DEVELOPMENT AND IMPLEMENTATION OF AN ONLINE WHEELCHAIR MAINTENANCE TRAINING PROGRAM

by

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Seventy-five million people worldwide need a wheelchair to perform activities of daily living and fully enjoy life. In the last couple of years, research has shown an increase in wheelchair breakdowns and the related adverse consequences among wheelchair users such as being injured or stranded; research also suggests that performing maintenance on wheelchairs can reduce the number of wheelchair breakdowns and associated injuries. Based on this evidence, an in-person Wheelchair Maintenance Training Program (WMTP) was developed with promising outcomes: participants increased their knowledge related to wheelchair maintenance and their capacity to perform maintenance activities. However, to run this training, extensive resources and time are required. The development of an online version of the WMTP could decrease the resources needed, making the training available for people around the globe. The Online WMTP was developed through an iterative approach in five different phases: content translation, internal review, external review, usability testing, and a pilot. The result of this process is a training program with online modules to teach clinicians how to train users in performing maintenance on their manual and power wheelchairs. The Online WMTP was implemented at the University of Pittsburgh with fourteen individuals who participated in the training program. Pre- and post-training results indicated a statistically significant increase in wheelchair maintenance knowledge, capacity, and confidence. There were no differences in learning outcomes for participants in the in-person compared to online training program, suggesting that both training

methods have a similar learning effects. Both training programs are an effective method for teaching wheelchair maintenance and have the potential of reducing wheelchair breakdowns since users can learn how to maintain their wheelchairs and how often to do it. Additionally, the Online version of the training program allows easier access for a broader population of trainees and can be modified and translated to different languages, making it accessible worldwide.

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PREFACE

I would like to thank all of those who helped make this work possible and enjoyable. Dr. Pearlman, thank you for your guidance, support, and for the multiple experiences around the globe you provided. Maria, thank you for encouraging me to have this adventure and supporting me through the journey; I've loved every second of it! Thanks to my committee members, Dr. Boninger, Dr. Worobey, Dr. Toro, and Dr. Cooper for your feedback and guidance. The support of the Center for Teaching and Learning at the University of Pittsburgh and the constructive feedback of internal and external reviewers was very valuable. Thanks to the Writing Center for the insightful writing advice. Special thanks to all members of the Collaboration on Mobility Training (COMIT) for letting me be part of this amazing team!

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Nomenclature:

WMTP: Wheelchair Maintenance Training Program

WMT-Q: Wheelchair Maintenance Training Questionnaire

WHO: World Health Organization

UNCRPD: United Nations Convention on the Rights of Persons with Disabilities

LMS: Learning Management System

CTA: Concurrent Think Aloud

1.0 INTRODUCTION

According to the World Health Organization (WHO), 15% of the world population has a disability, and 10% of those individuals— or 112 million people worldwide—needs a wheelchair (The World Bank, 2016; World Health Organization, 2011). In the United States, there are approximately 3.6 million adults using wheelchairs (Baum et al., 2012; LaPlante & Kaye, 2010). The National Spinal Cord Injury Statistical Center indicates that there is an increase of wheelchair use in people with spinal cord injury with years of wheelchair use with rates increasing from 58.6% the first year of injury to 79.9% 30 years after injury (National Spinal Cord Injury Statistical Center, 2015).

Access to an appropriate wheelchair, and the related services, is a right every individual with disability has, according to the United Nations Convention on the rights of Persons with Disabilities (United Nations, 2006). Appropriate wheelchairs allow people with disabilities to live healthy, be more productive and independent, and enjoy all human rights (World Health Organization, 2016).

Assistive technologies in general, and wheelchairs in particular, are one of the most important facilitators or barriers for social participation (Meyers, Anderson, Miller, Shipp, & Hoenigd, 2002; World Health Organization, 2008). Research has shown that full participation in society relies upon access to an appropriate wheelchair and the related services (Bayley, Cochran, & Sledge, 1987; Dalyan, Cardenas, & Gerard, 1999; Sie, Waters, Adkins, & Gellman,

1992; Toro, Eke, & Pearlman, 2016; Wylie & Chakera, 1988). A study looked at wheelchair user's perception on the factors that that enables or limits their ability to participate in different environments: in the home, in the community, and during transportation; this study found wheelchairs as the most common factor (Chaves et al., 2004).

1.1 THE CONSEQUENCES OF WHEELCHAIR FAILURE

Because of the importance of appropriate wheelchairs for individuals with disabilities, wheelchair problems, such as maintenance issues, can negatively impact the life of people with disabilities. Disrepairs can cause injuries such as abrasions or lacerations (reported in 70.7% by Chen et al), sprain or contusions, head injuries, fractures, and organ injuries (Chen et al., 2011).

Research has shown that up to 99% of inspected wheelchairs needed maintenance to perform correctly (Hansen, Tresse, & Gunnarsson, 2004; Young, Belfield, Mascie-Taylor, & Mulley, 1985). Moreover, there has been an increase in wheelchair failure rates; instances of users having to repair their wheelchairs has increased, from 44.8% in 2009 to more than 63.8% in 2016 (Calder & Kirby, 1990; Toro, Worobey, Boninger, Cooper, & Pearlman, 2016; Worobey, Oyster, Nemunaitis, Cooper, & Boninger, 2012; Worobey, Oyster, Pearlman, Gebrosky, & Boninger, 2014). Additionally, wheelchair users have experienced an increase in consequences due to a failure, from 22% in 2006 to 30% in 2011 (Worobey et al., 2012).

More than half (63.8%) of the individuals surveyed in a study (n=591) reported needing at least one repair in a six-month period, and 27.6% reported at least one adverse consequence as a result of the breakdown (Toro, Worobey, et al., 2016). Common consequences were being injured or stranded, having less mobility, and decreased quality of life (Toro, Worobey, et al.,

2016). This same study reported that 6.9% of those needing a repair did not complete it. The number of repairs completed at home by wheelchair users was 40% for manual wheelchairs and 14% for power wheelchairs, showing a willingness of users to complete repairs independently. In contrast, 50% of repairs were completed by a vendor, suggesting that users may not know how to perform maintenance on their wheelchairs or that the repairs require additional parts or are too complex for someone to complete at home (Toro, Worobey, et al., 2016).

Even though, the nature of wheelchair-related accidents is multifactorial, a study by Chen et al. displays three significant findings: properly maintained wheelchairs could reduce the risk of wheelchair accidents, wheelchair users perceive that wheelchair-related problems (component failures or technical issues) are one of the main causes of accidents and, some of these component failures can be easily solved if performing regular maintenance (Chen et al., 2011). When maintenance is performed, wheelchairs are in better working condition (Arledge et al., 2011) and the number of accidents and injuries for wheelchair users is significantly less likely to occur (Chen et al., 2011; Hansen et al., 2004).

1.2 WHEELCHAIR MAINTENANCE TRAINING PROGRAMS

Research has suggested that providing more information to wheelchair users on how to perform wheelchair maintenance and how to do routine wheelchair checkups might be a way to decrease the number of wheelchair repairs needed (Mann, Hurren, Charvat, & Tomita, 1996). This strategy can increase user's satisfaction with their wheelchairs (Fitzgerald et al., 2005), increase wheelchair reliability (World Health Organization, 2008) and decrease accidents and injuries (Hansen et al., 2004).

Hansen et al. (2004) studied 216 wheelchair users in a randomized control trial comparing wheelchair-related accidents between a maintenance intervention and a control group. Findings showed that the most common wheelchair problems can be easily fixed and that a regular wheelchair checkup significantly reduces accidents (Hansen et al., 2004).

Even though it is clear that teaching wheelchair users how to perform maintenance is a valuable and necessary strategy, there are few training programs available, and no standardized material or evaluation methods.

The World Health Organization's Wheelchair Service Training Package (WHO WSTP) is a five-day program that aims to "support the training of personnel or volunteers to provide an appropriate manual wheelchair" (World Health Organization, 2012). In the basic package on this training program, maintenance and repairs are explained in a 120-minute session and in the intermediate package maintenance, repairs, and follow-up are together in a 60-minute session. There is a very limited overview of the technical skills that can take much longer to learn. Furthermore, the training only contains information related to manual wheelchairs, so power wheelchair maintenance is not covered. Additionally, only a small percentage of the wheelchair providers are able to complete this program, since the number of trainings that are run are limited.

The International Society of Wheelchair Professionals (ISWP) (International Society of Wheelchair Professionals, 2016), UCP Wheels for Humanity (UCP Wheels for Humanity, 2016), and Motivation (Motivation, 2015) are some of the organizations providing wheelchair related education worldwide. Their trainings are based on WHO materials, where maintenance is not a predominant topic. Furthermore, the number of people needing training exceeds the number of professionals these organizations can currently train.

To address the problem of lack of standardized training and evaluation methods in wheelchair maintenance and repairs, a Wheelchair Maintenance Training Program (WMTP) and Wheelchair Maintenance Training Questionnaire (WMT-Q) were developed (Toro et al., 2017). The WMTP is a one-day in-person training aiming to teach clinicians how to perform maintenance on wheelchairs, so they can in turn train wheelchair users to maintain their own wheelchairs. The training lectures were developed base on websites, books, wheelchair maintenance technicians' experience, owner's manuals, and other materials (Toro et al., 2015). The WMT-Q was developed to evaluate wheelchair maintenance knowledge in clinicians, manual and power wheelchair users; the development followed a question generation, questionnaire pilot and test-retest reliability (Toro et al., 2017).

The WMTP and WMT-Q were launched in the US in the summer of 2014 and conducted with promising outcomes. The WMTP has proven to be an effective program to increase clinicians' training knowledge (Toro, 2015). One of the difficulties of the in-person WMTP was the limit on the number of participants being trained in each session, the resources used in preparing each class such as the space and copy of documents for participants, the limited number of experts to train the trainers, as well as the time participants had to take out or work to be trained; all this factors make it challenging to scale the training. If the same positive results could be accomplished in an online format, this would allow the training to be scaled at a low cost and have a broader impact. Based on this reasoning, the next step on the project was to create an Online Wheelchair Maintenance Training Program (WMTP) to make it available to a broader cohort of trainers.

1.3 THE IMPACT OF ONLINE LEARNING

The use of the internet as an educational platform has been increasing over time with good results. Research has proven that online learning increases access to education (Sinclair, Kable, Levett-Jones, & Booth, 2016) and is as effective as traditional learning with regards to the generation and retention of knowledge (Means, Toyama, Murphy, Bakia, & Jones, 2010; Pham et al., 2016).

In the last years, there has been an increasing demand for innovative methods in learning. The causes for this need are the new technologies available, ease of access to educational material online, increase in the number of people needing education and training in different settings, and limited educators and resources (World Health Organization & Imperial College London, 2015).

According to Sangrà and colleagues, online learning or eLearning is defined as "An approach to teaching and learning […] that is based on the use of electronic media and devices as tools for improving access to training, communication and interaction…" (Sangrà, Vlachopoulos, & Cabrera, 2012). From the teaching philosophy perspective, online learning is characterized by shifting the emphasis to the student, making him or her the center of the learning process (World Health Organization & Imperial College London, 2015).

Online learning has been proven to be as effective as traditional learning in healthcare professional education even when teaching practical skills, by increasing students' confidence in performing practical activities such as radiotherapy or surgery (Ackermann et al., 2010; Maertens et al., 2016; Pham et al., 2016; Sinclair et al., 2016).

The World Health Organization (WHO) Department of eHealth, Knowledge Management and Sharing, hired the Global Health Unit, at Imperial College in London, to

conduct a systematic review to evaluate the effectiveness of online learning in undergraduate healthcare professional education, the topics considered were students' knowledge, skills, attitudes and satisfaction in both non-networked computer-based eLearning and networked web-based eLearning. Additionally, this systematic review studied students and provider's perspectives about online education (World Health Organization & Imperial College London, 2015). Per their results, students find online learning useful in achieving their educational goals. The most common advantages, as stated by students, are ease of access and flexibility—self-paced learning allows them to complete learning at their own speed and intensity addressing their specific learning needs. The requirements of access to hardware and software, and familiarity with the technology, are characteristics that can make the learning process difficult. Some disadvantages found by students are the lack of in-depth discussion and the inability to clarify with a tutor in person (World Health Organization & Imperial College London, 2015).

Educational providers found the development of the online material time-consuming; nonetheless they found it easy to share, reuse, and edit, allowing long term monetary savings. An advantage, according to providers, is the large number of students that can be part of the course when compared to traditional training (World Health Organization & Imperial College London, 2015). Additionally, online education can facilitate skills acquisition and practice before working with real clients in orthopedics and nursing (Ackermann et al., 2010; Gerdprasert, Panijpan, Pruksacheva, & Ruenwongsa, 2010).

There are different factors that can influence the success of online learning. These factors are: the organizational setting, technological infrastructure, instructional systems design, curriculum development, and delivery of the program (World Health Organization & Imperial College London, 2015). All applicable critical success factors (CSF) were taken into

consideration for the development of the Online WMTP, as described in the development section of this thesis.

1.4 AIM OF THIS STUDY

The goal of this study was to develop an online version of the WMTP, making the program available to a larger population of trainees and streamlining any translation process for further dissemination in different countries. The aim of the Online WMTP is to teach professionals how to train users on wheelchair maintenance in an online learning environment. Two research questions were addressed in this study: 1) Does the Online WMTP significantly increase knowledge in wheelchair maintenance (as measured by the WMT-Q) 2) Does the increase in knowledge differ from online training when compared to the results of the in-person WMTP.

The next chapter describes the development and implementation of the online WMTP. The development was completed in multiple phases: Content translation, internal review, external review, usability test, pilot, and implementation; the methods and results for each of this phases are described in the following chapter (2). In chapter three, the findings, contributions of the study, limitations, and future work are described.

2.0 DEVELOPMENT AND IMPLEMENTATION OF AN ONLINE WHEELCHAIR MAINTENANCE TRAINING PROGRAM

2.1 BACKGROUND

Wheelchair users account for 1.5% of the world's population according to the World Health Organization (WHO); this means that 112 million people are in need of a wheelchair (World Health Organization, 2008). According to the United Nations Convention of the Rights of Persons with Disabilities (UNCRPD) (United Nations, 2006), mobility is a right that will allow people with disabilities to fulfill all other human rights.

As stated by the World Health Organization Guidelines on the provision of manual wheelchairs in less resourced settings, a wheelchair is appropriate when it meets the user's needs and environmental conditions, is available in the country, is safe and durable, and can be easily maintained (World Health Organization, 2008). Additionally, it should be delivered following the WHO 8 basic steps: referral, assessment, prescription, funding, wheelchair preparation, fitting, user training, and maintenance repairs and follow-up (World Health Organization, 2008).

Literature recognizes the importance of wheelchair maintenance to save repair costs and prevent injuries (Toro et al., 2017; World Health Organization, 2012; Worobey et al., 2012). Furthermore, the WHO states that "wheelchair service personnel have a responsibility to teach wheelchair users how to care for their wheelchair and cushion at home" (World Health

Organization, 2012). Unfortunately, very little training is available for wheelchair professionals to understand how to teach wheelchair maintenance to users.

To reduce this gap in trained wheelchair professionals, an in-person Wheelchair Maintenance Training Program (WMTP) was developed. To measure the impact of the training program, the Wheelchair Maintenance Training Questionnaire (WMT-Q) was also developed (Toro, 2015). Both the WMTP and WMT-Q were developed in parallel in different phases. The WMTP had an expert feedback phase followed by a pilot and implementation, and the WMT-Q had an expert feedback phase and a test re-test reliability phase followed by the implementation (Toro et al., 2015). The content of the training program was based on available literature and users' manuals. The maintenance tasks were divided into inspection and action items. Inspection activities are what the user checks in the wheelchair, and when a problem is identified, an action item is initiated.

The WMT-Q has two versions: clinicians' and users'. The clinicians' version is divided into different domains: Manual and Power Wheelchair Knowledge (open ended questions), general wheelchair maintenance knowledge (multiple choice questions), and capacity or performance (Appendix A). Each domain of the WMT-Q has acceptable test-retest reliability. See Table 1 based on (Toro, 2015). For the online use of the WMT-Q confidence questions were added to evaluate how confidence participants were performing each of the maintenance activities.

Table 1. WMT-Q test-retest reliability results

WMT-Q Clinicians' version	**ICC(3,1), [CI]**		
	Open-ended	Multiple choice	Capacity/performance
	0.783*, [0.468,0.922] 0.499+, [0.003,0.798]	0.876*, [0.657,0.958]	0.856*, [0.61,0.951]/ 0.886*, [0.652,0.966]

*p<.001; +p<.05;

The implementation of each in-person WMTP requires a significant effort in terms of resources (space, wheelchairs, toolkits, handouts) and time to prepare for the training. To scale and rapidly disseminate this training program around the world, an online version that can be run remotely was developed.

The Online WMTP was developed based on the content of the in-person WMTP looking to accommodate different training needs and to scale the program more easily. The program was developed in different phases and implemented with different cohorts of trainees. The WMT-Q was used to evaluate the outcomes of the program and questions related to confidence performing maintenance activities were added. The aim of the training was to train trainers on wheelchair maintenance through an online learning environment.

2.2 METHODS

2.2.1 Development of the Online WMTP

Five phases were part of the development of the online WMTP: content translation, internal review, external review, usability test, and pilot; the final step of the training program was its implementation. The Online WMTP was evaluated with a cross-sectional study of a convenience sample with all participants receiving online training. Figure 1 summarizes the complete process. The methodology of each phase is described below; the results will be described in the same order on the results section.

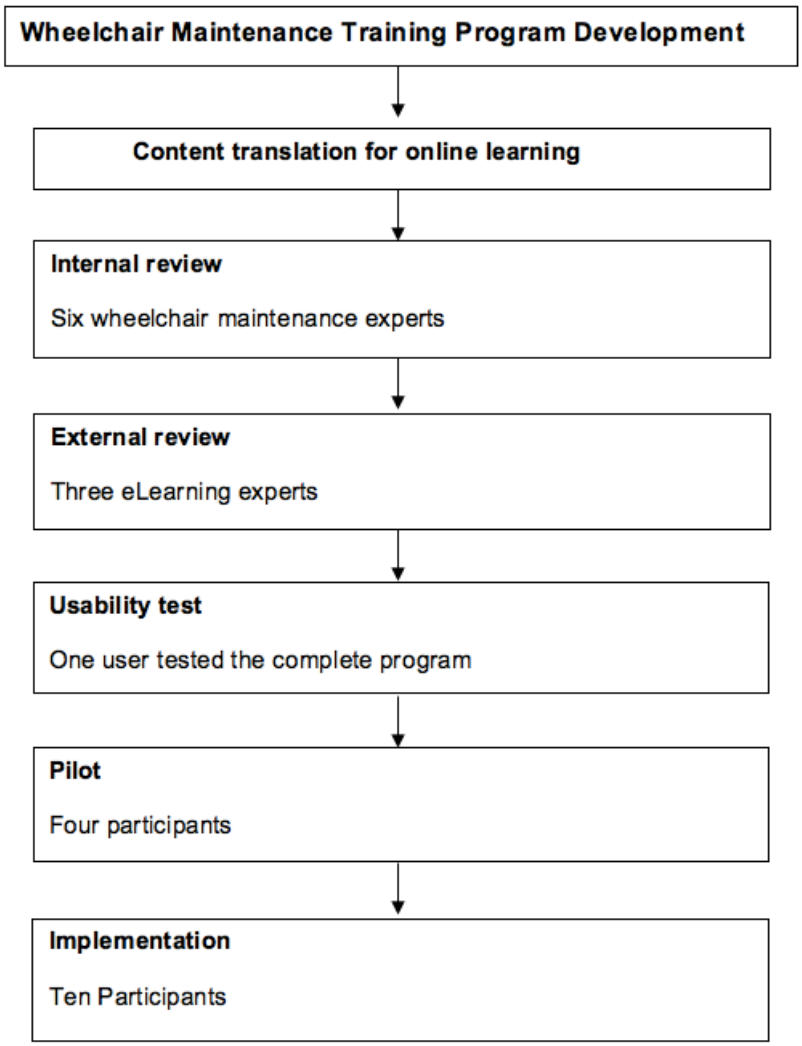

Figure 1. Development of the Online WMTP

2.2.1.1 Phase one: Online content translation

The format of the in-person WMTP was translated into an online environment. The content remained the same, and the course activities were to be completed during the same amount of time as the in-person program. Table 2 contains a comparison between the in-person and the Online WMTP activities including allocated time.

Table 2. Time and activities comparison

Time	In person Training	Time	Online Training
5 minutes	Introduction	15 minutes	Introduction, objectives, and relevance
10 minutes	Objectives and relevance		
15 minutes	Manual wheelchair maintenance video	80 minutes	Manual wheelchair maintenance lecture
90 minutes	Manual wheelchair maintenance hands-on		
15 minutes	Power wheelchair maintenance	80 minutes	Power wheelchair maintenance lecture
90 minutes	Power wheelchair maintenance hands-on		
60 minutes	Training materials overview	60 minutes	Logistics lecture and assignments
10 minutes	Discussion and summary	60 minutes	Synchronous meeting - Discussion and summary

Commercially available software was used for the development of the Online WMTP. CourseSites (Blackboard, Washington, DC, United States, 2015) was the learning management system (LMS) selected to host the training program (Figure 2). It is a free online learning platform to deliver content to students via internet 24/7; it can host different eLearning projects and allows communication between participants and with trainers (CourseSites, n.d.). The LMS allowed to organize the training material into four different modules and divide them in three weeks, the homepage also included an announcements space. Adobe Captivate version 7 and version 9 (Adobe Systems Incorporated, Mountain View, California, United States) were employed to adapt the Power Point presentations used in the in-person training into interactive online lectures. Adobe connect (Adobe Systems Incorporated, Mountain View, California, United States) was used to hold a synchronous meeting to give feedback about the maintenance activities. QuickTime Player v10.4 (Apple Inc. Cupertino, California, United States) was used to create an introductory video on how to use the LMS. The Wheelchair Maintenance Training Questionnaire as demographics questionnaires were created in Qualtrics (Qualtrics, Provo, Utah, United States).

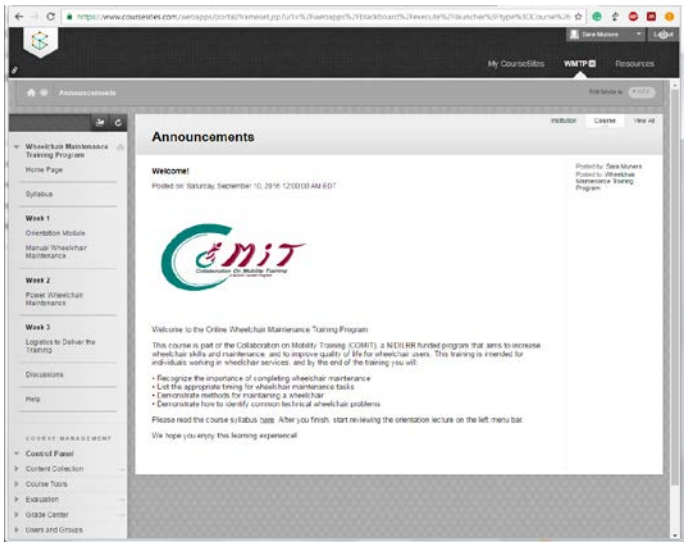

Figure 2. Online WMTP home page on CourseSites

In any online training program, certain common characteristics will ensure a better learning environment for participants; these characteristics are called critical success factors (CSF) and are divided into curriculum development, system design and intervention delivery, organizational setting and technological infrastructure. (World Health Organization & Imperial College London, 2015). CSF related to curriculum development and system design and intervention delivery were taken into consideration for the development of the Online WMTP. Additionally, the training program was based on the Quality Matters rubrics, designed to promote quality in online and blended courses. The general standards of this rubric are: The overall design of the course is made clear to the learner at the beginning of the course, Learning objectives or competencies describe what learners will be able to do upon completion of the course, Assessment strategies are integral to the learning process and are designed to evaluate learner progress in achieving the stated learning objectives or mastering the competencies, Instructional materials enable learners to achieve stated learning objectives or competencies, Course activities facilitate and support learner interaction and engagement, Course technologies support learners' achievement of course objectives or competencies, The course facilitates

learner access to support services essential to learner success, and The course design reflects a commitment to accessibility and usability for all learners (Shattuck, 2015). The online WMTP was compliant with all the standards but accessibility.

2.2.1.2 Phase two: Internal review

Six wheelchair maintenance experts who were part of the in-person program reviewed one of the four lectures. Since all the lectures had the same format only one was reviewed; the manual wheelchair lecture was selected to be evaluated; as the rest of the lectures, it had interactivity and immediate feedback after the questions. The syllabus of the entire training program was also reviewed. Comments from experts were based on a survey (Appendix B) and were used to improve the delivery of the training material.

2.2.1.3 Phase three: External review

The complete content within the LMS was reviewed by e-learning and content experts; a total of 3 reviewers provided feedback on the material. The feedback was received through a survey (Appendix C) and through an online synchronous meeting, in which open discussion allowed to clarify the comments from the survey. The domains in the survey included the ease to understand and usefulness of each lecture as well as modifications proposed for each lecture –adding, emphasizing, removing, or reducing content. Experts were asked to create a document with comments and screenshots while reviewing the training program and submit it to the study team by the end of the review process.

2.2.1.4 Phase four: Usability test

A usability test was done to identify any usability problems and determine user satisfaction with the training program. A four-hour session allowed one user to go through the entire training program; the process started with creating an account in the LMS and finished after adding assignments in the discussion forum. Concurrent Think Aloud (CTA) was used to identify user's feelings when interacting with the LMS. CTA are protocols used in usability testing common in web-based education (Olmsted-Hawala, Murphy, Hawala, & Ashenfelter, 2010). After the user finished reviewing the training program, ease of use and satisfaction questions were asked about the interaction on each portion of the training; the user was also asked about modifications she would like to recommend. After the user finished reviewing the training program, ease of use and satisfaction questions were asked about the interaction on each portion of the training; the user was also asked about modifications she would like to recommend.

2.2.1.5 Phase five: Pilot

Four participants were recruited as part of the pilot; they were more than 18 years of age and did not have any upper or lower extremities injury that would prevent them from performing maintenance on a wheelchair. The University of Pittsburgh Institutional Review Board approved the study and all participants signed the informed consent prior enrollment in the training program. They were asked to complete the training program and give feedback based on their experience. The feedback was collected through a questionnaire (Appendix C) at the end of the program and during an online synchronous meeting through guided questions. A manual wheelchair, a power wheelchair, and different tools were available during the three weeks for participants to use, since performing hands-on activities was an important part of the training

program. These tools were available at the Human Engineering Research Laboratories in Pittsburgh.

2.2.2 Implementation of the Online WMTP

The program was implemented starting in November 2016 in the University of Pittsburgh; implementation in different Spinal Cord Injury Model Systems Sites was planned for future trainings. The technological infrastructure in these sites could support the training program's hardware, software, and connectivity needs (internet connection).

Individuals between 18 and 75 years old without any upper or lower extremities injury preventing them to perform maintenance were recruited. The Institutional Review Board of each site approved the study; all participants were locally enrolled and signed informed consent prior to starting the training program. A manual of operations explaining how to enroll participants in the training program was developed and shared with each site to ensure the same procedures were followed during enrollment.

Different cohorts of participants were enrolled. The results for the first cohort of participants, trained during November 2016, are shown in this thesis; data collection is still ongoing for other cohorts.

After obtaining informed consent, participants received an email with a link to enroll in the training program and a video on how to use CourseSites. The WMT-Q was used to evaluate participants' knowledge, confidence and capacity of performing maintenance activities. This questionnaire was completed by each individual at the beginning and at the end of the training program. During the last week, a synchronous meeting was held to answer participants' questions and receive feedback about the training program.

2.2.2.1 Feedback after the implementation

There were general questions to guide the discussion in the synchronous meeting (Appendix D) both during the pilot and implementation. The main discussion topics were participant's feelings about online and in-person education, the usability of the LMS, the technical challenges they may have encounter, and the interaction with other participants and with the trainer through forums. The meeting was audio recorded and the recording was transcribed; inductive methods to condense the data were used to look for common themes (Thomas, 2006).

A survey related to the content of the training program was also completed during the last week (Appendix C). Participants commented about the content of each lecture and recommended if the content was sufficient or if it needed to be modified (increased or decreased); participants also rated the ease on understanding the training material.

2.2.2.2 Wheelchair Maintenance Training Questionnaire

Power analysis

A power analysis was completed based on the in-person training of clinicians. For the WMT-Q, an effect size of 1.16 was found for a change with in-person training and for a significance of 0.05 and power of 0.9 a sample size of 13 would be required (G*Power, Heinrich-Heine-Universität Düsseldorf, 2016).

Statistical analysis

For both research questions, the alpha level was set a priori at 0.05. To answer whether there is a significant difference in the mean score of the WMT-Q domains (open ended questions for

manual and power wheelchairs, multiple choice questions about wheelchair knowledge, capacity, and confidence of performing maintenance), a paired t-test was used.

To answer if there is a difference in the increase of the WMT-Q scores for those who were part of the in-person program and those in the online program, an independent sample t-test was used; The dependent variables used for this analysis were knowledge (multiple choice questions) and the capacity questions since this were more sensitive to knowledge; confidence questions were not analyzed because they were not collected for the in-person training. The data from the in-person WMTP was based on a previous study with 10 participants.

2.3 RESULTS

2.3.1 Development of the Online WMTP

2.3.1.1 Phase one: Online content translation

Content translation resulted in four CourseSites learning modules: orientation, manual wheelchair, power wheelchair, and logistics to deliver the training. Embedded in the training are specific guidelines for when to review each module and when to complete the assignments. The training material was designed to be reviewed over a three-week period with maintenance tasks practiced in pairs. Reminders were set for every five days, prompting the next training activity. A guide was established for participants detailing recommendations on how to divide the training material during the three weeks as follows: week one, orientation lecture, manual wheelchair lecture and assignments; week two, power wheelchair lecture and assignments; and week three, lecture on how to train wheelchair users and assignments. A synchronous meeting was planned

for the third and final week to answer questions. Outcome measures were embedded in the training with direct links to the WMT-Q and a feedback survey. Table 3 shows the recommended lectures and assignments (with descriptions) for participants to complete during each week.

Table 3. Weekly lectures and assignments

Week	Lecture and Assignment	Description
Week 1	Review of Orientation lecture	Lecture to introduce the training program, explain dates and expectations, and increase familiarity with the material
	Review of manual wheelchair lecture	Lecture on how to perform maintenance activities on manual wheelchairs
	Introductions in the forum	Online forum for participants and trainers to introduce themselves
	Completion of manual wheelchair questions	Document to report items practiced and upload pictures to document difficulties while performing maintenance activities
Week 2	Review of power wheelchair lecture	Lecture on how to perform maintenance activities on power wheelchairs
	Completion of power wheelchair questions	Log document to report items practiced and upload pictures to document difficulties while performing maintenance activities
Week 3	Review of logistics lecture	Lecture on how to train wheelchair users in maintenance
	Attendance of online synchronous meeting	Online meeting to reinforce correct maintenance techniques and answer questions in real time with visual feedback
	Completion of assignment on wheelchair repair resources	Assignment to identify nearby places where wheelchair users can get their wheelchair repaired posted on an online forum
	Recording of video assignment	Assignment to apply training knowledge gained and identify resources for trainers posted on an online forum

Each of the training lectures was recorded with narration and closed captions were made available. To make them easy to understand and remember, all the lectures were interactive and followed the same structure. The first slide displays the name of the lecture, and the subsequent

slides display the different inspection and action items on each part of the wheelchair. Participants click on each item to learn how to perform maintenance on different wheelchair components (Figure 3). After reviewing each item, a check box appears on the slide, prompting participants to go to the next item (Figure 4).

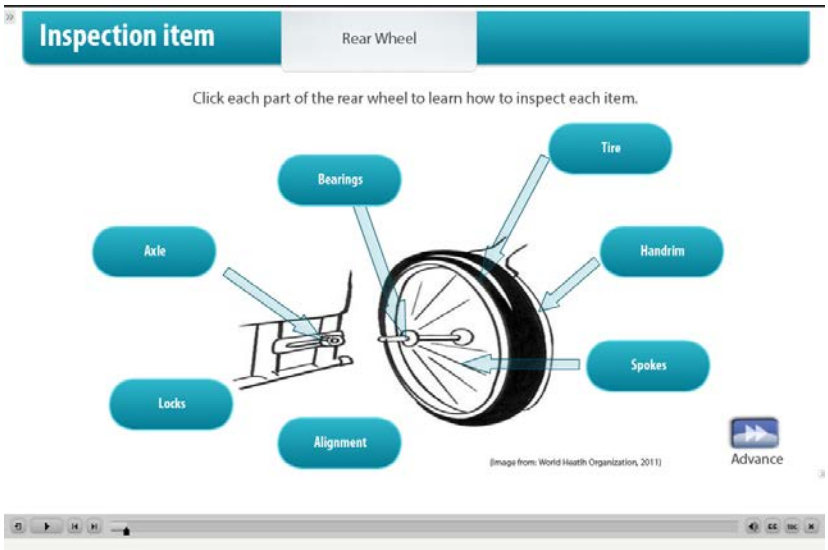

Figure 3. Manual wheelchair lecture- rear wheel interactive lecture

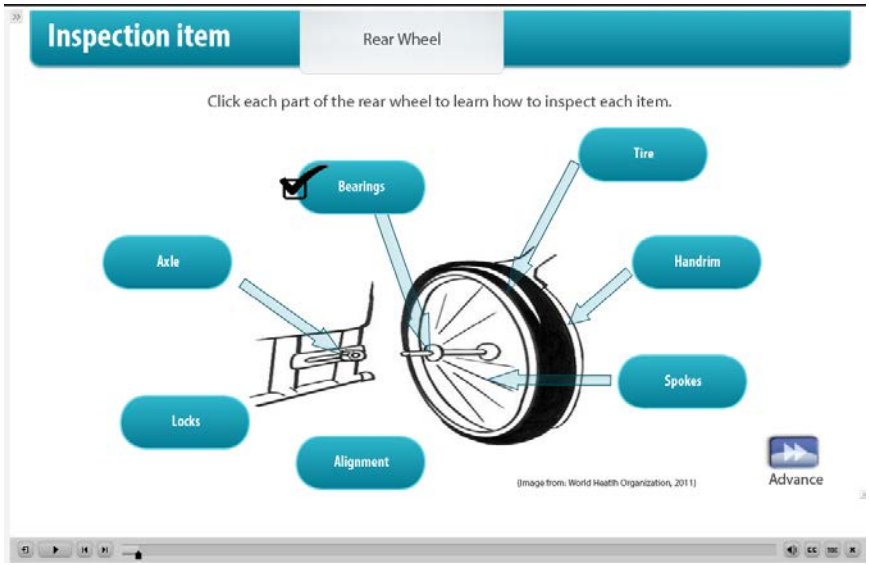

Figure 4. Manual wheelchair lecture- rear wheel interactive lecture showing that Bearings was already reviewed

A tool bar above each slide shows, from left to right, whether the material is an action or inspection item, the wheelchair component, and the time to perform that specific item. Figure 5 displays an example of the tool bar for the action item of charging the batteries that should be performed daily.

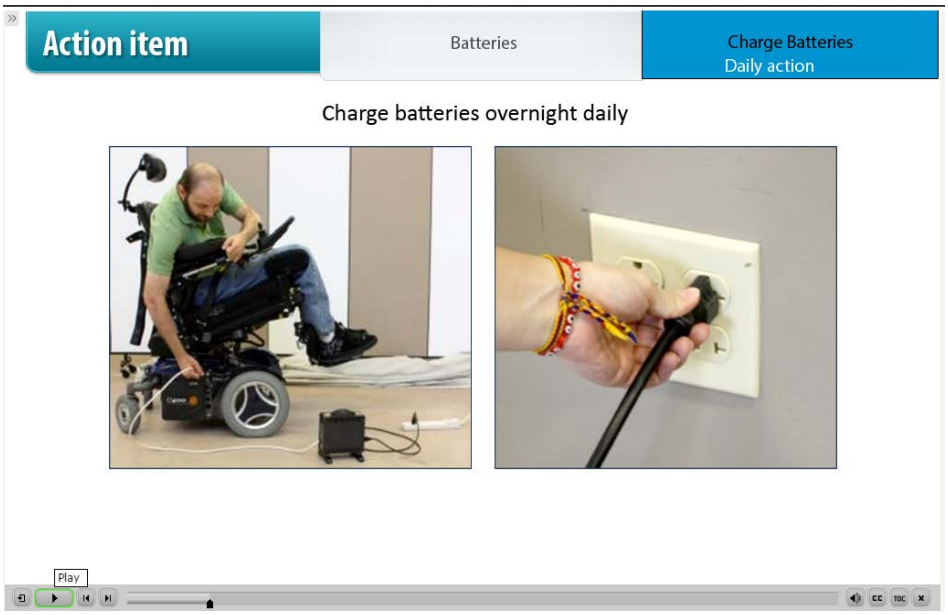

Figure 5. Power wheelchair lecture- action items

For both inspection and action items, participants were asked to practice what they learned, take pictures of the maintenance performed, and reflect on those findings. An additional prompt reminding of the importance of completing the hands-on activities and taking the pictures was also added. Figures 6, 7 and 8 show the prompts for each of these steps.

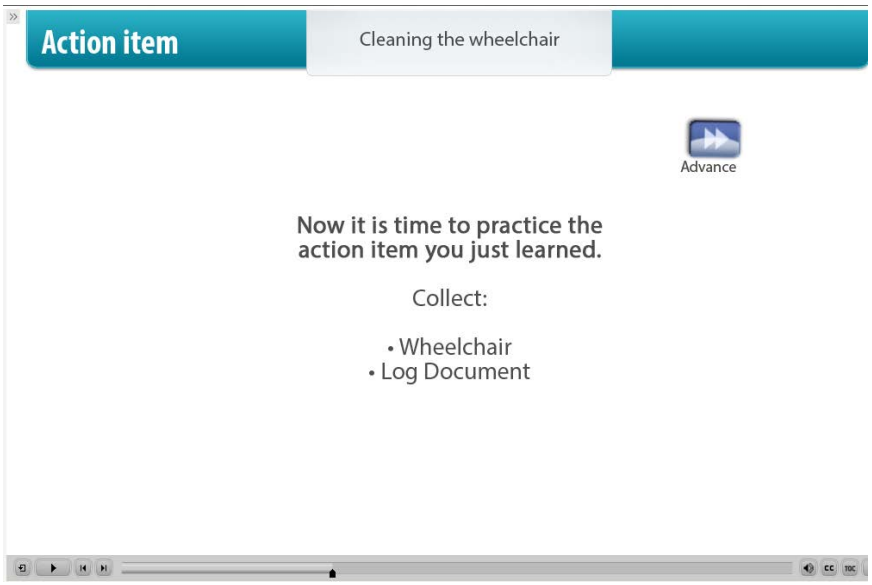

Figure 6. Power wheelchair lecture- action items asking participant to perform the hands-on activities

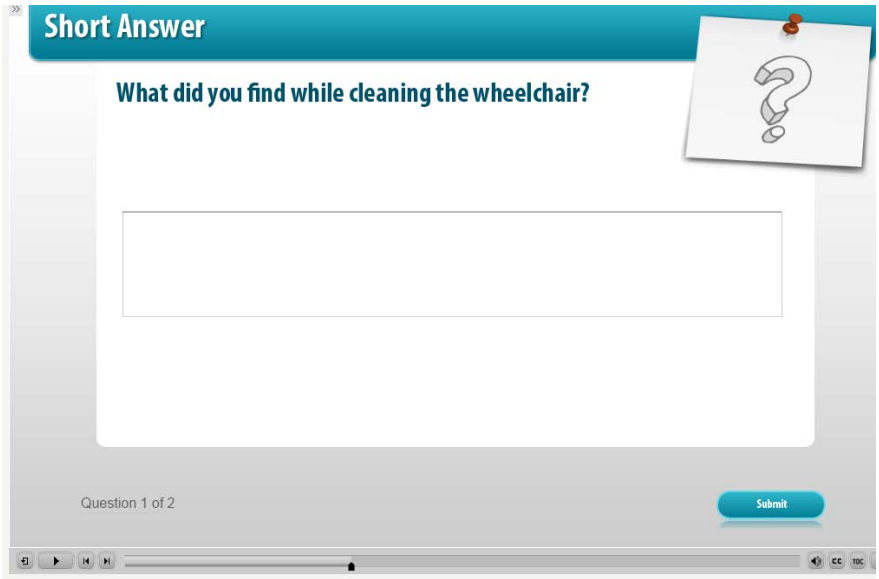

Figure 7. Power wheelchair lecture- action items asking participant to reflect on the findings

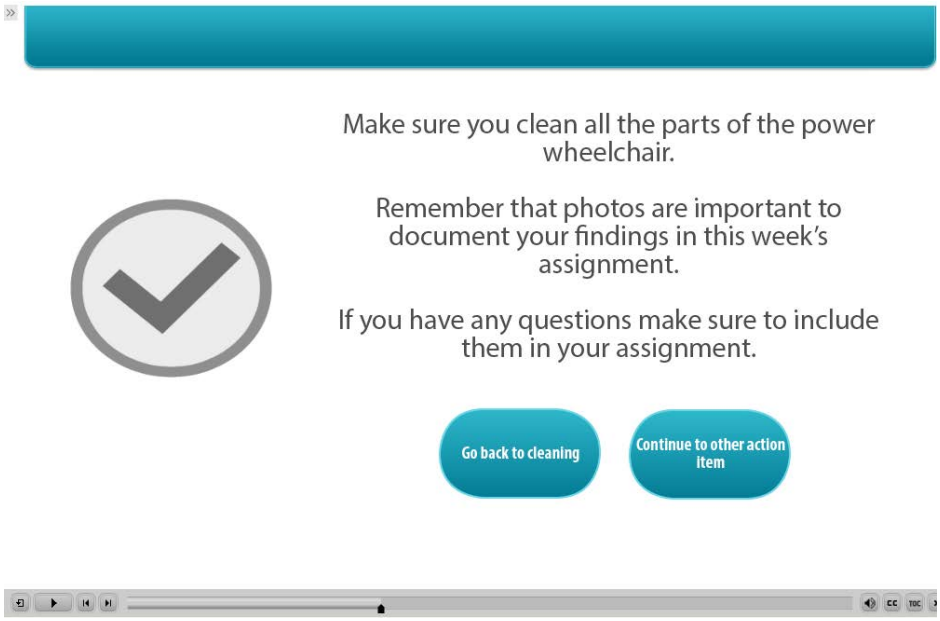

Figure 8. Power wheelchair lecture- action items asking participant to take pictures and complete the assignment

The following CSF were included in the design of the Online WMTP:

In terms of Curriculum development:

- Changes were made in the in-person lectures to make them suitable for an online learning environment, allowing interactivity and immediate feedback.
- Additional resources were created; videos of different maintenance activities, pictures of wheelchairs needing repairs, and audio files of motor sounds, allowed participants to better understand wheelchair needs in real life situations.
- The use of lectures, assignments, and videos allowed participants with different learning styles to better grasp the knowledge.
- It was recommended for participants to look at the lectures at their own pace and to practice each maintenance activity as much as they needed to to feel comfortable performing them; these recommendations tailored the program to individual needs.

In terms of System design and intervention delivering:

- An orientation lecture was created and the syllabus was available always for participants; these resources helped to set-up expectations.
- A synchronous meeting was held allowing active discussion with other participants and increasing interactivity between participants and trainers. The aim of the meeting was to reinforce proper maintenance techniques (showed by the trainer) and to answer questions in real time with visual feedback.
- The lectures were set-up to give immediate feedback and to allow reviewing specific portions of the training if needed.

A trainer with experience in online education and wheelchair training, was in charge of using the LMS, giving feedback on assignments, answering participant's questions, and running the online synchronous meeting.

2.3.1.2 Phase two: Internal review

Based on reviewers' comments modifications were made in the training materials. First, the lectures were modified by decreasing the number of pictures on each slide and re-organizing the headings and pictures on the slides; these changes made the lectures easier to understand. Second, blinking arrows and highlighted areas were added to the lectures so participants could follow the images while listening to the lecture (Figure 9).

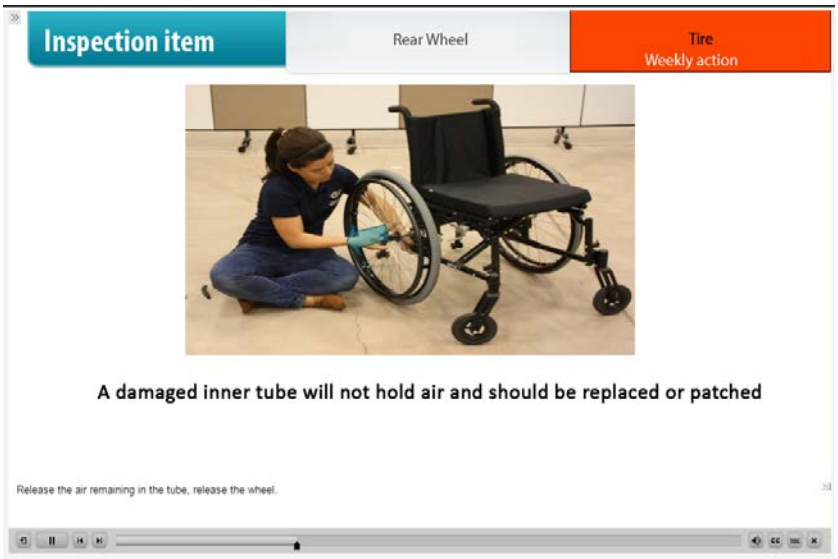

Figure 9. Blinking arrow pointing how to remove the rear wheel

Third, new resources were developed and added, including a reference library video showing how to perform maintenance activities, and audio files with sounds of power wheelchair's motors in disrepair state. Fourth, a background section was added to the syllabus and references were updated.

2.3.1.3 Phase three: External review

The external review survey was completed by 66% (n=2) of the reviewers; comments from those who did not answer the survey were taken into consideration during the synchronous meeting. The documents sent by reviewers were extremely valuable since screenshots were used to exemplify questions and comments. One of the reviewers, for example, used a screenshot of a slide in the lecture to recommend mixing images and texts to help users retain more information.

Based on expert's feedback, one of three possible actions were taken: modify based on the recommendation, do not modify and ask for user's feedback during the usability test and pilot phases, or do not modify since the recommendations were out of the scope of the training

program. The items that were not modified at this phase will be discussed in the future work section of this thesis.

During this phase, the following modifications were completed:

- The lectures were divided into smaller portions (Table 4); within each lecture, brief assessments of knowledge were added
- Some of the lectures were recorded again to improve the audio quality
- An Orientation video on how to use CourseSites was recorded an added to the training material
- The software used was upgraded from Captivate v7 to v9; Version 9 fixed a lot of the bugs (such as difficulties in the table of contents) that surfaced in previous versions and improved the user interface
- Minor changes were made for clarity; The menu was reordered, lectures names were added, and at the end of each lecture links to assignments were placed
- More interactivity and additional resources such as elective activities and a glossary terms were added
- Information was added to the lecture Logistics to deliver the training. This information explained how the wheelchair user can position himself to perform the maintenance activities

Table 4. Detailed lecture names and time

Lecture	**Time**
Orientation lecture	15 minutes
Introduction (Manual Wheelchair lecture)	22 minutes
Casters (Manual Wheelchair lecture)	5 minutes
Cushion and frame (Manual Wheelchair lecture)	5 minutes
Supports (Manual Wheelchair lecture)	7 minutes
Rear wheel (Manual Wheelchair lecture)	10 minutes
Action items (Manual Wheelchair lecture)	4 minutes

Table 4 (continued)

Supports (Power Wheelchair lecture)	10 minutes
Casters and frame (Power Wheelchair lecture)	4 minutes
Cushion and drive wheels (Power Wheelchair lecture)	5 minutes
Electrical systems (Power Wheelchair lecture)	7 minutes
Action items (Power Wheelchair lecture)	4 minutes
Logistics to deliver the training Lecture	8 minutes

2.3.1.4 Phase four: Usability test

An undergraduate mechanical engineer student completed the training program. User's comments highlighted strengths and flaws about the interaction with the LMS. The interactivity of the lectures, the videos and the ease on navigating the lectures were highly valued by the user. The content of the syllabus was particularly appreciated, as shown in this comment: "I like having a material list, and it's definitely good to have the expected time for each of the modules, especially if the person is trying to budget the time during the week". As per the lecture on how to deliver the training program, a strength found was the use examples throughout the lecture; according to the user: "It gives specific instructions on where you can find the material, how you should deliver, and […] set-ups of the class, like having people work in pairs".

Some difficulties were encountered such as the incorrect use of the closed caption, and problems when viewing the material in a different order; modifications were made to improve these issues. According to the user, all the content was useful except the video library; there was no clear information related to the library so descriptions were added explaining the content of each particular video.

There were no errors for the tasks: Registering and logging in, answering questionnaires, and adding assignments into the discussion board. Non-critical errors were found while viewing

the lectures since it was difficult for the user to go back and navigate in a different order within a lecture. Detailed instructions on the use of the table of contents were added to the Orientation video.

The CTA process showed the user satisfaction with the LMS, with comments such as “I wish my class websites were like this”.

2.3.1.5 Phase five: Pilot

Four graduate students with a mean age of 24.75 years participated in the pilot phase; they were paired to complete the hands-on activities with a partner. All participants finished the program, all of the lectures were reviewed and all of the activities were done; 3 out of 4 of the participants attended the synchronous meeting and they all completed all questionnaires.

Modifications were made for the next phase of the project based on participants’ comments and trainer experience. Participants asked for more interaction with comments such as: “It would be nice to know what problems the others found on their wheelchairs”; and “it would be good to talk to the instructor about specific questions if they arise”. When asked what ways of interaction they would like to use, participants agreed that asynchronous discussions were best. Forums were added to each assignment allowing peer interaction and feedback from trainer.

Other planned revisions include trainer’s feedback based on real world examples and include photos of different wheelchairs. Additionally, instead of having one manual and one power wheelchair, three wheelchairs of each type will be available at the Human Engineering Research Laboratories for participants to practice the hands-on activities. Based on feedback from the trainer’s experience, the notifications will be sent with an email copy, since participants did not look at the notifications tab of the LMS. Modifications in the syllabus were made to

better explain the time expected to be spent in each activity and if the activity should be complete individually or in pairs.

2.3.2 Implementation of the Online WMTP

A total of fourteen participants were part of the pilot and first cohort of the training program; since no modifications were made on the lectures between the pilot and implementation, the data was analyzed together. The online WMPT participants were graduate students and they were split equality in terms of gender (7m and 7f); they had a mean age of 25.5 years ±2.87. The mean for years of experience working in wheelchair provision was 0.85 years ±1.04 for manual wheelchairs and 0.50 years ±0.86 for power wheelchairs.

2.3.2.1 Feedback after the implementation

In general, participants commented that the LMS was easy to use and the duration of the training was adequate. Peer interaction was relevant for them since it helps them learn better; when asked to expand on that statement one participant said “I think we learnt better and faster. For example, we would go over the same section together, one person didn’t get it and the other person can explain it”.

According to participants, the main advantage of online training programs, when compared to in-person, is the self-pace instruction. They commented: “We can do it at our own pace and whenever we had free time”; it allows “more flexibility with schedules”; “Saves time because people may have different levels of knowledge to begin with”; and “We can repeat the parts that we don’t understand that much as many times as we need”.

The main advantage of in-person training that cannot be accomplished when training online was the presence of a trainer that can make sure everyone is following instructions as requested. Nonetheless, they agreed that the online synchronous meeting was sufficient to clarify questions, particularly with the visual feedback as stated by one participant “If it’s with video, you can show to clarify”.

Most participants prefer online trainings instead of in-person trainings, the main reason relates to time, as one participant commented “I don’t think I would have time to attend a 3 week in-person training program”.

When asked about the organization of the training program, participants commented that the duration was adequate, as stated by them, “it was quite widely spaced and did not take up much time”; as per the format of the WMTP they commented that is was adequate, but some had difficulties with the LMS and recommendations to improve it were a common theme. As stated by one participant: “The program was intuitive, however, CourseSites did cause some minor technical issues, specifically the navigation between content”.

According to this cohort of trainees, having more hands-on maintenance activities and wheelchairs in state of greater disrepair could be beneficial. A better organization of the lectures with smoother transitions and modifications of assignments were also recommended. In one of the assignments participants needed to answer some questions in a document and add pictures of the maintenance activities; they recommended to have a different way of submitting pictures to make the process more straightforward.

The main technical difficulty encountered was during the synchronous meeting, the wifi connection did not support video during the meeting, so only audio was used and demonstration videos were added later that day for participant’s reference.

Most participants found the content easy to understand (see Figure 10). Pictures were one of the characteristics that participants reported increased the understanding of the training material. Recommendations to improve this even more included to add more videos and real world examples through the training, as well as to slow down the pace of the lectures for better understanding.

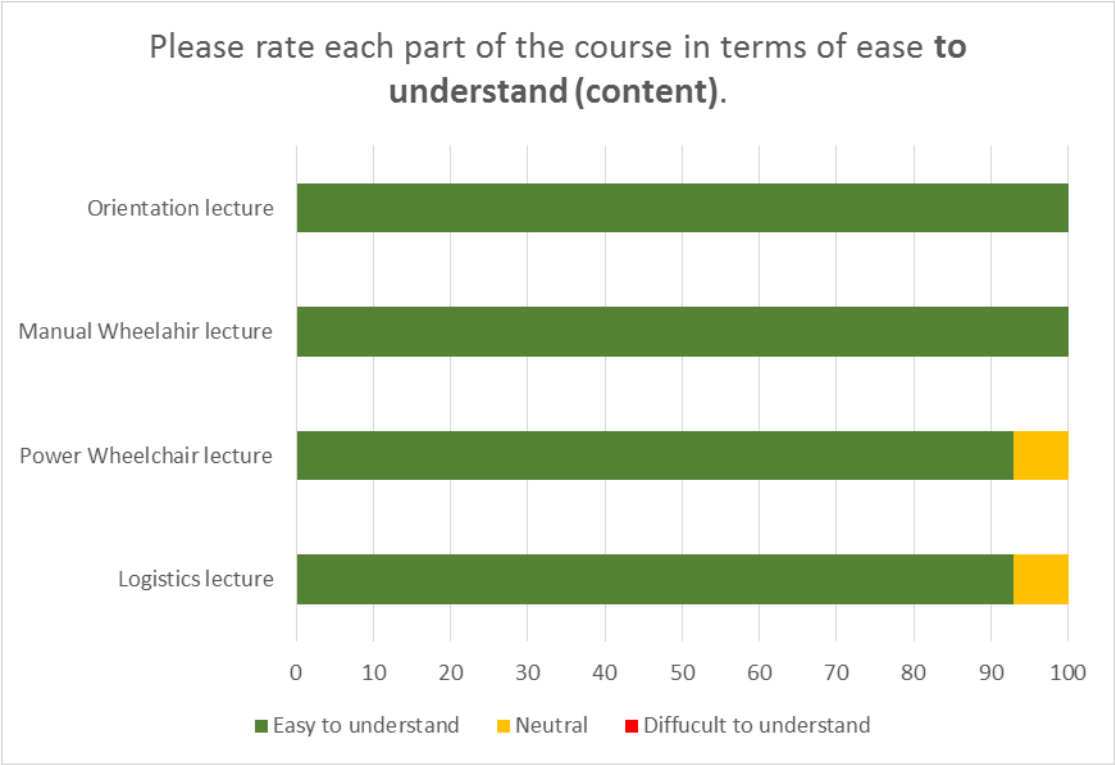

Figure 10. Participant's opinion about the ease to understand of the lectures

The lectures that were most useful for participants were the manual and power wheelchair lectures. Practical activities were considered helpful, as suggested by this participant: "I thought the hands-on, tangible information from the manual and power wheelchair lectures were helpful in my field because they produced the most information that I would be liked to use in my work". For those working already in the field, the training program was relevant:

The manual wheelchair lecture was the most useful. It was the most useful because I work with manual wheelchairs on a regular basis. It is helpful to know what to look for in

order to help me make my participants aware of these items if they are in need of repair. I have encountered manual wheelchair breakdowns when my participants come in for subject testing, and now I am more aware of what to look for and how to recommend they get them fixed.

Other participants commented: “The manual lecture provided good insight into the impact of my work, especially the caster and wheel information”, and, “In the power wheelchair lecture it was useful to see all the maintenance activities that are user initiated. This helped me think about how to better design these devices going forward”. Participants found the content of the training program to be useful: 71% found the manual wheelchair lecture useful, 64% found the power wheelchair lecture useful, 36% found the logistics lecture useful, and 21% found the orientation lecture useful (see Figure 11).

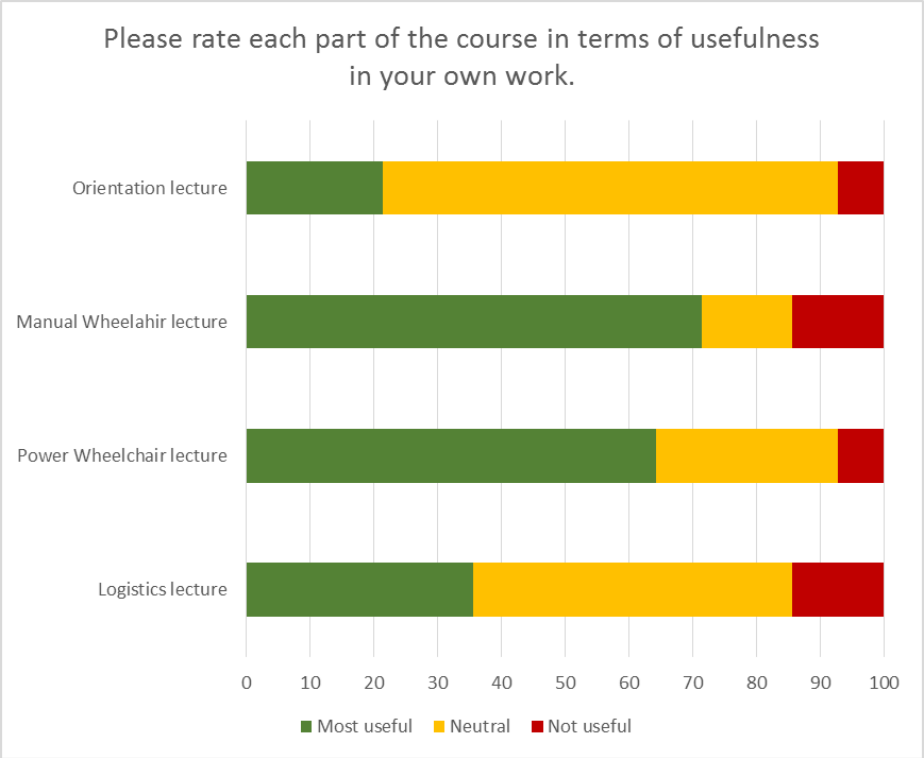

Figure 11. Participant's opinion about the usefulness of the lectures

Most of the content's length was enough to acomplish the learning objectives (Figure 12). One participant suggested to reduced the content of the orientation lecture.Others suggested for the content to be added or enhpazised in the following areas: logistics to deliver lecture (2 participants), manual wheelchair lecture (3 individuals), power wheelchair lecture (4 participants). Information such as different brands, wheelchair models and insurance coverage were suggested as additions.

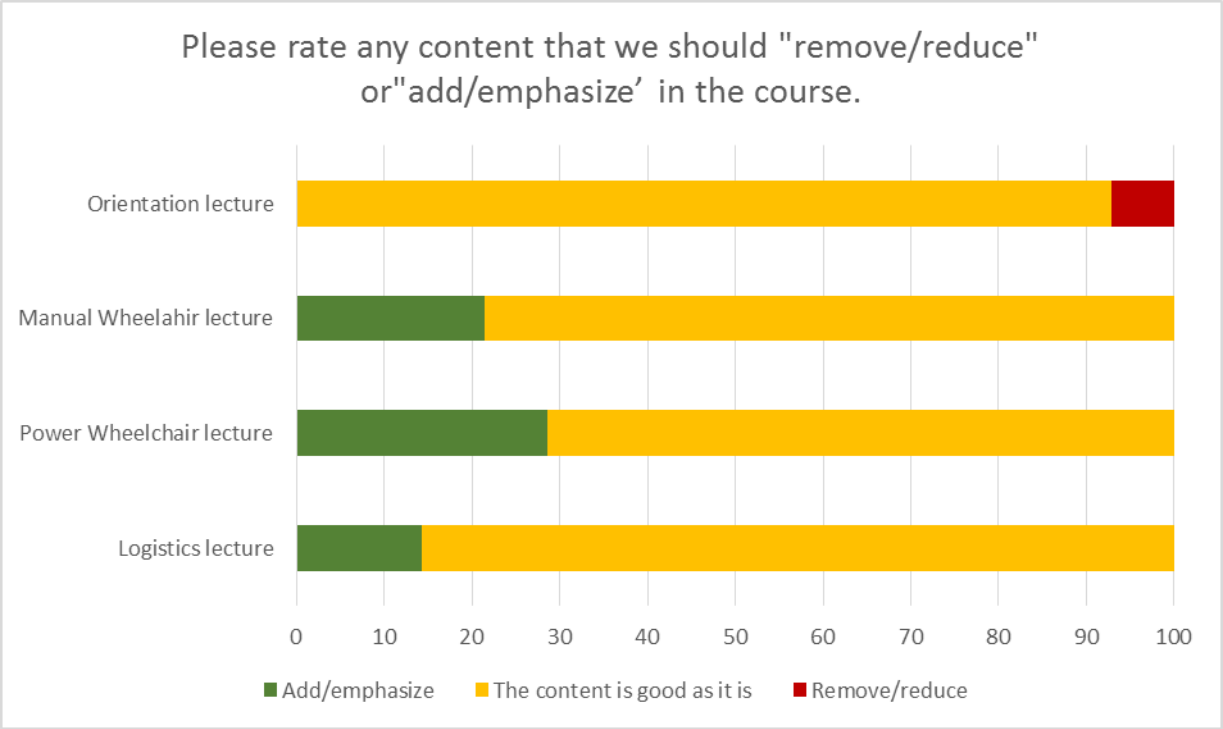

Figure 12. Participant's opinion about content modifications

64.3% of trainees answered they would definetly recommend the training program to their colleagues, and 35.7% answered they probably would recommend it (see Figure 13). All participants found the trianing program to be useful, 28.57% found it extremely useful, 42.86% very useful and 28.57% moderately useful (see Figure 14).

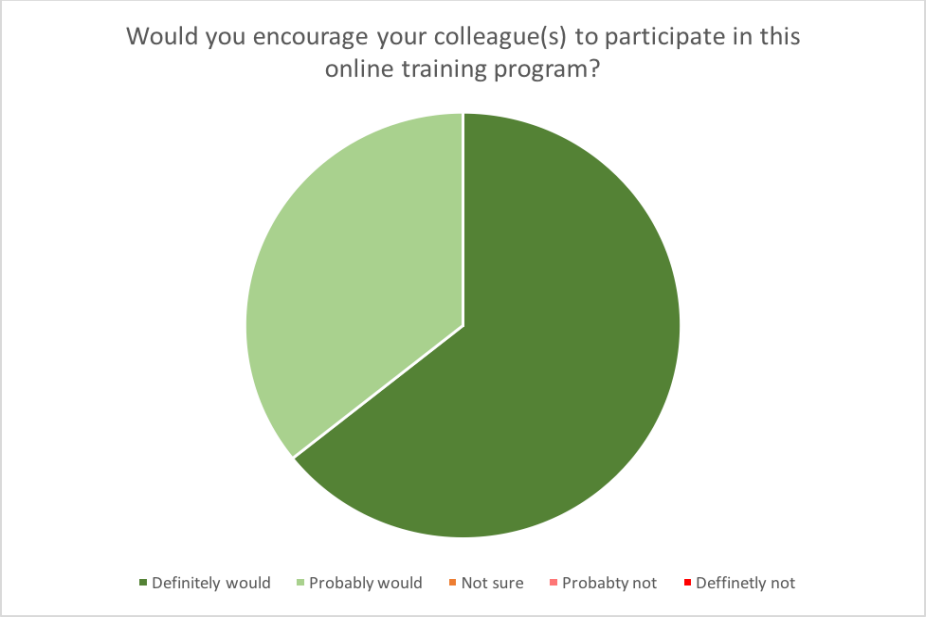

Figure 13. Participant's opinion about recommending the training program

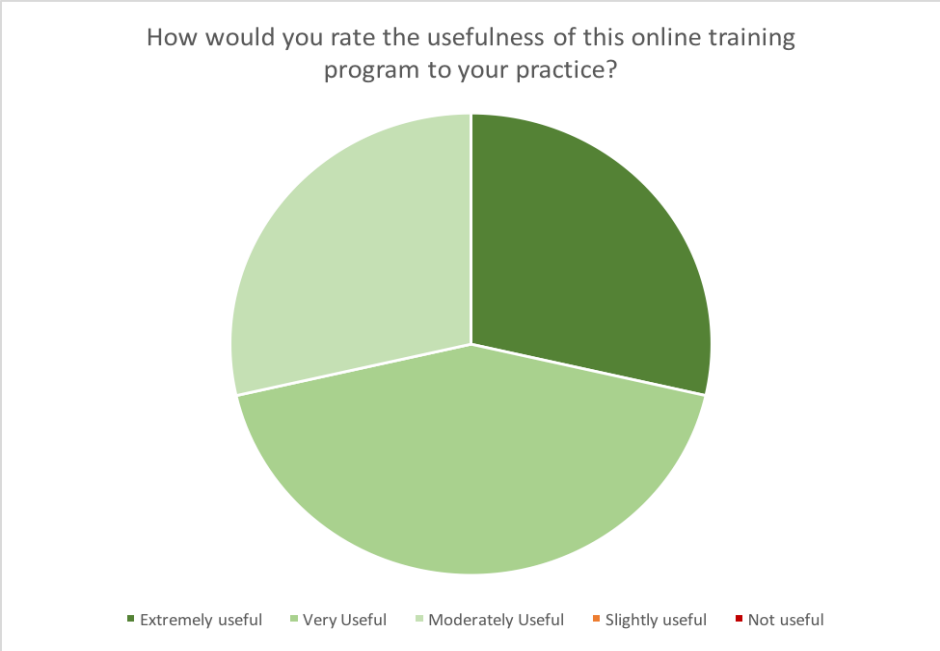

Figure 14. Participant's opinion about the usefulness of training program

2.3.2.2 Wheelchair Maintenance Training Questionnaire

The online WMTP group was significantly less experienced compared to the participants in the in-person training program who had an average of 3.95 years ±2.11 and 3.74 years ±2.04 for manual and power wheelchairs, respectively.

Table 5 presents the descriptive statistics of participants' scores before and after the training in the different WMT-Q domains for the online and in-person group (the data for the in-person training is based on (Toro, 2015)). There was an increase after the training in all domain scores for both groups. The boxplot in Figure 15 shows the scores in each domain for the online group and the one in Figure 15 for the in-person group.

Table 5. Descriptive statistics of online and in-person participant's scores

WMT-Q Item		**Online Training (n=14)**		**In-Person Training (n=10)**	
		Mean	**SD**	**Mean**	**SD**
Open ended Manual Wheelchair	Pre	24.23	15.41	31.78	11.47
	Post	30.10	8.60	55.00	17.83
Open ended Power Wheelchair	Pre	20.15	11.77	29.37	16.48
	Post	34.69	14.78	47.50	24.80
Multiple choice (knowledge)	Pre	46.42	19.13	57.72	18.68
	Post	70.45	17.26	78.63	14.69
Capacity	Pre	51.38	25.25	46.45	29.29
	Post	97.23	4.35	99.67	1.02
Confidence	Pre	41.01	22.30	N/A	
	Post	92.08	7.89		

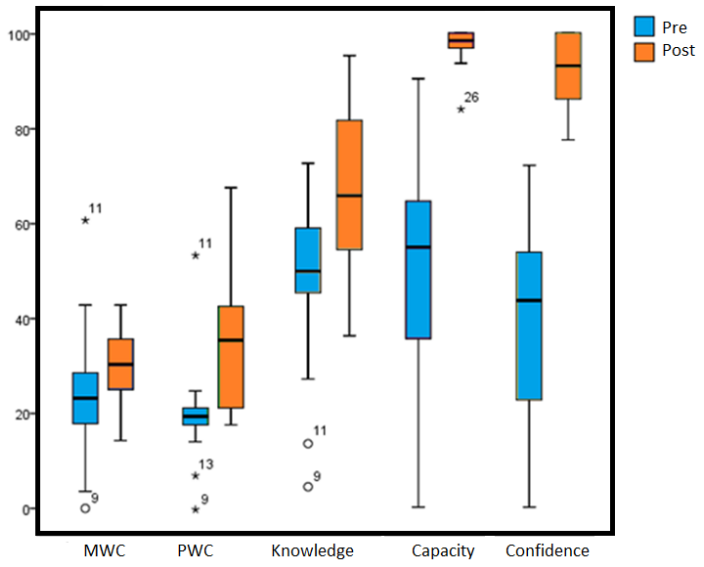

Figure 15. Boxplot showing the pre-training and post-training scores in each domain of the WMT-Q for the online group

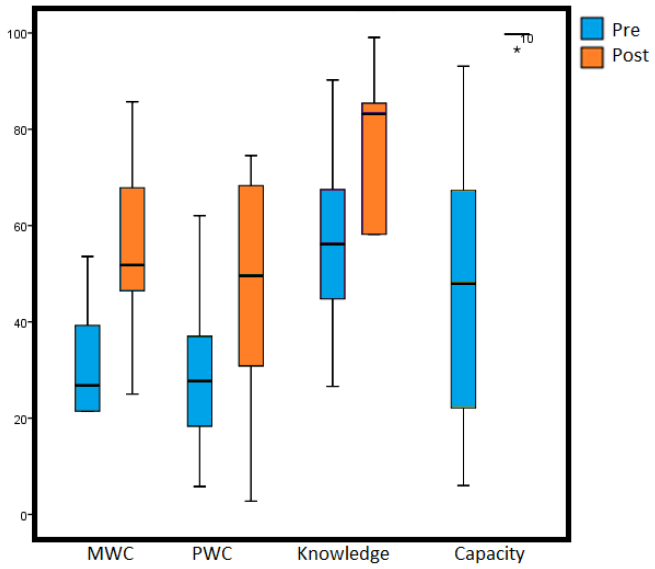

Figure 16. Boxplot showing the pre-training and post-training scores in each domain of the WMT-Q for the in-person group

A paired t-test indicated that there was a significant increase in scores after online training for the following domains: power wheelchair open-ended questions, $t(13) = -2.940$, $p<.05$, $d=1.630$; multiple choice questions of knowledge, $t(13) = -5.162$, $p<.001$, $d=2.863$;

capacity, t(13) = -6.545, p<.001, d=3.630; confidence, t(13) = -9.399, p<.001, d=5.213. The open-ended questions about manual wheelchairs were not significantly higher after the training. Most of the items reach 100% capacity; Table 6 contains all the items evaluated and the score after the training.

Table 6. Maintenance items and capacity post-training score

Maintenance item	**Capacity score**
Wipe down a wheelchair and cushion	100.00
Remove dirt and lint from the caster axles	100.00
Check the pressure in the tires, and inflate them	100.00
Check the spokes of the manual wheelchair wheels	92.86
Check manual wheelchair wheel locks	100.00
Lubricate manual wheelchair moving parts	100.00
Clean a manual wheelchair quick-release wheel axle	100.00
Check and tighten all nuts and bolts	100.00
Check the movable parts in a manual wheelchair	100.00
Check the wheel and caster bearings	100.00
Check the tires, casters, and anti-tip wheels	100.00
Check whether the cushion and cover need repair	100.00
Check whether the upholstery needs repair	100.00
Check the wheel alignment	100.00
Check manual wheelchair cross brace folding mechanism	100.00
Check whether the plastic parts need repair	100.00
Check the weld points	92.86
Check the manual wheelchair hand rims	100.00
Check the backrest canes or posts	85.71
Clean the power wheelchair seat function mechanism	85.71
Check the power wheelchair electrical connections	92.86
Check all the power wheelchair wiring	92.86
Check the casters for flutter	100.00
Check the power wheelchair joystick and rubber boot	100.00
Check the seat belt	100.00
Check the power wheelchair battery charger cable	100.00
Check the brakes in a power wheelchair	100.00
Check the power wheelchair motor	100.00
Check the power wheelchair controller	100.00
Check the power wheelchair lever	92.86
Contact a wheelchair maintenance expert	78.57

As per the independent-sample t-test, there were statistical difference in scores between in-person (knowledge: M=20.90, SD=13.31; capacity: M=53.22, SD=28.82) and online (knowledge: M=24.02, SD=17.41; capacity: M=45.85, SD=26.21) participants; knowledge: t(22)=-.468, p=.644, capacity: t(22)=-.652, p=.521.

Table 7 shows a comparison of the effect size for the analyzed domains in the online and in-person trainings. Cohen's d shows a similar effect size in both analyzed domains after the online and in-person training.

Table 7. Cohens'd for knowledge and capacity in both training programs

WMT-Q domains	**Cohen's d**	
	In-person	**Online**
Multiple choice (knowledge)	3.166	2.863
Capacity	3.893	3.630

In summary, after the Online WMTP, participants significantly increased their scores in knowledge related to power wheelchairs and maintenance in general, as well as capacity and confidence in performing maintenance activities. There was a similar trend of increased knowledge and capacity for participants in both training programs indicating web-based training is a viable avenue for delivering maintenance training.

3.0 DISCUSSION AND SIGNIFICANCE

An Online Wheelchair Maintenance Training Program (WMTP) was developed and implemented. The results of this work suggest that the online methodology is effective to improve knowledge, capacity and confidence in participants related to wheelchair maintenance.

The use of the Critical Success Factors (CSF) during the development of the online WMTP was fundamental for the success of the training program. In this study, the iterative approach to the design of educational material was effective; the modifications made during the development of the program were noted by participants as strengths of the WMTP. During different phases of the development, the organization of the training material was improved; these, and the use of pictures and videos, appeared to be one of the most important characteristics to make the material easy to understand. During the internal and external review, comments asking to create a video library, audio files and a glossary of terms were recurrent. During the usability test, these characteristics were found as strengths of the training program. This finding aligns with the literature confirming that an approach to incrementally develop and modify educational tools based on feedback is important; this is because it allows early problem solving as well as adding functionalities according to the target needs (Nogry, Jean-Daubias, & Guin, 2017). According to the World Health Organization and Imperial College London's systematic review, some advantages of online training are the ease of access and flexibility (World Health Organization & Imperial College London, 2015). Our results agree with this statement;

participants found self-paced learning to be the main advantage about the online WMTP; this flexibility was the main reason for them to prefer online instead of in-person learning environments. Nonetheless, this preference cannot be generalized since research has shown that learning preferences differ based on student's learning inclinations (Beyth-Marom, Saporta, & Caspi, 2005).

In different phases of the development, recommendations to improve the hands-on activities and to have more wheelchairs available were recurrent. This aspect was challenging, since even though the training program instructions suggested practicing as many times as needed to feel comfortable performing the maintenance activities, participants only practiced once on each wheelchair and always on the last day before the due date. A possible solution might be the use of peer feedback as an engagement method, asking participants to perform a maintenance activity, and performing the same activity again after receiving feedback from a peer. Different papers have shown the importance of active learning pedagogies to improve engagement both in traditional and non-traditional learning (Smith, Sheppard, Johnson, & Johnson, 2005; Tinapple, Olson, & Sadauskas, 2013).

This training program was developed during a three-week period; there is flexibility to compress or extend the time of the training but this may influence learning, research has shown that the more structure the learning method is, less triaging time will be required (Kirby, Bennett, Smith, Parker, & Thompson, 2008).

During the implementation of the training program, participants requested to have more real-world examples, such as pictures of different wheelchairs, and more wheelchairs to perform maintenance on; this finding relates to information in literature suggesting that case studies and experiential learning help to improve different skills in both traditional and non-traditional

learning methods (Billingsley & Scheuermann, 2014; Duncan, 2005; Krassadaki, Lakiotaki, & Matsatsinis, 2014).

Participants agreed that the online synchronous meeting was sufficient to clarify questions at the end of the training program. Unfortunately, there was no visual feedback during the meeting with the first cohort of participants. This might have been caused do to the use of the same wifi by several people. This technical difficulty was easily solved by recording and sending videos after the meeting. Nonetheless, it shows the importance of understanding the hardware and software requirements of online training programs and the resources available where the training will be implemented (World Health Organization & Imperial College London, 2015). These requirements should be taken into consideration especially when the training is delivered in a developing country or a low-resource setting. For the next cohort of this project, we hope not to encounter this challenge again since it will be held in different sites of the Spinal Cord Model Systems so participants would not be connected to the same wifi during the synchronous meeting.

Some participants recommended slowing down the pace of the lectures for better understanding. Adding instructions to encourage them to look at the training at their own pace can help them better grasp the knowledge and tailor the program to their learning needs. This is another advantage of online learning, since it makes the student the center of the learning process (World Health Organization & Imperial College London, 2015).

All participants found the training program useful, nevertheless, 41% found the content to be neutral in terms of usefulness for their work. This discrepancy can be explained because this cohort of participants is not currently working in wheelchair service; the next cohort will work in

wheelchair services and this will give a better estimate of the training usefulness per the population it was developed to serve.

Another important request from participants was to add information about different wheelchair models, brands, and insurance coverage. This was not the intendent content of the training program, but it shows the need to have more training related to wheelchairs and wheelchair services.

Having wheelchairs in more disrepair states was also requested, connecting with organizations that perform maintenance on wheelchairs and asking them to share the wheelchairs for participants to perform maintenance on can be a way to tackle this and having wheelchair available for future trainings outside of a research setting. Asking participants to have tools available is also important, the tools needed for this program are commonly found in must houses.

Overall, our results showed that the Online WMTP significantly increases wheelchair maintenance knowledge, capacity, and confidence while performing maintenance activities. The scores for open-ended questions about manual wheelchairs did not significantly increase after the training. One possible explanation is that open-ended questions take more effort to answer. After the training participants wrote more wheelchair components but were not as specific as before the training in explaining the maintenance items and timing which affected the total score. Additionally, the last questionnaire was answered the last day of the training and participants might have been in a rush answering; for the next cohort, more time will be given to fill in the last questionnaire.

Based on learning outcomes, our results suggest that online learning seems to be comparable in-person training. This result reinforces previous work that found no statistical

difference between the effectiveness of in-person vs. online delivery of education (Means et al., 2010).

3.1 KEY CONTRIBUTIONS OF THE STUDY

This study contributes to research on the efficacy of online training within the wheelchair sector:

- We confirmed that an iterative approach is effective when designing educational programs; additionally, we provided a reference for the development of online training programs improving wheelchair provision.
- We confirmed some relationships in the teaching and learning model between traditional and non-traditional learning such as the preference for experiential learning and the importance of peer interaction.
- We proved that online training seems to be comparable to in-person training to increase wheelchair maintenance knowledge and capacity of performing maintenance activities.

The results of this work are particularly relevant when a face-to-face approach is not feasible; this study has proven that online training in wheelchair maintenance can improve knowledge, capacity, and confidence; moreover, this training program has the potential to decrease wheelchair breakdowns and their related adverse consequences.

3.2 LIMITATIONS OF THE STUDY

The main limitations on this study were faced during the development of the training program. Accessibility in the learning management system (LMS) was not considered; consequently, users with visual impairments would be unable to access the information. Additionally, the interaction between the LMS and the tool used to record the lectures made user interaction with the LMS somewhat difficult.

Information was collected to evaluate how participants can perform maintenance on a wheelchair or train users. Nonetheless, the WMT-Q is a self-report tool and participants' skills were not evaluated. In one assignment during the last week of the training program participants sent a video delivering a portion of power point presentation, as if they were training wheelchair users; There is a need to better assess participants training needs.

As per the sample of this study, not all participants were currently working in wheelchair service; the content of the training program might not be relevant for these participants, and their learning experience may differ from that of experienced wheelchair professionals. In the in-person training the participants were going to train wheelchair users afterwards, therefore it was assumed that they were very motivated to learn since they were going to apply the knowledge right away. If the sample in the online program would have had the same characteristics, perhaps, there would have been better scores in the online vs the in-person.

There was no reliability testing for the confidence portion of the Wheelchair Maintenance Training Questionnaire (WMT-Q).

3.3 CONCLUSION

Wheelchair breakdowns and repairs are increasing and multiple adverse consequences can result from these problems. A WMTP was developed and implemented with good learning outcomes; to scale this training and make it available to a broader population of trainees, an online version of the program was developed. This thesis presents a successful approach to the design of the Online WMTP as well as results from the implementation with a cohort of participants.

This study showed that both traditional and non-traditional teaching methods can increase learning related to wheelchair maintenance. After the online training, there was a statistically significant increase in knowledge, capacity, and confidence as measured by the Wheelchair Maintenance Training Questionnaire (WMT-Q); when comparing the two learning methods (online and in-person) no statistically difference was found in terms of knowledge gained, suggesting that online training seems to be comparable to in-person training to teach wheelchair maintenance.

3.4 FUTURE WORK

Based on the external review during the development of this training program, we would further improve the questionnaires to make them more user friendly looking for other LMS options with better interaction among learning tools. Additionally, a certification of the Online WMTP by an external body is needed; this certification should include an evaluation by knowledge experts such as the International Society of Wheelchair Professionals (ISWP), but also by eLearning

experts such as Quality Matters (QM) to make sure both the content and LMS are adequate and ensure its revision over time.

The sample studied in this thesis had very little experience working in wheelchair services. An interesting research path would be to investigate whether there is any difference in learning outcomes for those with extensive experience in wheelchair provision compared to those with less experience.

More research is needed to understand whether participants of the training program retained their knowledge, and whether the program elicits changes in clinician practices regarding wheelchair service and particularly to maintenance training.

This training program was developed as a training of trainers; the next step should be to verify whether we can directly train wheelchair users. The development of an application that can deliver training, alert the user when maintenance is required, and collect data related to wheelchair breakdowns is an ideal way of integrating the training into the user's life; this tool can also help studying if there is a long-term impact in wheelchair breakdowns and adverse consequences when training users in wheelchair maintenance.

According to Medicare policies, repairs are covered when necessary to make the equipment usable, but in general terms wheelchair maintenance is the user's responsibility (Department of Health and Human Services. Centers for Medicare & Medicaid Services, 2016); an idea to empower wheelchair users (particularly children and adolescents) to perform maintenance on their wheelchairs is to create an app-based game that can improve the timing and quality of their wheelchair maintenance.

There is an important need for better trained wheelchair service professionals; the development of the in-person and online WMTP is just one way to tackle this issue; there must

be curriculum integration allowing therapists to access this training as part of their education. Web-based programs, such as this one, are resources that can be used by therapy programs to educate clinicians-in-training without increasing the burden on educators. Additionally, manufacturers need to be involved in developing maintenance guides since all wheelchairs have different characteristics particularly when doing advance training, which is not part of the WMTP.

The need for trained wheelchair providers is also true in the international context; in low income countries, a lot of wheelchair providers are community members instead of rehabilitation professionals. Training programs such as the Online WMTP should be available for them to improve the wheelchair delivery around the globe; thus, efforts to culturally translate this training program are needed.

APPENDIX A

WHEELCHAIR MAINTENANCE TRAINING QUESTIONNAIRE

1. Please enter your participant id: _____

2. How many years of experience do you have in manual wheelchair provision? _____ years

3. How many years of experience do you have in power wheelchair provision? _____ years

A.1 DOMAIN 1: KNOWLEDGE MANUAL WHEELCHAIRS

Please answer the following questions on wheelchair maintenance.

1. A manual wheelchair user comes to you with questions related to the regular maintenance of their wheelchair to keep it running well. The wheelchair user wants to know what items they should 'check' on a regular basis, and also what maintenance activities they should 'perform' on a regular basis.

On the lines below, please provide a list of 5 to 10 items that you would tell the wheelchair user to check and activities they should perform on a regular basis. Be sure to be specific and comprehensive, and include the frequency of each item (e.g. daily, weekly, monthly, yearly).

Think of a check as an inspection and the activities that you perform as an intervention.
As an example related to someone's house, it is important to 'check' (or 'inspect') the batteries in a smoke detector every six months, and also important to 'change' the filter on the furnace every 6 months.

A.2 DOMAIN 2: KNOWLEDGE POWER WHEELCHAIRS

2. A power wheelchair user comes to you with questions related to the regular maintenance of their wheelchair to keep it running well. The wheelchair user wants to know what items they should 'check' on a regular basis, and also what maintenance activities they should 'perform' on a regular basis.

On the lines below, please provide a list of 5 to 10 items that you would tell the wheelchair user to check and activities they should perform on a regular basis. Be sure to be specific and comprehensive, and include the frequency of each item (e.g. daily, weekly, monthly, yearly). *As an example related to someone's house, it is important to 'check' the batteries in a smoke detector every six months, and also important to 'change' the filter on the furnace every 6 months.*

A.3 DOMAIN 3: KNOWLEDGE OPEN ENDED QUESTIONS

Please answer the following multiple choice questions.

Importance of wheelchair maintenance

1. How many times more likely is a wheelchair user to sustain an injury if he/she does not maintain the wheelchair?

☐$_1$ No increased likelihood to sustain injuries

☐$_2$ Two times more likely

☐$_3$ Five times more likely

☐$_4$ Ten times more likely

☐$_6$ I do not know

2. Approximately, what percentage of wheelchair users in the community experience wheelchair-related injuries each year?

☐$_1$ Less than 1%

☐$_2$ 5% to 18%

☐$_3$ 30% to 52%

☐$_4$ 62% to 70%

☐$_6$ I do not know

3. The majority of commercial wheelchairs tested by independent wheelchair testing laboratories meet the minimum durability standards set forth by ANSI/RESNA Wheelchair Standards.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

4. The number of wheelchair breakdowns in the United States has been decreasing over time.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

5. Approximately, what percentage of wheelchair users with spinal cord injury have reported at least one wheelchair breakdown in the past 6 months?

☐$_1$ 20-30%

☐$_2$ 50-60%

☐$_3$ 70-80%

☐$_6$ I do not know

6. Which of the following can be a consequence of a wheelchair breakdown? (select all that apply)

☐ $_1$ Being stranded at home and missing work and appointments

☐$_2$ Being injured

☐$_3$ More likely to get a shoulder overuse injury

☐$_6$ I do not know

7. Power wheelchairs have more frequent breakdowns than manual wheelchairs.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

8. Injuries due to a wheelchair breakdown occur more frequently among power wheelchair users if they have powered seat functions compared to no power seat functions.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

Health insurance policies

9. A consequence of frequent wheelchair breakdowns is the increased cost to the health care system.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

If 9 is true, then answer:

10. In the United States, wheelchair repairs and replacement costs account for approximately what annual percentage of the direct wheelchair expenditures by a large-scale provider for wheelchairs (such as the Department of Veterans Affairs or Medicare)?

☐$_1$ 5%

☐$_2$ 10%

☐$_3$ 30%

☐$_4$ 50%

☐$_6$ I do not know

In the United States, many health insurance policies follow Medicare's coverage. The following questions are related to Medicare's policies, which may or may not apply to all of your clients' health insurance.

11. It is Medicare's policy to replace a wheelchair every five years, regardless of the wear and tear on the wheelchair.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

12. Medicare's policy is to replace a wheelchair cushion every two years.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

13. Medicare's policy reimburses wheelchair providers for an annual preventive maintenance checkup for manual or power wheelchairs.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

14. Medicare's policy is to reimburse for the repair of wheelchair parts when they are in state of disrepair. For example, a new battery will be reimbursed when the current battery is not holding charge during an average day.

☐$_1$ True☐$_0$ False ☐$_6$ I do not know

Maintenance Practice

15. Lubricating moving parts is considered a good practice; therefore, it is recommended to lubricate sealed bearings.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

16. All pneumatic tires should be inflated to 150lb to reduce rolling resistance.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

17. Tightening the wheel spokes at home with a spoke wrench is recommended when loose spokes are identified.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

18. Tires should be inflated after you adjust the wheel-locks to improve braking performance.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

19. To maximize the lifespan of the wheelchair batteries, they need to be run down completely before recharging them.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

20. Power wheelchair or scooter batteries need to be charged only with the charger that is provided with the wheelchair.

☐$_1$ True☐$_0$ False ☐$_6$ I do not know

21. Well-maintained power wheelchair or scooter batteries are expected to last 5 years.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

22. Tightening loose bolts with all your force will guarantee that they will not become loose again.

☐$_1$ True ☐$_0$ False ☐$_6$ I do not know

A.4 DOMAIN 4: CAPACITY AND CONFIDENCE

Please answer questions about maintenance activities that a wheelchair user might perform on their own wheelchair. For each activity, you will answer **if you can do the activity** and whether you currently train the users on how to do it.

1.a Do you know how to wipe down a wheelchair and cushion?

☐$_1$Yes ☐$_0$No

1.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

1.c Do you currently train wheelchair users and/or caregivers on how to wipe down a wheelchair and cushion?

☐$_1$Yes ☐$_0$No

2.a Do you know how to remove dirt and lint from the caster axles?

☐$_1$Yes ☐$_0$No

2.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

2.c Do you currently train wheelchair users and/or caregivers on how to remove dirt and lint from the caster axles?

☐$_1$Yes ☐$_0$No

3.a Do you know how to check the pressure in the tires, and inflate them if they are low?

☐$_1$Yes ☐$_0$No

3.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

3.c Do you currently train wheelchair users and/or caregivers on how to check the pressure in the tires, and inflate them if they are low?

☐$_1$Yes ☐$_0$No

4.a Do you know how to check whether the spokes of the manual wheelchair wheels are adjusted correctly? ☐$_1$Yes ☐$_0$No

4.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

4.c Do you currently train wheelchair users and/or caregivers on how to check whether the spokes of the manual wheelchair wheels are adjusted correctly?

☐$_1$Yes ☐$_0$No

5.a Do you know how to check whether the manual wheelchair wheel locks (brakes) are working properly, and adjust them if necessary?

☐$_1$Yes ☐$_0$No

5.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

5.c Do you currently train wheelchair users and/or caregivers on how to check whether the manual wheelchair wheel locks (brakes) are working properly, and adjust them if necessary?

☐$_1$Yes ☐$_0$No

6.a Do you know how to lubricate manual wheelchair moving parts, such as the folding mechanism, front casters, and exposed hinges?

☐$_1$Yes ☐$_0$No

6.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

6.c Do you currently train wheelchair users and/or caregivers on how to lubricate moving parts?

☐$_1$Yes ☐$_0$No

7.a Do you know how to clean a manual wheelchair quick-release wheel axle and axle housing?

☐$_1$Yes ☐$_0$No

7.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

7.c Do you currently train wheelchair users and/or caregivers on how to clean the quick-release wheel axle and axle housing?

☐$_1$Yes ☐$_0$No

8.a Do you know how to check all nuts and bolts, and how to tighten the loose ones?

☐$_1$Yes ☐$_0$No

8.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

8.c Do you currently train wheelchair users and/or caregivers on how to check all nuts and bolts, and how to tighten the loose ones?

☐$_1$Yes ☐$_0$No

9.a Do you know how to check whether the parts in a manual wheelchair that are originally designed to be released, such as leg supports, foot supports, arm supports, back supports, and tilt mechanisms, are working and adjusted properly?

☐$_1$Yes ☐$_0$No

9.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

9.c Do you currently train wheelchair users and/or caregivers on how to check whether the parts in a manual wheelchair that are originally designed to be released, such as leg supports, foot supports, arm supports, back supports, and tilt mechanisms, are working and adjusted properly?

☐$_1$Yes ☐$_0$No

10.a Do you know how to contact a wheelchair maintenance expert to have a wheelchair professionally serviced?

☐$_1$Yes ☐$_0$No

10.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

10.c Do you currently recommend wheelchair users and/or caregivers get the wheelchair thoroughly serviced by a wheelchair maintenance expert?

☐$_1$Yes ☐$_0$No

11.a Do you know how to check whether the wheel and caster bearings are working properly and do not need adjustment or maintenance?

☐$_1$Yes ☐$_0$No

11.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

11.c Do you currently train wheelchair users and/or caregivers on how to check whether the wheel and caster bearings are working properly and do not need adjustment or maintenance?

☐$_1$Yes ☐$_0$No

12.a Do you know how to check whether the tires, casters, and anti-tip wheels are in need of repair or replacement?

☐$_1$Yes ☐$_0$No

12.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

12.c Do you currently train wheelchair users and/or caregivers on how to check whether the tires, casters, and anti-tip wheels are in need of repair or replacement?

☐$_1$Yes ☐$_0$No

13.a Do you know how to check whether the cushion and cover are in need of repair or replacement?

☐$_1$Yes ☐$_0$No

13.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

13.c Do you currently train wheelchair users and/or caregivers on how to check whether the cushion and cover in need of repair or replacement?

☐$_1$Yes ☐$_0$No

14.a Do you know how to check whether the upholstery is in need of repair or replacement?

☐$_1$Yes ☐$_0$No

14.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

14.c Do you currently train wheelchair users and/or caregivers on how to check whether the upholstery is in need of repair or replacement?

☐$_1$Yes ☐$_0$No

15.a Do you know how to check the wheel alignment?

☐$_1$Yes ☐$_0$No

15.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

15.c Do you currently train wheelchair users and/or caregivers on how to check that the wheels are aligned?

☐$_1$Yes ☐$_0$No

16.a Do you know how to check whether the manual wheelchair cross brace folding mechanism is working properly or in need of repair or replacement?

☐$_1$Yes ☐$_0$No

16.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

16.c Do you currently train wheelchair users and/or caregivers on how to check whether the manual wheelchair cross brace folding mechanism is working properly or in need of repair or replacement?

☐$_1$Yes ☐$_0$No

17.a Do you know how to check whether the plastic parts, such as the side or clothing guard or shrouds, are in need of repair or replacement?

☐$_1$Yes ☐$_0$No

17.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

17.c Do you currently train wheelchair users and/or caregivers on how to check whether the plastic parts, such as the side or clothing guard or shrouds, are in need of repair or replacement?

☐$_1$Yes ☐$_0$No

18.a Do you know how to check whether the weld points are intact and free of cracks?

☐$_1$Yes ☐$_0$No

18.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

18.c Do you currently train wheelchair users and/or caregivers on how to check the weld points?

☐$_1$Yes ☐$_0$No

19.a Do you know how to check whether the manual wheelchair handrims are in need of repair or replacement?

☐$_1$Yes ☐$_0$No

19.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

19.c Do you currently train wheelchair users and/or caregivers on how to check whether the manual wheelchair handrims are in need of repair or replacement?

☐$_1$Yes ☐$_0$No

20.a Do you know how to check whether the backrest canes or posts are in need of repair or replacement?

☐$_1$Yes ☐$_0$No

20.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

20.c Do you currently train wheelchair users and/or caregivers on how to check whether the backrest canes or posts are in need of repair or replacement?

☐$_1$Yes ☐$_0$No

21.a Do you know the process to clean the power wheelchair seat function mechanisms and tracks (tilt, recline, leg support elevator, and seat elevator)?

☐$_1$Yes ☐$_0$No

21.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

21.c Do you currently train wheelchair users and/or caregivers on how to clean the power wheelchair seat function mechanisms and tracks (tilt, recline, leg support elevator, and seat elevator)?

☐$_1$Yes ☐$_0$No

22.a Do you know how to check that the power wheelchair electrical connections are firmly in place?

☐$_1$Yes ☐$_0$No

22.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

22.c Do you currently train wheelchair users and/or caregivers on how to check that the power wheelchair electrical connections are firmly in place?

☐$_1$Yes ☐$_0$No

23.a Do you know how to check that all the power wheelchair wiring is safe by checking the rubber wire housing is in need of repair or replacement and all wires are properly secured with no chance of being caught between moving parts?

☐$_1$Yes ☐$_0$No

23.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

23.c Do you currently train wheelchair users and/or caregivers on how to check that all the power wheelchair wiring is safe by checking the rubber wire housing is in need of repair or replacement and all wires are properly secured with no chance of being caught between moving parts?

☐$_1$Yes ☐$_0$No

24.a Do you know how to check the casters for flutter?

☐$_1$Yes ☐$_0$No

24.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

24.c Do you currently train wheelchair users and/or caregivers on how to check the casters for flutter?

☐$_1$Yes ☐$_0$No

25.a Do you know how to check whether the power wheelchair joystick and rubber boot are in need of repair or replacement?

☐$_1$Yes ☐$_0$No

25.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

25.c Do you currently train wheelchair users and/or caregivers on how to check whether the joystick and rubber boot are in need of repair or replacement?

☐$_1$Yes ☐$_0$No

26.a Do you know how to check whether the seatbelt is in need of repair or replacement?

☐$_1$Yes ☐$_0$No

26.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

26.c Do you currently train wheelchair users and/or caregivers on how to check whether the seatbelt is in need of repair or replacement?

☐$_1$Yes ☐$_0$No

27.a Do you know how to check whether the power wheelchair battery charger cable is in need of repair or replacement?

☐$_1$Yes ☐$_0$No

27.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

27.c Do you currently train wheelchair users and/or caregivers on how to check whether the power wheelchair battery charger cable is in need of repair or replacement?

☐$_1$Yes ☐$_0$No

28.a Do you know how to check whether the brakes in a power wheelchair are working properly?

☐$_1$Yes ☐$_0$No

28.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

28.c Do you currently train wheelchair users and/or caregivers on how to check whether the brakes in a power wheelchair are working properly?

☐$_1$Yes ☐$_0$No

29.a Do you know how to check whether the power wheelchair motor is working properly or is in need of repair or replacement?

☐$_1$Yes ☐$_0$No

29.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

29.c Do you currently train wheelchair users and/or caregivers on how to check whether the power wheelchair motor is working properly or is in need of repair or replacement?

☐$_1$Yes ☐$_0$No

30.a Do you know how to check whether the power wheelchair controller is working properly, including power seat functions, indicators (battery, speed, etc), and horn?

☐$_1$Yes ☐$_0$No

30.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

30.c Do you currently train wheelchair users and/or caregivers on how to check whether the power wheelchair controller is working properly, includes power seat functions, indicators, and horn?

☐$_1$Yes ☐$_0$No

31.a Do you know how to check if the lever that disengages the motor or brakes on a power wheelchair is working properly?

☐$_1$Yes ☐$_0$No

31.b How confident are you?

☐$_1$ Fully ☐$_2$ Somewhat ☐$_3$ Not at all

31.c Do you currently train wheelchair users and/or caregivers on how to check that the lever that disengages the motor or brakes on a power wheelchair is working properly?

☐$_1$Yes ☐$_0$No

APPENDIX B

INTERNAL REVIEW FEEDBACK FORM

Manual Wheelchair Lecture

Date:

You feedback is extremely valuable to the refinement of this training program. Please answer the following questions related to the manual wheelchair lecture of the training program. Please take into consideration things such as time allotted to review the lectures content of the lecture and the information on the syllabus such as assignments and synchronous meetings.

1. Please describe any part of the course that you found difficult to understand
2. Please describe any part of the course you think will be most useful
3. Please describe any content that we should ‘add/emphasize’ in the course.
4. Please describe any content that we should ‘remove/reduce’ in the course.
5. Please describe any other improvements you would make to the course in terms of:
    a. Duration of the lecture in the training program:
    b. Format of the online training program:
6. Please use the space below to write any additional recommendations:

APPENDIX C

FEEDBACK FORM

You feedback is extremely valuable to the refinement of this training program. Please answer the following questions related to the sessions of the training program. Please take into consideration things such as time allotted to review each of the lectures, content of the lectures, assignments and synchronous meetings.

1. Please rate each part of the course in terms of ease to understand (content).

	Easy to understand	Neutral	Difficult to understand
Introduction lecture	❍	❍	❍
Manual Wheelchair lecture	❍	❍	❍
Power Wheelchair lecture	❍	❍	❍
Logistics lecture	❍	❍	❍

2. Please describe the session and what was difficult to understand, in terms of the content of the lectures; for example: In the Manual Wheelchair Lecture, it was difficult to understand how to change the brakes because there weren't enough pictures.Sessions: Introduction lecture, Manual Wheelchair lecture, Power Wheelchair lecture, Logistics lecture.
3. Please rate each part of the course in terms of usefulness in your own work.

	Not useful	Neutral	Most useful
Introduction lecture	❍	❍	❍
Manual Wheelchair lecture	❍	❍	❍
Power Wheelchair lecture	❍	❍	❍
Logistics lecture	❍	❍	❍

4. Please describe the session and what was most useful; for example: In the Power Wheelchair Lecture, it was useful to see how to troubleshoot when the joystick is not working, because I've encountered this problem in my daily practice.Sessions: Introduction lecture, Manual Wheelchair lecture, Power Wheelchair lecture, Logistics lecture.
5. Please rate any content that we should "remove/reduce" or"add/emphasize' in the course.

	remove/reduce	the content is good as it is	add/exphasize
Introduction lecture	❍	❍	❍
Manual Wheelchair lecture	❍	❍	❍
Power Wheelchair lecture	❍	❍	❍
Logistics lecture	❍	❍	❍

6. Please provide comments to clarify your selection for the content that we should ‘remove/reduce’ or "add/emphasize’ in the different sessions of the course.Sessions: Introduction lecture, Manual Wheelchair lecture, Power Wheelchair lecture, Logistics lecture.
7. Please describe any other improvements you would make to the course in terms of the duration of the online training program.
8. Please describe any other improvements you would make to the course in terms of the format of the online training program.
9. Would you encourage your colleague(s) to participate in this online training program?

❍ Definitely would
❍ Probably would
❍ Not sure
❍ Probably not
❍ Definitely not

10. How would you rate the usefulness of this online training program to your practice?

❍ Extremely useful
❍ Very useful

- ❍ Moderately useful
- ❍ Slightly useful
- ❍ Not useful

APPENDIX D

FEEDBACK TEMPLATE QUESTIONS

1. Compared to in-person training, in your opinion what were the advantages and disadvantages of completing a training online?
2. Were there tasks that were difficult to understand in the online training?
    a. If yes, did this session answer them?
    b. Would you have preferred an in-person meeting?
3. Do you have feedback on the usability of CourseSites (LMS)? (what was easy/hard to use?)
4. Did you have any technical challenges during the training?
5. Was your internet connection sufficient to see the training without any challenges?
6. Was it easy to see the lectures (volume, quality on your computer screen)
7. The first email that was sent had a link to a video on how to use CourseSites
    a. Did you watch the video?

b. Was it helpful?

8. How much interaction did you have with other participants? Would you have liked to interact more/less?
9. Would you have liked to interact more/less with the trainer in the study?
10. Any other feedback you would like to share?

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