	0	0	1	0
	Self (reflection)	0	0	0	0	0	2	3	4	2	1	3	0	0	1	1
	Total	2	7	8	0	0	6	3	9	6	4	6	0	0	2	1

ID: 5 Phillips	Rating	Low					Medium					High				
	Timepoint	A	O	J	A	M	A	O	J	A	M	A	O	J	A	M
	Course content (understanding?)															
	Knowledge	1	2	1	0	0	4	1	1	1	1	0	0	0	0	1
	Skills	1	0	1	0	0	2	0	0	1	1	0	0	0	0	1
	Behaviors	0	0	0	0	0	2	0	0	0	0	0	0	0	2	2
	Others (interprofessionality)	0	0	0	0	0	3	0	2	0	0	0	0	0	2	2
	Self (reflection)	0	1	0	0	0	2	0	2	1	0	1	0	0	1	2
	Total	2	3	2	0	0	13	1	5	3	2	1	0	0	5	8
ID: 3 Polisano	Rating	Low					Medium					High				
	Timepoint	A	O	J	A	M	A	O	J	A	M	A	O	J	A	M
	Course content (understanding?)															
	Knowledge	1	1	0	0	0	5	0	0	1	0	0	0	0	1	0
	Skills	1	0	0	0	0	3	0	2	1	0	1	0	0	2	0
	Behaviors	1	0	0	0	0	2	0	1	0	0	0	0	0	1	0
	Others (interprofessionality)	0	0	0	0	0	1	0	0	0	0	1	0	0	2	0
	Self (reflection)	0	0	0	0	0	4	0	2	0	0	0	0	0	1	0
	Total	3	1	0	0	0	15	0	5	2	0	2	0	0	7	0

APPENDIX H

GENERIC ASSESSMENT FORM

Assistive Technology Assessment Variables

Client Background:

Describe the person by their age, gender, diagnoses, prognosis, medical history etc.

Existing AT Devices:

List or describe current AT devices the person is using. Identify how the devices were procured, age, and why device(s) no longer meet their needs.

Body Systems & Structures:

Assess and describe the persons current and expected future physical-motor (i.e. strength, range of motion, coordination, balance, mobility, oral-motor), cognitive (i.e consciousness, orientated, memory), and perceptual (i.e. vision, hearing, sensation) or other body system capacities as relevant to the AT interventions being considered.

Activity:

Assess and describe the person's current ability to perform Activities of Daily Living (i.e. bathing, dressing, eating, transfers, mobility, weight shifts) as relevant to the AT interventions being considered.

Participation:

Determine the person's current and expected near future ability to participate in activities that are meaningful to them (i.e. Instrumental Activities of Daily Living, work, leisure, community participation) as relevant to the AT interventions being considered. Current and past education, vocation, and leisure interests should also be addressed and considered.

Client Goals:

Have the client express in their own words what their goals are for AT interventions.

Environment:

Assess and describe the person's current and/or expected near future living situation or locations where AT devices will be used (i.e. location, living structure, accessibility, caregivers). Determine their means of transportation if applicable. Determine what support systems are in place to ensure set-up, utilization, maintenance and/or repair of the AT devices.

Clinical Trials/Simulations:

Describe AT options tried, why they were chosen, outcome, and person's impression. For real assessments, describe where the device was tried (i.e. clinic or natural setting) and for how long.

Recommendations:

Describe equipment recommendations (i.e. specifications, brand, manufacturer or supplier source). For real assessments, attach copy of order, justify any upgrades or features not part of the basic equipment package. Briefly explain why other lower cost alternatives were ruled out.

Outcome Measures:

Discuss any standardized or non-standardized outcome measures used pre and post AT intervention as well as the results.

Implementation:

Discuss the plan for delivery, fitting, implementation, training, maintenance, repair, upgrades, follow-up, and reassessment.

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