Development of a Low Tech Assistive Technology Kit

An Interactive Qualifying Project (IQP) Report

March 5, 2015

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ABSTRACT

This project's goal was to develop and implement a low-tech assistive technology kit in collaboration with the Seven Hills Foundation. The kit will be used to assemble AT solutions to help these individuals achieve independence. We conducted site assessments and assembled solutions with the staff and participants of Seven Hills. Ultimately, we found that our kit will not be beneficial to all participants due to the variation of disabilities between each individual and will need to be personalized.

ACKNOWLEDGEMENTS

We would like to thank several people who were instrumental to the completion of our Interactive Qualifying Project. First, we would like to give a very special thank you to Jean Des Roches, our sponsor contact from the Seven Hills Foundation. She allowed us to take control of the project, was very helpful with scheduling all meetings and important events throughout the term. Jean Des Roches maintained great communication with our team and had helpful insight during the project. This project would not have been as successful without her help. We would like to thank Alissa Rivard and Catherine Joseph whom were helpful in setting up the participant training session and completing our site assessment of ASPiRE! Worcester. We would also like to thank the staff and participants who took part in our training sessions. Finally, we would like to thank our advisors Angel Rivera and Robert Traver for their guidance in completing this project.

EXECUTIVE SUMMARY

About the Problem

Individuals affected with developmental disabilities are at a disadvantage in their daily lives. According to the 2010 U.S Census Bureau, 56.7 million out of 310.5 million Americans suffer from a physical or cognitive disability. Thus, nearly 1 in 6 people in the United States have a developmental disability. Developmental disabilities hinder these individuals' ability to perform daily activities such as eating or brushing their teeth.

The Seven Hills Foundation is a non-profit organization that strives to help people with developmental disabilities. In 2012, they established the ASPiRE! program to help their participants achieve the independence they deserve. With dozens of different activities, each participant has the ability to choose which activities they participate in based on their interests. Seven Hills is moving in a direction to increase the autonomy of these individuals to help them gain confidence and achieve independence.

About the Project

In order to accomplish their mission, the Seven Hills Foundation and the Worcester Community Project Center, an affiliate of Worcester Polytechnic Institute (WPI), assigned us the task of developing and implementing a low-tech assistive technology (AT) kit. The kit contains many tools and materials to assemble low-tech AT solutions. Examples of solutions that can be built using the kit's components are a twist-tie modified marker grip, a table-top cane holder and weighted utensils. The staff and participants of the Seven Hills Foundations will use this kit to build solutions that can help these individuals with disabilities in their daily lives. It will make many daily activities easier, instill confidence in the participants and overall allow them to live more independent lives.

Methodology

To achieve our goal, we first completed the three objectives listed below. Completing each objective required conducting various methodological strategies including interviews, site assessments and staff presentations.

OBJECTIVE 1: ASSESS THE BASELINE NEED

In order to assess baseline need for the kit, we conducted a study to quantify the prevalence of physical and cognitive disabilities at the ASPiRE! Program. The study involved

interviewing staff at ASPiRE! and observing the participants at the facility. From the study, we determined that all participants had a cognitive disability and 75% of them also had a physical disability. Due the wide variety of disabilities that the participants have and the varying degrees to which their lives are affected by their disabilities, we decided that the kit would include general solutions that would be useful to most participants. The solutions will mostly cater to the physical disabilities of the participants as it is difficult to use low-tech AT to help individuals with cognitive disabilities.

Objective 2: Develop the Kit

When developing the low-tech AT kit, we used Dr. Willkomm's book *Assistive Technology Solutions in Minutes Book II* and supplementary online research as sources for potential solutions. We then created a rubric and used it to evaluate our potential solutions. The rubric was used to assign each solution a score from 1 to 9 in the following categories:

- Frequency of use
- Impact on lives of participants and
- Convenience of assembly.

To ensure that we did not exceed our prototype development budget of $500 we selected only the highest scoring solutions for inclusion in the kit. We created a bill of materials that listed the materials and tools needed for the kit along with costs and vendors. These tools and materials were then purchased and included in our kit.

Objective 3: Implementation

We chose training sessions as our method for implementing our AT kit. We held two training sessions at ASPiRE!. Our first training session was for the staff. During this training session, we introduced our project, taught the staff how to build a few simple solutions and got feedback on how to improve the kit. Our second training session was for the participants and was used to teach participants to build a few simple solutions.

Key Findings

Completing the objectives mentioned above uncovered various findings that allowed us to develop the kit for the Seven Hills Foundation.

We have found that the low-tech AT kit will leave an impact on many participants. The proto-type was able to contain the materials to construct 90% of the solutions in the book *Assistive Technology Solutions in Minutes: Book II*. Some of the solutions have proven to be versatile and customizable, particularly those for loc-line and twist ties. They can be adjusted for length and size to fit different participants and varying degrees of motion. From a participant training session, we saw the impact these solutions had on them. We assisted these individuals in assembling various solutions that they utilized to overcome specific challenges they each faced. The participants responded with joy and excitement. They gave us their own feedback that they liked using the solutions better and it helped them. It was clear that the kit will be used to help these individuals in some ways.

Unfortunately, some of the solutions in the kit are difficult to be constructed by the disabled themselves. A site assessment at the ASPiRE! building has shown that we overestimated the capabilities of the disabled. All of the participants exhibit some form of cognitive disability. This makes it difficult for them to construct the more advanced solutions. There are also certain physical disabilities that would prevent the users from constructing their own solutions. Finally, due to the variation of disabilities and severity between individuals, our kit will not be beneficial to all participants. Therefore the kit will be unable to promote independence to the degree we had hoped.

Finally we estimate the kit to cost roughly $300. The prototype itself was found to be rather expensive. We attribute this to the shipping costs and the quantity some items are sold in. Some of the materials are sold in quantities large enough to satisfy three kits over. Materials and tools are also sold over different vendors, some unavailable locally. This leads to shipping that can be greater than the cost of the object itself. We have found it to be better to buy locally whenever possible and to expect an excess in some materials.

Recommendations

Using our findings, we offer recommendations on how to improve our study as well as possibilities for future studies.

Based on the finding that there is a large variation of disabilities between individuals we recommend that the Seven Hills Foundation optimizes the personalization of kits. Different kits should contain different tools and materials in order to assemble AT solutions that address their personal needs. One way to simplify the process of personalizing kits is to create an AT solution

database. Using the database, you can apply a filter of a disability, impairment or challenge. It will then show you solutions that can help address the problem you wish to address. Information with the solution name includes materials and their costs, vendors, instructions and similar solutions. The database should be easy to modify to allow the staff or participants to add solutions which they have researched and wish to create.

The prevalence of iPads to address cognitive disabilities for the Seven Hills participants led us to recommend a high-tech project involving iPads. We found that each iPad has its own set of applications. This makes it difficult for staff to find an app that a single participant may need to communicate or to use for entertainment. A project should consist of linking all iPads to contain the same apps and provide a layout to organize these apps for ease of use by the staff and participants. The project deliverable should also include recommendations for other helpful apps and the development of an app based on research and staff/participant needs.

Our final recommendation is to buy items in bulk and store them in one location. This will make assembling the kits much easier and optimize personalization. When considering a kit for a specific participant, one can easily assemble their kit with only the materials and tools necessary to address their individual challenges. Assembly of the kits in a Seven Hills location will open up employment for the Therapeutic Works Option (TWO) program participants. It will also minimize the cost to produce one kit by reducing per unit pricing and also avoiding unreasonable shipping prices.

AUTHORSHIP

Overall, the major chapters of this report were drafted by all members of the team. The drafting of this report was divided relatively evenly. However, most of the sections did have one or two primary contributors to drafting as well as to editing.

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Literature Review	Kevin Lou	Kevin Lou
Methodology	Nathan Ghion	Nathan Ghion
Findings & Discussion	Kevin Lou	John Valley
Recommendations & Conclusion	Dalton Oakley	Dalton Oakley
Appendix A	John Valley	All
Appendix B	John Valley	Nathan Ghion
Appendix C	Dalton Oakley	All
Appendix D	Kevin Lou, Nathan Ghion	All
Appendix E	John Valley	All

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CHAPTER ONE: INTRODUCTION

Americans affected by physical and mental disabilities are disadvantaged in society. Their disabilities make it difficult to perform daily routines. Fortunately, there are ways to help overcome this challenge. The Seven Hills Foundation in Worcester is dedicated to ameliorating impaired individuals by using assistive technology. The Foundation has been providing services and support for people in need since 1951. Seven Hills focuses on "empowering individuals with disabilities to live more fulfilling lives by becoming members of their respective communities through individualized supports and services" (Seven Hills Family Services, 2014). Their mission is to help those with disabilities or crippling ailments pursue a healthier and more independent life-style. This organization aspires to become a national leader in health and human service agencies that are addressing unmet community needs.

Seven Hills Family Services, an affiliate of Seven Hills, created the ASPiRE! program to promote the independence of its participants. For the disabled, greater independence can lead to higher self-esteem and require less supervision. Participant' independence will also allow Seven Hills Family Services to better allocate the time of its professional caregivers. In addition, the Seven Hills Family Services time could be used more efficiently by also supporting family members of the participants. Seven Hills Family Services is considering low-tech assistive technology (AT) as a way to help its participants achieve this independence.

Our goal is to develop and implement an AT kit for Seven Hills Family Services. Such a kit would feasibly contain basic tools and materials that can assist individuals in daily routines. We will also train the staff of ASPiRE! to effectively use the kits with participants. While low-tech and locally produced, we expect these kits to make a difference in the autonomy of the lives of the participants.

CHAPTER TWO: LITERATURE REVIEW

The following chapter examines key topics that are relevant to the scope of our project. It begins with a description on the ASPiRE! program of the Seven Hills Foundation and the major stakeholders that will benefit from our project. In this chapter we investigate types of developmental disabilities, and their associated educational strategies for participants and their care-takers. This chapter concludes with relevant case studies featuring the challenges facing disabled individuals, assistive technology options and successful educational strategies.

2.1 ASPiRE! Program description and Stakeholders

"ASPiRE! Worcester has modernized the way that habilitation, workforce readiness, and employment services are typically offered by promoting personal choice and self-determination in a more dynamic and dignified, community-driven environment for the disabled participants" (Seven Hills Foundation, 2014). The agency is a model for Innovative Lifelong Learning in a self-directed program available only through ASPiRE!. The ASPiRE! program provides individuals with disabilities access to opportunities for the development of skills necessary to pursue their areas of interest.

The participants are encouraged to independently choose which programs they will participate in each day. Programs include, Workforce Readiness & Employment, Sports/Internet Café, Ceramics Studio, Art Studio, Music Studio, Technology Center, Health and Wellness Center, and a Radio Station, among others. The variety of options allows more participants to have greater autonomy in their daily lives.

The Workforce Readiness & Employment program is among the most sought out in ASPiRE!. The program provides vocational training, education, and job placement services for adults seeking employment-related services including:

- Functional vocational assessment
- Career planning
- Resume development
- Job-specific training
- Job placement
- Specific skill development
- Benefits education/coordination (Seven Hills Foundation, 2014)

The activities prepare participants to obtain and maintain the highest level of competitive and

meaningful employment.

Our project will engage disabled participants in the ASPiRE! program to promote their independence. Other stakeholders affected by the development and implementation of an AT kit will be those who have close relationships with the participants. These stakeholders include the staff of the ASPiRE! program as well as other caregivers, and the friends and family of the participants.

2.2 Developmental Disabilities

To better understand the range of capacity and challenge facing our clients, we need to review the various types of disabilities and the practical reality of disability studies. According to the Developmental Disabilities Assistance and Bill of Rights Act, a developmental disability is defined as a disability that "originated at birth or during childhood, is expected to continue indefinitely, and substantially restricts the individual's functioning in several major activities" ("About Developmental Disabilities," 2014). Developmental disabilities are the result of a mental or physical impairment or a combination of both that begins before an individual reaches the age of twenty two (Services, 2014). These disabilities result in significant limitations in three or more of the following: "self-care, receptive and expressive language, learning, mobility, self-direction, capacity for independent living and economic self-sufficiency" ("About Developmental Disabilities," 2014). According to the CDC, 15% of children aged 3 through 17 years in the USA have one or more developmental disabilities ("CDC - Developmental Disabilities, Facts - NCBDDD," 2014). These conditions tend to last a lifetime and depending on the severity of the condition, can inhibit a person's ability to function normally. As such, it is important to address these problems and maximize the individual's ability to contribute to society and have a sense of accomplishment.

There are a number of conditions that qualify as developmental disorders, including autism, ADHD, cerebral palsy, learning and intellectual disabilities. Based on how they affect lives, developmental disabilities can be classified as either physical or cognitive. A physical disability is any bodily impairment that can limit an individual's ability to be independent. Examples of physical disabilities include hearing loss, impaired vision and paralysis. Paralysis can range from limitations in using one hand to the inability to use any body part. Disabilities such as hearing loss or impaired vision make it harder for the affected to hear and see. This makes it harder for them to do simple things such as crossing a street. However, assistive

technology such as hearing aids and prescription glasses can be used to help people hear and see better respectively.

A cognitive disability is any disability that limits an individual's cognition. The cognitively disabled have problems with a vast array of mental abilities related to attention, memory, judgment, reasoning, problem solving and comprehension. For example, Intellectual Disability is a disability that limits an individual's ability to "learn at an expected level and function in daily life" ("CDC - Developmental Disabilities, Facts - NCBDDD," 2014). An individual is said to have an intellectual disability if he or she has an intelligence quotient less than or equal to seventy. Children with an intellectual disability find it difficult to communicate their wants and needs and can take longer than their peers when learning to "speak, walk, dress or eat without help" ("CDC - Developmental Disabilities, Facts - NCBDDD," 2014). Intellectual disability has a multitude of causes such as injury, disease, birth defects, infections and cognitive disabilities such as Down Syndrome, Fetal Alcohol Syndrome and Fragile X Syndrome ("CDC - Developmental Disabilities, Facts - NCBDDD," 2014).

2.3 Assistive Technology

Assistive technology (AT) devices are used to help obtain normal bodily function for disabled or rehabilitating people. The level of technology is categorized into non-technical, as in a cane, low-tech, as in a tape recorder, and high-tech, as in a tablet (Edge & Kroth, 2007). In this way, AT is designed to address either physical disabilities, cognitive disabilities, or both. We have listed several examples below that illustrate low-tech solutions (see figures 1-3).

Figure 1: Example of low-tech AT solution-Prescription glasses

Figure 2: Example of a low-tech AT solution-iPad stand

Figure 3: Example of a low-tech AT solution-Wheelchair

Cognitive AT is used as an educational tool and to promote self-determination. Computer programs serve to educate, help rehabilitate, and assist in day-to-day activities (Katsioloudis & Jones, 2013, p. 26). People with speech impediments and communicative disabilities rely on augmentative and alternative communication (AAC) technologies (Beukelman, Fager, Ball, & Dietz, 2007). The programs used to help cognitive disabilities include text to speech or speech to text programs, known as speech-generating devices (SGD) (Katsioloudis & Jones, 2013, p. 26). These programs are highly prevalent in devices like smart phones and iPads. Cognitive AT targets those that have difficulty learning or communicating.

Physical AT addresses shortcomings in mobility and perception (NICHD 2012). High tech solutions can be envisioned in ongoing research such as the neural interface systems that

repair nerve damage and regain body functions (Hochberg, Donoghue, Nurmikko, Black, 2007). Cowan et al. (2012) touched on high tech prosthetics that involves nervous system interfaces and computer-vision enhanced controls. However, these solutions require more advances in technology. Prevalent forms of physical AT are low tech and include devices like glasses, wheelchairs, and canes. The kit will contain AT solutions such as iPad stands, pencil grips, and cane holders.

2.4 Education of Disabled Individuals

A key component of the project is to teach the participants how to use the AT kit. It is imperative to have patience and provide care to these participants (Tayman, 2010). Each individual with disabilities has a unique set of strengths and weaknesses. Time should be spent to learn about each participant and ensure that instructions to build the solutions are understood (Taymans, 2010). A concept known as self-determination, to be discussed later, will provide the framework for teaching the participants how to use the kit to make AT solutions.

2.4.1 Self-Determination & Its Importance

Field, Martin, et al. (1998, p. 2) defined self-determination as "a combination of skills, knowledge and beliefs that enables a person to engage in goal-directed, self-regulated, autonomous behavior". In simpler terms, self-determination includes all of the necessary components for an individual to have an independent life. The most prominent model of self-determination was created by Field & Hoffman. This model identifies six elements that lead to the development of self-determination (Field &Hoffman, 1994). Figure 4 depicts the six attributes of the self-determination model.

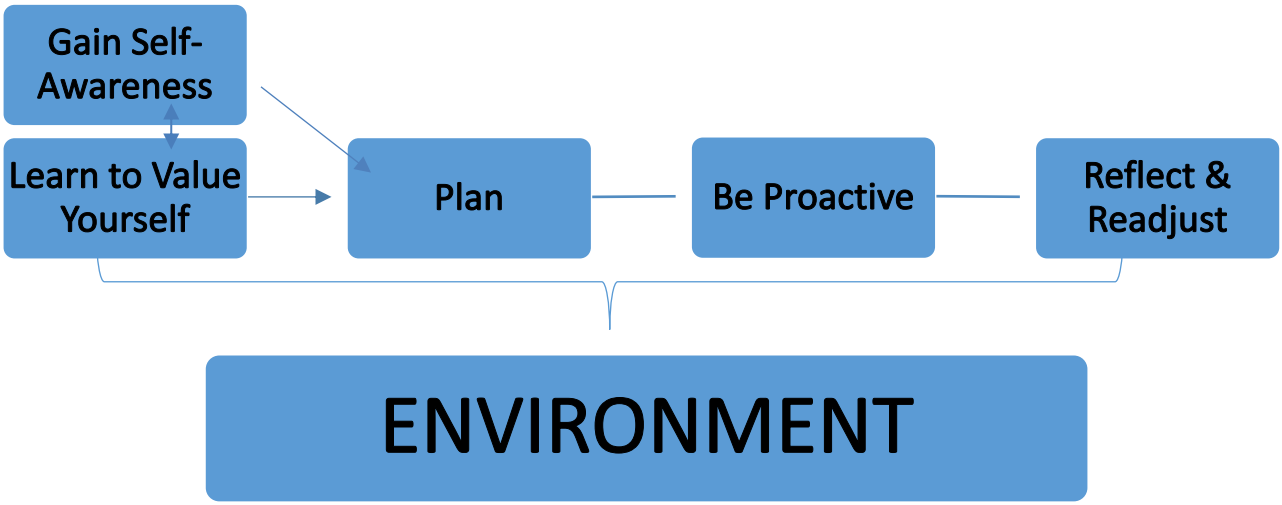


Figure 4: Adapted from Field & Hoffman's self-determination model (1994)

‘Gaining self-awareness’ and ‘learning to value oneself’ are the foundation of self-determination (Taymans, 2010, p. 20). By building this foundation, the individual can continue to develop the necessary skills to ‘plan’, ‘be proactive’, and ‘reflect & readjust’. The individual’s environment, including family, friends and teachers, directly affects an individual’s development of self-determination. Environmental influences can either inhibit of promote development.

The establishment of self-determination in individuals with disabilities is important for both legal and social reasons. Legally, individuals with developmental disabilities have the right to receive federal assistance. However, the individual must provide documentation of his or her disability and fully disclose all strengths, weaknesses, limits and needs in order to receive accommodations (Gerber & Price, 2005). Self-determination gives the individual the ability to fully disclose this information because he or she is aware of his or her capabilities. Socially, self-determination can also help an adult with disabilities adjust and prepare to seek employment (Tilson & Hathaway, 2010). The confidence that is developed with self-determination helps and individual overcome social challenges.

2.4.2 Promoting Self-Determination Using Educational Practices

There are three basic practices to promote self-determination in education for adults with disabilities (Gerber, 2009; Hock, 2009; Swanson, 2009). The three practices are (Taymans, 2010, pp. 21-24):

1. Direct Teaching of Self-Determination
2. Infusion of Self-Determination Activities
3. Integration of Explicit Instruction and Accommodations

The first practice involves promoting skills that are applicable to all adults with disabilities. A teacher develops a curriculum full of lessons that teach these skills. A few of these general skills include self-awareness, goal setting, stress management, and communication. These skills and others can build a foundation of self-determination for individuals with disabilities.

In some cases, self-determination cannot be taught directly. The second practice involves creating educational activities that focus on the attributes of the self-determination model. Wehmeyer and Field (2007) have developed many examples of activities that do this. An example activity that emphasizes the ‘plan’ attribute is to give the participants a task and have them develop a plan of action. Other examples include asking the participants to identify their

strengths or providing examples of renowned individuals who have overcome major challenges to obtain success. These examples help the participants 'gain self-awareness' and 'learn to value oneself.'

The third practice is based on explicit instruction and accommodations. Explicit instruction uses task-analysis to choose a specific task to be accomplished by an individual. A detailed, or "explicit," set of instructions will be provided to explain how to complete the task. Hock (2009) noted that it is important for the teacher to provide clear explanations, demonstrate with a visual model of each step, be patient and practice with the individual, and give positive and helpful reinforcement. Alterations in the explicit instruction accommodate for the differences in strengths and weaknesses between individuals (Taymans, 2010). This establishes a personal relationship between the teacher and the learner that makes it easier for the participant to learn.

2.5 Case studies

We identified three case studies to help further our project. The first case study informed us on the usage of assistive technology that help with physical disabilities. Case study two provided an example of communication methods between individuals with disabilities and their care-givers. The final case study describes an AT kit that included lessons and materials to educate children with disabilities through an interactive and musical experience.

Case Study 1: Lasting Effects of Assistive Technology

Demers et al. (2008) conducted a study on the persistence of assistive technology (AT) post prescription. The goal was to determine the dependence of patients on their AT. The researchers found that only 23% of the patients continued to use the provided AT five weeks after their discharge from the hospital. Their findings show that, "participants with a neurological diagnosis were highly prevalent … involving the continued use of the AT procured at onset" (Demers et al., 2008, p. 80). The cognitively impaired continue to use the provided AT. Orthopedic patients tend to discontinue using the provided AT. This suggests that subjects with mental disabilities require and grow more dependent on their AT than physical disabilities. Rehabilitating patients are quicker to dispose of their physical AT completely or replacing them with other forms of AT. With this in mind, solutions will be chosen if they will be used frequently over a long period of time.

Case Study 2: Communicative Signs

Darren Chadwick (2008) observed the different effects training made over a six and

twelve month period on caregiving staff of various ages and genders. The effectiveness of training is measured by the staff's ability to reproduce twenty core hand signs. The staff was split into two groups of thirty, one received various methods of training, and another received no training. Findings show that those that received training performed significantly better. Surveys were also conducted where results showed positive feedback on the amount of different methods of training used, including formal training, videos and cards. However, while awareness of the signs was raised, staff did not incorporate them into daily use. Light et al. (1992) suggests this might be due to the staff being unaware of the effectiveness of AAC with the patients. Chadwick (2008) also offers the explanation that the staff were embarrassed to use signs, suggesting that it may be better to train staff comfortable with one another rather than groups of individuals. This study stresses the importance of training as related to our project. The staff and participants will be trained to ensure easy, proper and effective use of the AT kit.

Case Study 3: Musical Kit and Method

Marie Logan explained how she used her own experience to develop a music-based curricula and the materials needed to engage children with severe developmental delays and disabilities to participate in activities through the sharing of music (Logan, 2001). She invented a method and kit for teaching disabled students through music. The kit includes a wide use of an illustrated songbook and individual sound recordings of songs with lyrics. The children find the pages of the songbook with the recordings of the songs using icons or graphic images. Her method permits the students to find the appropriate page in the song book for following along as the selected song is being played, while also allowing the students to choose their favorite song selections to be taught. The method and kit also provide the instructor with recommendations of activities for engaging the students. These activities are specific to the selected song being heard. The most important concern for Logan was to create the methods and materials that prompt a generally non-communicative child choose the song that he or she would like to understand. This encourages participation in activities through the sharing of music, and teaches the disabled child some measure of subjects including reading, counting and number recognition, group skills, interpersonal skills, leisure skills and critical thinking skills (Logan, 2001). This method created an alternate method for teaching disabled students and creating independence. According to the comments about this invention, several teachers were very satisfied with the student’s positive results (Logan, 2001).

2.6 Summary

Through our research, we identified four key concepts to better comprehend our assistive technology project. First, we differentiated between physical and cognitive disabilities. Second, we identified the types of assistive technology used to support and help those with disabilities. Third, we learned through the Musical Kit case study that interactive demonstrations on how to use the kit could be effective. Finally, we acknowledged that when educating adults with disabilities it is important to instill confidence through the development of self-determination.

CHAPTER THREE: METHODOLOGY

The goal of our project was to develop and implement a low-tech assistive technology (AT) kit to promote independence in the participants of ASPiRE!. The following objectives directed the choice of methods:

1. Assessing baseline need for the kit
2. Developing the kit
3. Implementation of AT kit

3.1 Objective 1. Assessing Baseline Need the Kit

As requested by the Seven hills Foundation, we made an AT kit that will help developmentally disabled participants of the ASPiRE! Program achieve more independent lives. To make an AT kit that suits the needs of the stakeholders we first assessed the type of disabilities the participants of the ASPiRE! Program experience. Based on the type of disabilities, we evaluated which AT solutions would provide the most use, impact, and convenience for Seven Hills.

Our team conducted a study among the ASPiRE! participants to quantify the prevalence of each major type of disability, physical or cognitive, at the ASPiRE! Program. The study involved interviewing staff at ASPiRE! and observing the participants during their daily routines at the facilities. We observed the participants' interactions with the staff, how they learned and the level of complexity of the tasks that they are capable of performing. From the study, we determined that all participants had a cognitive disability and 75% of them also had a physical disability. Due the wide variety of disabilities that the participants have and the varying degrees to which their lives are affected by their disabilities, we decided that the kit would include general solutions that would be useful to most participants. The solutions will mostly cater to the physical disabilities of the participants as it is difficult to use low-tech AT to help individuals with cognitive disabilities.

3.2 Objective 2. Developing the Kit

When developing the low-tech AT kit, we conducted research to find potential solutions that could be included in the kit. We then created a rubric and used this rubric to evaluate potential solutions. The budget provided by the agency was $500; therefore development of the prototype could not exceed this limit. After a cost analysis was completed, the most feasible

combination of low-tech AT solutions was chosen for inclusion in the kit. This cost analysis is shown in Appendix C.

We used Dr. Willkomm's book *Assistive Technology Solutions in Minutes Book II* and supplementary online research as sources for potential solutions. Then we evaluated all potential solutions. Scores were assigned to each potential solution based on a rubric we created. It is shown below in Figure 5. It was used to evaluate AT solutions based on convenience of assembly, impact on lives of the participants and frequency of use. It was used to assign each solution a score on a 1 to 9 scale in each of the three categories. Solutions that earned a score of 7 or higher in two or more of the categories were chosen for inclusion in the kit. The tools and materials needed to build these solutions were then purchased and placed in the kit. Feedback and suggestions from caregiving staff at ASPiRE! were also used in determining the final components of the AT kit.

	1 (low priority)	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9 (high priority)**
Convenience	Hard for able bodied staff to construct. Requires multiple attempts and improperly assembled solution.		Hard for staff to construct. Multiple attempts, effectively assembled solution.		Easy for staff to construct. Couple attempts, effectively assembled solution.		Hard for users to construct. Multiple attempts, improperly assembled solution.		Easy for the users to construct and utilize the solution themselves.
Impact	Minimal improvement of life quality and independence.		Slight improvement of life quality and independence		Major improvements of life quality and independence.		Major improvements, positive user response.		Virtual necessity. Positive user response.
Frequency of use	Once a month or greater		3 weeks		2 weeks		Weekly usage		Daily use

Figure 5: Rubric for evaluating AT solutions.

3.3 Objective 3. Implementation of AT Kit

Two training sessions were conducted for the staff and participants. The first training session included only staff and the second included participants supervised by staff. The use of a

training manual helped demonstrate solutions in the sessions. Lastly, an open discussion with the staff was used to determine the effectiveness of the kit and modifications were made to the kit based on feedback.

The first training session presented the kit. We showed the prototype of the kit, materials included, and why we chose the materials. We introduced the AT book and showed how our kit integrates these solutions. We showed the staff how to construct a few AT solutions using Industrial Twist Ties. The staff was able to recreate these solutions during the session. We held an open discussion with the staff and asked for feedback on our kit. The staff supplied feedback on the degree of fit between the components of the kit and participants' needs. Modifications were made to the kit based on feedback.

The participant training session was similar to the staff training. Likewise, the kit and materials were introduced. Next, we demonstrated solutions from the AT book. In this session we provided the participants with specific materials and tools to create AT solutions. Hands-on demonstrations were more effective than verbal explanations. The participants were walked step by step through various solutions and asked to give feedback on those solutions. Feedback from both training sessions can be seen in Appendix B.

A training manual was included in the kit. This manual has a list of each of the final solutions as well as where they can be found in the book. We also included the page number in the book where the solution is made along with tips on how to use different tools and materials in the kit. An assembly guide was included in the kit. This is a detailed step-by-step guide on how to create the kit itself. This was necessary to include because the kit will be made numerous times and we want to ensure all the requirements of the kit are met for each replication. The assembly guide and training manual are shown in Appendix D and E respectively.

3.4 Handling Our Data

All data collected during the project was kept on a laptop of one of the group members. It was encrypted and protected with a password. While any interviews were being conducted, the interviewee was asked for permission to record the conversation. Any direct quotes from an interview were sent to the individual being quoted and only used if that individual approved. The data was kept until the end of the project and then destroyed.

During a site assessment of the ASPiRE! Program site, we investigated the types of disabilities of each participant and determined if each disability can be classified as physical,

cognitive or both. However, the anonymity of every participant was protected. This information will not be used outside of the context of the project and the individual participants will not be able to be identified based on our data or writing

3.5 Project Timeline

Figure 6 shows a week-by-week timeline of our main objectives and major tasks that we completed during the project. It breaks the project down into a seven-week timeline and the black boxes indicate which tasks we completed in the corresponding weeks.

WEEK / TASK	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Determine Baseline Need	■	■					
Choose & Evaluate Solutions		■	■	■			
Build Prototype				■	■		
Implementation					■		
Assess Cost						■	■

Figure 6: Timeline of our project.

Chapter Four: Key Findings & Discussion

In this chapter, we discuss our findings. First, we will discuss findings from the site assessments that we conducted. Second, we will discuss the findings related to the cost of prototype development. This chapter concludes with the feedback that we received from the staff and participants of ASPiRE! after initial implementation of the kit.

During our site assessments of ASPiRE!, we learned that every participant had a cognitive disability. This inhibits them from constructing the more complex AT solutions. The participants have varying degrees of cognitive disabilities so not all of them are capable of constructing the simpler solutions. For that reason, staff will be expected to construct the solutions the participants cannot. This will limit to a degree both the increase in participant independence and the better allocation of caregiving staff's time that we hoped our kit would provide. However, we feel that once solutions are made, greater independence will be reached by the participant. Most participants are capable of using the solutions effectively.

We found that customizing our kit for participants with specific disabilities was impractical due to the large number and degree of disabilities found at ASPiRE! However, the kit will still remain versatile and provide general solutions that can be used by most participants. Several solutions can be created multiple ways. This allows certain materials to be substituted by cheaper, more accessible materials. Finally we have found that stocking single kits with materials to be cumbersome and expensive. One way of reducing the cost is to buy materials in bulk for multiple kits.

However, the proposed kit provides generalized solutions. The site assessment gave us an estimate of 45 participants with physical disabilities. We have found there to be enough variation between each participant that specialized solutions and materials cannot be included. Fortunately, the problems created by the disabilities have similarities. We have noticed a significant number of participants confined to wheelchairs and a large dependency on iPads. Solutions that assist these groups of participants will have more importance. Problems unique to individuals will be considered but will not be a focus of the kit. Our kit will be designed to assist the greatest possible number of participants.

Certain solutions are disregarded because the small impact they have on participants. Using the rubric introduced in the 'Methodologies' section of this report, we ranked possible AT solutions as well as those found in the book, *Assistive Technology Solutions in Minutes II*. We

have found some solutions to be too complex to build on a regular basis or irrelevant. For example, one solution was a leaf blower attached to a wheelchair. This solution was too complicated to create. As a result, this solution and similar solutions are excluded from the kit.

Specific materials and tools are our first priority. Most of the raw materials needed are cheap and available in bulk. Some of the solutions can be constructed in multiple ways. This allows the materials that are harder to acquire to be substituted with more accessible materials. The numerous types of tape and Velcro included are interchangeable. Velcro has replaced dual-lock, BB rounds replaced buckshot, and PVC can replace loc-line. A few solutions demand specific materials that cannot be substituted with others. This includes the wheelchair bracket, loc-line, and PVC. These solutions can also be impossible to construct and customize without the use of hardware tools. To name a few, the flashlight, micro torch, automatic wire stripper, scissors and ratcheting PVC cutter. By prioritizing the essential solutions, we have decided upon the materials and tools to include in our kit. A detailed list can be found in the appendix.

While constructing our prototype we have also found that it is better to buy materials in bulk. The materials sold are often through multiple vendors making shipping costs high. Only 40% of the materials were sold locally. The remaining 60% of materials were purchased online. We found that supplying a single kit will have shipping costs that outweigh the cost of the actual materials. For example, the shipping was $17 from modular hose, while the loc-line material purchased was $20.

The staff and participant training sessions provided our team with useful findings. The staff provided our team with suggestions on how to improve our kit with the focus of ASPiRE! participants in mind. Some suggestions included fine tuning certain solutions to better fit the needs of the participants. For example, one suggestion was to lengthen the loc-line for the wheelchair iPad holder. This will allow the participant to mount the iPad holder anywhere on his/her chair comfortably. Another important finding was to include a bill of materials in every kit. The bill will include the item, how much of it, price and where it was purchased. This will make purchasing new materials easier for the staff. Lastly, we found that by labeling the tools and materials in the kit, navigating the kit would be significantly improved. Labels would have page numbers directing to the book about how to use each tool.

CHAPTER FIVE: RECOMMENDATIONS & CONCLUSION

Chapter five summarizes our findings discussed in the previous chapter. We provide recommendations based on these discoveries. Our recommendations include suggestions for how to revise our current study as well as launch new studies.

Recommendation 1: Highly Personalized Kits

The site assessment of ASPiRE! Worcester helped us realize that the kit which we have developed will not be able to cater to all individuals. This is due to the varying degree of disabilities between each participant. One recommendation stemming from this finding is to develop highly personalized kits. The idea would be to target a small group of individuals with similar disabilities, or even a single participant. The kit can then be filled with tools and materials to build solutions that will cater to the target's needs. In this case, more personalized kits would leave much larger impacts on the individuals because they are specific to his or her needs. However, this approach would be expensive because many different kits would need to be developed for different participants or groups. This is an impactful, yet expensive option.

Recommendation 2: AT Solution Database

Another option to address this issue is to create an AT solution 'database' after the development of our AT kit. This database would use our kit as a foundation for personalized expansion. The database would consist of a list of AT solutions that are found in research. Each solution would be provided with a list of materials, instructions if available, source such as a book or a website, and the disabilities or impairments that it can help address. Our kit will provide some near-universal solutions to help many participants, but also provide storage additional tools and materials to be purchased for assembling additional solutions. With such a database, staff or participants can look up included solutions that address a specific need. For example, if someone searched for "Tremor in hand(s)" they would see information for the 'Weighted Utensils' solution detailed in *Assistive Technology Solutions in Minutes: Book II*. The database should be simple to use and to modify in order to add any solutions that staff or participants have found through research. To enhance the usefulness of this database, it should be developed as an app for an iPad to be used in cooperation with AT kits.

Recommendation 3: High-tech AT with iPads

A piece of information that we learned during our site assessment is that the Seven Hills Foundation uses iPads as an effective high-tech AT solution. Using various memorization and

communication applications (apps), their use of iPads assist participants suffering from cognitive disabilities. Unfortunately, even though there are many iPads available, each has different apps. This makes it difficult to provide participants with an iPad that has a communication or memory-developing app on it who need these in certain situations.

A future project that we suggest is to study this high-tech aspect of Seven Hills. Research should be conducted to learn about the apps that are used to help address cognitive disabilities by Seven Hills. The project should also require research about iPads and their functions on whether or not all iPads under Seven Hills could be connected to have the same apps. This would allow a general layout to be created. It would be used to organize the apps in a way that make it easy for the staff and, more importantly, the participants to find and use the apps they require or want to use. The deliverables will be the layout, recommendations for other apps to use and the creation of an app based on research and organization needs.

Recommendation 4: Storage & Purchasing in Bulk

During the development of the low-tech AT kit, we came across some monetary limitations. Many useful materials for the kit include various adhesives. These items come in large amounts which are not required for a single kit. Also many of these materials are cheap and can be found online easily. The problem is that shipping costs were often five times the cost of the item itself. This would make the cost of a kit much more expensive than it needs to be. Thus, we recommend to use a small number of vendors that sell desired tools and materials in bulk. Buying these items in bulk will be more cost-effective when producing many kits for various programs throughout Seven Hills.

Another possibility would be to establish a space at one of the Seven Hills locations to act as storage. Materials should be purchased in bulk and stored at this location. With all of the materials in one location, the kits will be easily assembled. They can be assembled by Therapeutic Works Option employees to help some individuals with disabilities gain employment. Kits can also be tailored for specific participants by only including the materials needed for chosen solutions. This will ensure the cost to assemble the kits will be reduced to a minimum.

Recommendation 5: Phase-Two of AT Kit Project

The finding that our kit will not help all participants in the Seven Hills Foundation led to Recommendation 1, previously described above, and also to the idea of a ‘Phase-Two’ of this

project. A continuation of this project would help increase the personalization of the kit for participants, improve the kit and ultimately promote the independence of the participants even more.

One suggestion would be to conduct further supplemental research into low-tech AT solution possibilities. For our project, we primarily used the book, *Assistive Technology Solutions in Minutes: Book II*, as inspiration for solutions to include in the kit. We conducted some supplemental research and found different ways to assemble similar solutions and then bought different materials accordingly. However, further research should be conducted. A project should focus on researching AT solutions aside from those included in the book. A team should also work to brainstorm and develop a few low-tech AT solutions of their own that would address the needs of the participants of the Seven Hills Foundation.

Even though the kit will be implemented at all Seven Hills locations, we focused on implementation at ASPiRE! Worcester. In order to increase the effectiveness of the kit, a new project should target residential homes of the Seven Hills Foundation. ASPiRE! has a more freeform and autonomous structure for the participants than residential sites. Thus, to improve the kit's ability to help more participants, the needs of individuals in residential locations should be studied and addressed. New solutions should be researched and incorporated into the kit. This will allow the kit to be adapted to any Seven Hills location.

Conclusion

In conclusion, the kit was developed and implemented at the ASPiRE! Worcester site. The kit included various tools and materials that can be used to assemble low-tech AT solutions. To instruct the staff and participants in regards to building solutions, we developed an instructional document with advice about each tool and material. The kit also contains a copy of *Assistive Technology Solutions in Minutes:Book II* which provides visual and written instructions to assemble the solutions using the kit's components. In order to encourage employment for some participants, assembly instructions were included to enable TWO participants to produce the kits themselves. These documents, along with the kit, will allow participants to build solutions that will help them overcome many challenges.

We observed that the kit had an impact on a few participants during our project. Based on the potential to assemble many solutions that help individuals with different disabilities, the kit will help promote independence in the lives of many participants. However, it is important to

note that we did find that there is a large variation of type and severity of disabilities between individuals. Based on this, our kit will not be beneficial to all participants in its current state. Thus, kits should be adapted to individuals' specific needs in future projects.

REFERENCES

About Developmental Disabilities. (2014). *Institute on Community Integration*. Regents of the University of Minnesota. Minneapolis, MN. Web.

Beukelman, D. R., Fager, S., Ball, L., & DIETZ, A. (2007). AAC for Adults with Acquired Neurological Conditions: A Review (Vol. 23, pp. 230-242). Augmentative and Alternative Communication.

Blank, G. (2000). Conducting A Focus Group. *Lehigh University*.

Boedicker, L. K. (2013). Progressive Education as Continuing Education for the Developmentally Disabled. *International Journal of Progressive Education*, *9*(2), 34.

Center for Disease Control & Prevention. (2013, December). Facts About Developmental Disabilities. *National Center on Birth Defects and Developmental Disabilities*. Atlanta, GA. Web.

Center for Disease Control & Prevention. (2014, September). Attention-Deficit/Hyperactivity Disorder (ADHD). *National Center on Birth Defects and Developmental Disabilities*. Atlanta, GA. Web.

Chadwick, D. D., & Jolliffe, J. (2009). A pilot investigation into the efficacy of a signing training strategy for staff working with adults with intellectual disabilities. *British Journal of Learning Disabilities*, *37*(1), 34-42.

Cowan, R. E., Fregly, B. J., Boninger, M. L., Chan, L., Rodgers, M. M., & Reinkensmeyer, D. J. (2012). Recent trends in assistive technology for mobility. Journal of neuroengineering and rehabilitation, 9(1), 20-20.

Cuzzocrea, F., Larcan, R., & Westh, F. (2013). Family and parental functioning in parents of disabled children. *NORDIC PSYCHOLOGY*, *65*(3), 271-287.

Donoghue, J. P., Nurmikko, A., Black, M. and Hochberg, L. R. (2007). Assistive technology and robotic control using motor cortex ensemble-based neural interface systems in humans with tetraplegia. The Journal of Physiology, 579: 603–611.

Dym, Clive L. *Engineering Design. a Project-based Introduction*. New York: John Wiley & Sons, 2014.

Family Center on Technology and Disability. (2012). Assistive technology 101. Retrieved August 9, 2012.

Field, S., & Hoffman, A. (1994). Development of a Model for Self-Determination. *Career*

Development for Exceptional Individuals.

Field, S., Martin, J., Miller, R., Ward, M., & Wehmeyer, M. L. (1998). A Practical Guide to Teaching Self-Determination. Reston, VA: *Council for Exceptional Children*.

Gerber P. J. (2009). Transition and adults with learning disabilities. In J. M. Taymans (Ed.), Learning to achieve: A review of the research literature on serving adults with disabilities (pp. 211-228). *National Institute for Literacy*. Washington DC.

Gerber, P. J., & Price, L. A. (2005). To be or not to be LD: Self-disclosure and Adults with Learning Disabilities. Thalamus, 25, 18-29.

Gibson, F. W., Lawrence, P. S., & Nelson, R. O. (1977). Comparison of three training procedures for teaching social responses to developmentally disabled adults. *American journal of mental deficiency*.

Hock, M. F., (2009) Teaching methods: Instructional methods and arrangements effective for adults with learning disabilities. In J. M. Taymans (Ed.), Learning to achieve: A review of the research literature on serving adults with disabilities (pp. 183-200). *National Institute for Literacy*. Washington DC.

Janet, A. K., Mary, O., & Lisa, L. (1988). Causal Attributions of Learning-Disabled Children: Developmental Patterns and Relation to Academic Progress. *Journal of Educational Psychology, 80*(1), 82.

Katsioloudis, P. J., & Jones, M. (2013). Assistive technology: fixing humans. *Technology and Engineering Teacher, 72*(7), 26.

Light, J., Dattilo, J., English, J., Gutierrez, L., & Hartz, J. (1992). Instructing Facilitators to Support the Communication of People Who Use Augmentative Communication Systems. *Journal of Speech and Hearing Research, 35*(4), 865-875.

McNaughton, D., & Bryen, D. N. (2007). AAC technologies to enhance participation and access to meaningful societal roles for adolescents and adults with developmental disabilities who require AAC. *Augmentative and Alternative Communication, 23*(3), 217-229.

Roger, L. K., & Denzil, E. (2007). Assistive Technology and Devices. *Counseling and Human Development, 39*(9), 1.

Swanson, H. L. (2009). Assessment of adults with learning disabilities: A quantitative synthesis of similarities and differences. In J. M. Taymans (Ed.), Learning to achieve: A review of

the research literature on serving adults with disabilities (pp. 15-70). *National Intstitute for Literacy*. Washington DC.

Taymans, J. M., (2010, October). Learning to Achieve: A Professional's Guide to Educating Adults with Learning Disabilities. *National Institute for Literacy*. Washington DC.

Tilson, G. P., & Hathaway, S. (2010, January) Employment experiences and outcomes for youth and adults with learning disabilities: Status of empirical research and the implications for adult education. *National Institute for Literacy*. Washington DC.

Wagner, E. H., Austin, B. T., & Michael Von, K. (1996). Organizing Care for Patients with Chronic Illness. *The Milbank Quarterly, 74*(4), 511-544.

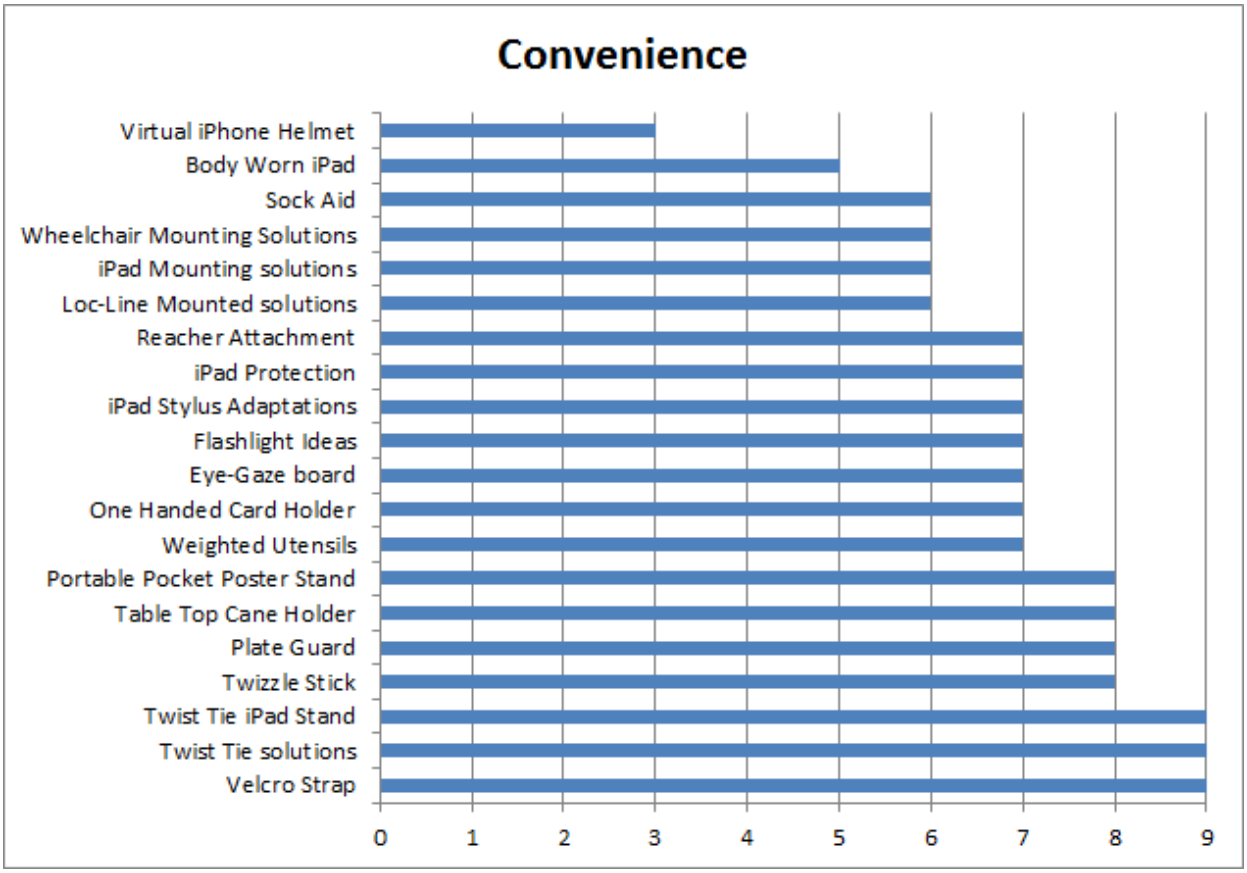
Ward, K. (2013). *Researching the City, A Guide for Students* (R. Rojek Ed.): Sage Publications.

Wehmeyer, M. L., & Field, S. (2007) Self-determination: Instructional and Assessment Strategies. Thousand Oaks, CA. *Corwin Press*.

APPENDIX A: AT SOLUTIONS EVALUATION RUBRIC & SAMPLE OF RANKINGS

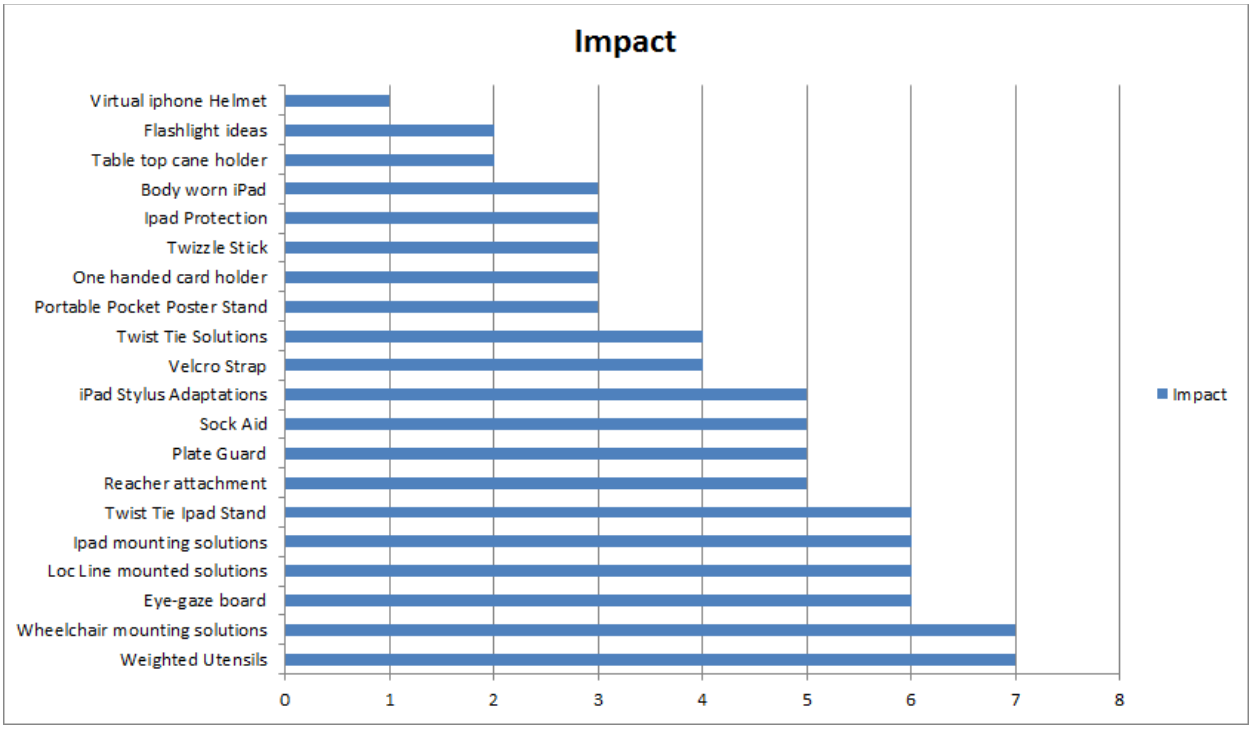
	1 (low priority)	2	3	4	5	6	7	8	9 (high priority)
Convenience	Hard for able bodied staff to construct. Requires multiple attempts and improperly assembled solution		Hard for staff to construct. Multiple attempts, effectively assembled solution.		Easy for staff to construct. Couple attempts, effectively assembled solution.		Hard for users to construct. Multiple attempts, improperly assembled solution.		Easy for the users to construct and utilize the solution themselves.
Impact	Minimal improvement of life quality and independence. Negative user response.		Slight improvement of life quality and independence		Major improvements of life quality and independence.		Major improvements, positive user response.		Virtual necessity. Positive user response.
Frequency of use	Once a month or greater		3 weeks		2 weeks		Weekly usage		Daily use

The above table represents the evaluation rubric our team used when ranking assistive technology solutions. The solutions were evaluated based on 3 categories: convenience of assembly, impact on the lives of participants and the frequency of use. Each solution would rank 1 through 9 in each of the categories. Solutions that scored a 6 or higher in at least two categories were included in the kit.



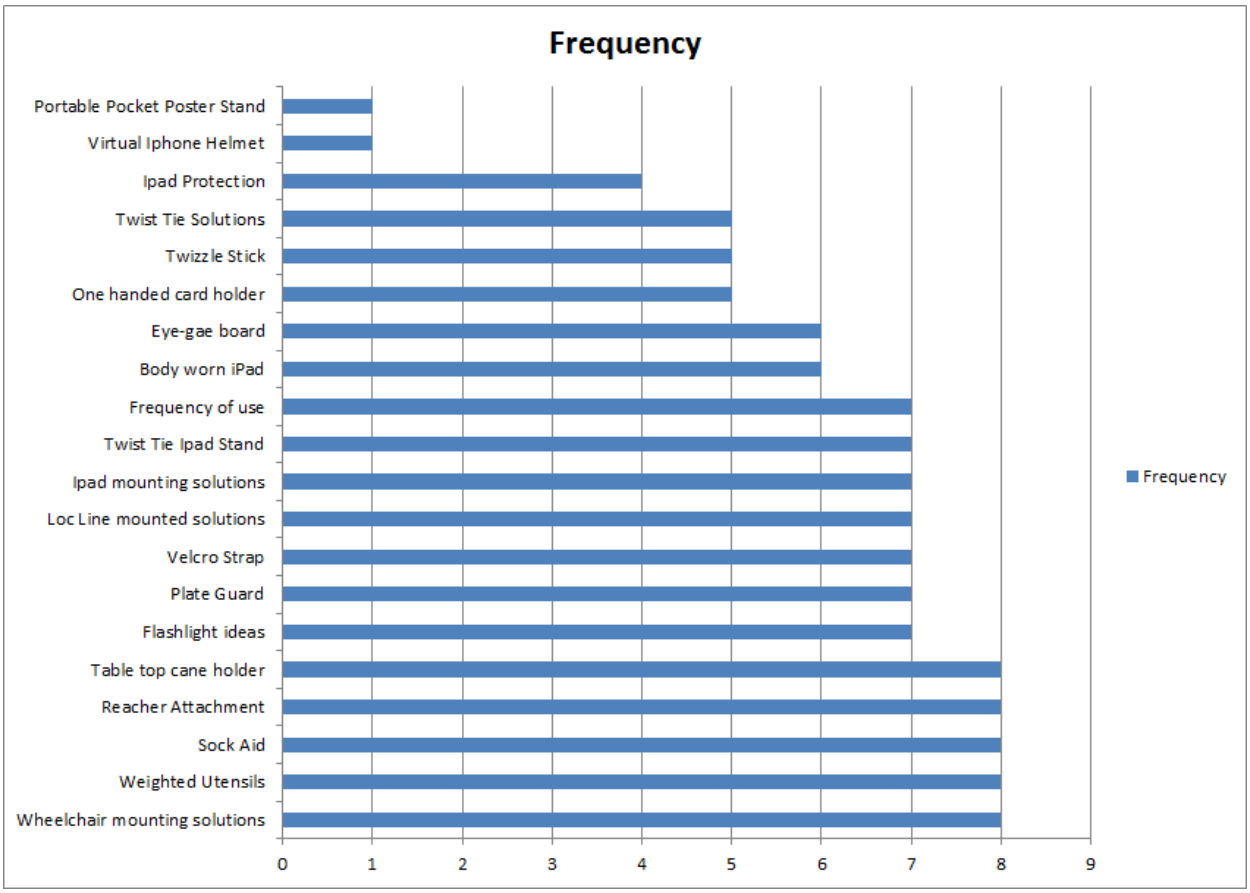
Graph 1: Convenience Ranking

Graph 1 shows how our team ranked 20 of the solutions for its convenience of assembly. This category ranks each solution based on how easily it can be made. For example, if the solution uses less materials or takes less time to create then it will rank higher and vice versa.



Graph 2: Impact Ranking

Graph 2 shows how our team ranked 20 of the solutions for its impact on the lives of the participants. This category ranks each solution based on how each solution improves the lives of and promotes more independence in the lives of the participants. For example, a solution such as a weighted utensil that helps a participant eat would score higher than an iPad Stand.



Graph 3: Frequency of Use Ranking

Graph 3 shows how our team ranked 20 of the solutions for its frequency of use for the participants. This category ranks each solution based on how regularly each solution will be used by the individuals. For example, if the solution is used every day it was ranked with an 8 or 9 and vice versa.

APPENDIX B: OBSERVATIONS & FEEDBACK FROM TRAINING SESSIONS

Staff Training Session: February 18, 2015

- Swiveling Base for iPad Stand
  - Make it very easy so participants with low strength can turn the iPad
- Coated Spoons and Other Utensils
  - Rubbery coating
  - Like a baby spoon
  - Plastisol
- Utensils that can bend
- Amounts of Loc-Line will vary for different participants
  - Wheelchairs vary for each participant
- Look at alternative tapes
  - That aren't as sticky and permanent
- Different container options
  - Clear or bigger
- Form-It
- Silicone Molds
- Stiff Bristle Brush
- To continue our project:
  - Create a database for kit solutions
- Ideas for Participant Session
  - Start with showing them Twist-Ties
  - Be slow and clear with instructions

Participant Training Session: February 20, 2015

- Varying degrees of disabilities
  - However, there are similar trends in the types of problems individuals face
- Did very well with the Twist-Tie solutions
- Their independence and abilities were improved using certain solutions
- The swiffer reacher helped a participant in a wheelchair pick items up off the ground.
  - He was very happy with what he accomplished by using the AT solutions
- Our team used the Loc-Line to support a switch on a participants wheelchair
  - Gave her the ability to put the switch in different locations
- We should set up a labeling system for the materials and tools in the kit
- Make sure a master lock is on the kit when it is not being used
  - Several items in the kit could hurt the participants (blow torch, box cutter)

APPENDIX C: COST ANALYSIS OF THE KIT

Cost Analysis**				
Item Name	**Quantity**	**Cost***	**Vendor**	**Model # [1]**
Acrylic Sheets	2 (14" x 10")	$ 8.48	Home Depot	
Adjustable Flagpole Bracket	1	$ 5.75	Amazon	
Assistive Technology Solutions in Minutes: Book II [2]		$ 50.00	Institute on Disability Bookstore	pb900
BB Gun Bullets [3]	400	$ 0.63	Walmart	000977591
Black Self-Fusing Silicone Tape	12 feet	$ 6.85	Amazon	
Carpet Tape [4]	1 foot	$ 0.33	Home Depot	50-605-12
Clear Corner Guard (3/4")	2 (1 foot each)	$ 1.52	kofflersales.com	A673
Corrugated Plastic [5]	2 (8" x 12")	$ -	Politicians	
Deluxe Butane Blow Torch [6]	1	$ 16.27	Amazon	
DVD Spindle [7]	1	$ 1.23	Amazon	
Hold-It Adhesive Strips	25	$ 4.62	Walmart	
Husky 22" Toolbox [8]		$ 14.97	Home Depot	
Industrial Twist Tie (17") [9]	3	$ 7.50	Amazon	
Loc-Line (1/2") [10]	2 feet	$ 13.66	modularhose.com	51801
Loc-Line (3/4")	2 feet	$ 17.06	modularhose.com	61501
Loc-Line Pliers (1/2")	1	$ 11.25	modularhose.com	78002
Loc-Line Pliers (3/4") [11]	1	$ 14.33	modularhose.com	78004
Magnum Steel Epoxy Putty	2 oz	$ 6.00	Amazon	
Mini Flashlights [12]	2	$ 0.90	Amazon	
Mounting Disc (3/4")	1	$ 11.39	modularhose.com	90610
Mounting Tape	1	$ 5.99	Michael's	
PVC pipe (3/4")	1.5 feet	$ 1.14	Home Depot	
Ratcheting PVC Cutter	1	$ 11.98	Home Depot	
Rubber Bands [13]	50	$ 0.29	Walmart	552257109
Ruler (6")	1	$ 3.97	Home Depot	
Spring Clamp (3/4")	1	$ 7.36	modularhose.com	510001
Swiffer Duster Handle	1	$ 8.97	Home Depot	003700029918
Table-cloth Spring Clamps	4	$ 1.99	Amazon	
Tubular Wheelchair Clamp	1	$ 45.46	modularhose.com	90750
Uglu Adhesive Strips [14]	Assorted	$ 10.86	Amazon	
Utility Knife	1	$ 7.98	Home Depot	
VELCRO Hook portion	3 feet	$ 1.00	uline.com	12722
VELCRO Industrial Tape [15]	2 feet	$ 4.49	Home Depot	
VELCRO Loop portion	3 feet	$ 1.00	uline.com	12723
VELCRO One-wrap	1	$ 9.27	Home Depot	
	Total	**$ 314.49**		

** The list on the previous page contains all recommended materials for the developed low-tech assistive technology kit. It serves as a cost analysis and guideline to help produce a general, or 'skeleton,' kit that can be used as a foundation for personalized kit. We optimized the amount of solutions that could be built to support many individuals who face different challenges while still reducing the price by $120.00 since prototype development. Keep in mind that this document is still only a recommendation. The combination of materials mentioned in the list can be used to create a large variety of AT solutions as examples. However, some of these solutions may not be useful for certain participants or in a certain Seven Hills location. Since this document acts merely as a guideline for creating low-tech AT kits, feel free to add or remove materials when producing a kit based on the solutions you wish to build. This kit opens many doors for the staff and participants of the Seven Hills Foundation to include any materials and tools which they feel appropriate for the participants being supported with it.

* The 'Cost' column as well as the 'Total Cost' quantity does not include labor costs. This is because we do not currently know who will be assembling the kits and the wages they will be given. Based on our time determining an organized layout and assembling the kit with the recommended amount of materials, it would take 1 hour at maximum to produce one kit. We recommend that Therapeutic Works Option participants assemble these kits as a form of employment.

[1]: The "Model #" column provides the model or product number of the tool/material from the vendor we used. However, in many cases it was very difficult to find these identification numbers for most items. If unsure when purchasing materials, reference the book as a visual demonstration. If the book does not help clarify, please feel free to contact us at **iqpsevenhills@wpi.edu**.

[2]: This book was written by Dr. Therese Willkomm. It provides instructions for the solutions that can be assembled using the kit's components. All solutions were created by her unless otherwise stated. We do not take credit for developing these solutions. The book can be purchased in bulk for discounted prices. As stated by the website, all proceeds go to research into assistive technology.

[3]: Most often BB gun ammo comes in containers of a very large quantity. We purchased a 6000-count for about $10.00. Separate amounts into Ziploc bags to use for the 'Weighted Utensils' solution.

[4]: It is recommended to use Double-sided reinforced fiberglass carpet tape. We purchased a different type of carpet tape and it proved to be very effective for the designated solutions.

[5]: Corrugated plastic is the material that politicians use for their campaigning signs most often. Typically, these individuals will have no problem donating them after they finish using them. If not they can be purchased cheaply at fantasticdisplays.com in sheets of 18" x 24". These sheets can be cut up into multiple sizes to make different solutions with only one sheet.

[6]: We did not purchase butane for this torch because we did not want to provide this with the kit without permission. Thus, a small butane tank is not included in the cost analysis.

[7]: The order came with two empty DVD spindles. One spindle can make about 2 or 3 "Plate Guard" solutions.

[8]: This toolbox was cheap yet very convenient for this kit. It has a lot of room to be organized, but may be a little heavy for some individuals. Research into other container designs should be conducted.

[9]: It is imperative to get the industrial twist-ties rather than non-industrial. Industrial are much stronger even though they bend so much. They also have a soft padding material around them which make them comfortable for some solutions. On Amazon, they come in 2-packs and are very versatile, but we recommend three per kit.

[10]: Loc-Line hose can be purchased in very large quantities to reduce the per-unit cost and supply many kits. Two feet per kit will provide room for adjustments in lengths for different solutions. The hose that is ¼" in diameter is not necessary for the most useful solutions.

[11]: A set can be purchased with ¼" and ½" Loc-Line pliers. However, ¼" Loc-Line has minimum usefulness for the solutions our kit can be used to assemble. Thus, you should purchase ¾" pliers to work with the corresponding sized hose.

[12]: The mini flashlights that we purchased are very cheap. However, they are too small and dim. This would not be beneficial to somebody with low vision in the dark. Thus, other min flashlight options should be researched.

[13]: We purchased a box of 950 rubber bands from Walmart for under $6.00. This amount could be used to supply anywhere from 19 – 50 kits. Our recommendation is to include 50 rubber bands which is many more than necessary.

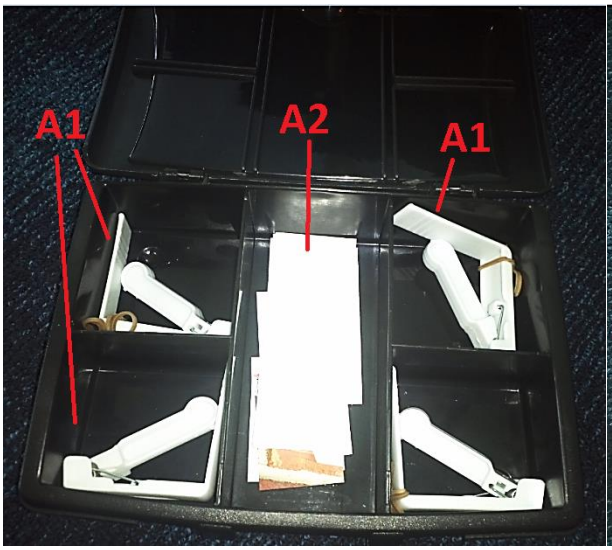
[14]: UGlu strips have multiple uses for many different solutions. We purchased a small box of assorted sizes for about $11.00. A box of 250-count can be purchased for about $30.00 and would be much cheaper to supply many kits.

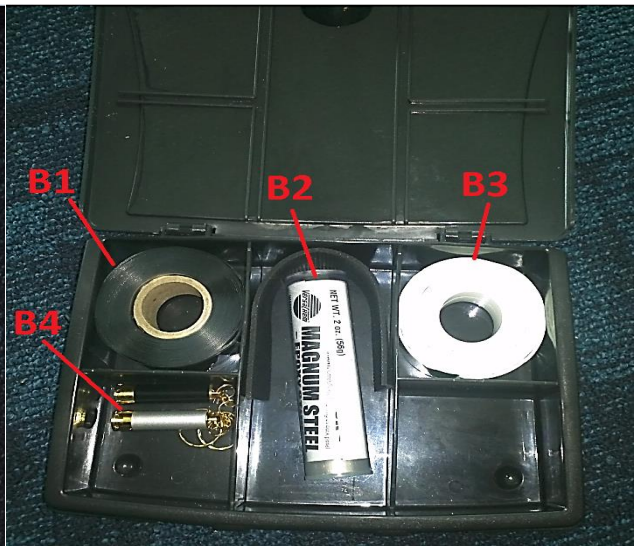
[15]: The VELCRO industrial tape has a similar structure and function to the VELCRO hook and loop portions. We recommend that you only buy the VELCRO hook and loop spools instead. You can buy in a much larger quantity.

APPENDIX D: KIT ASSEMBLY MANUAL

This manual shows the tools and materials included in the low-tech assistive technology (AT) kit. It also shows the quantities of each material and how they are arranged within the kit.

Top Compartments



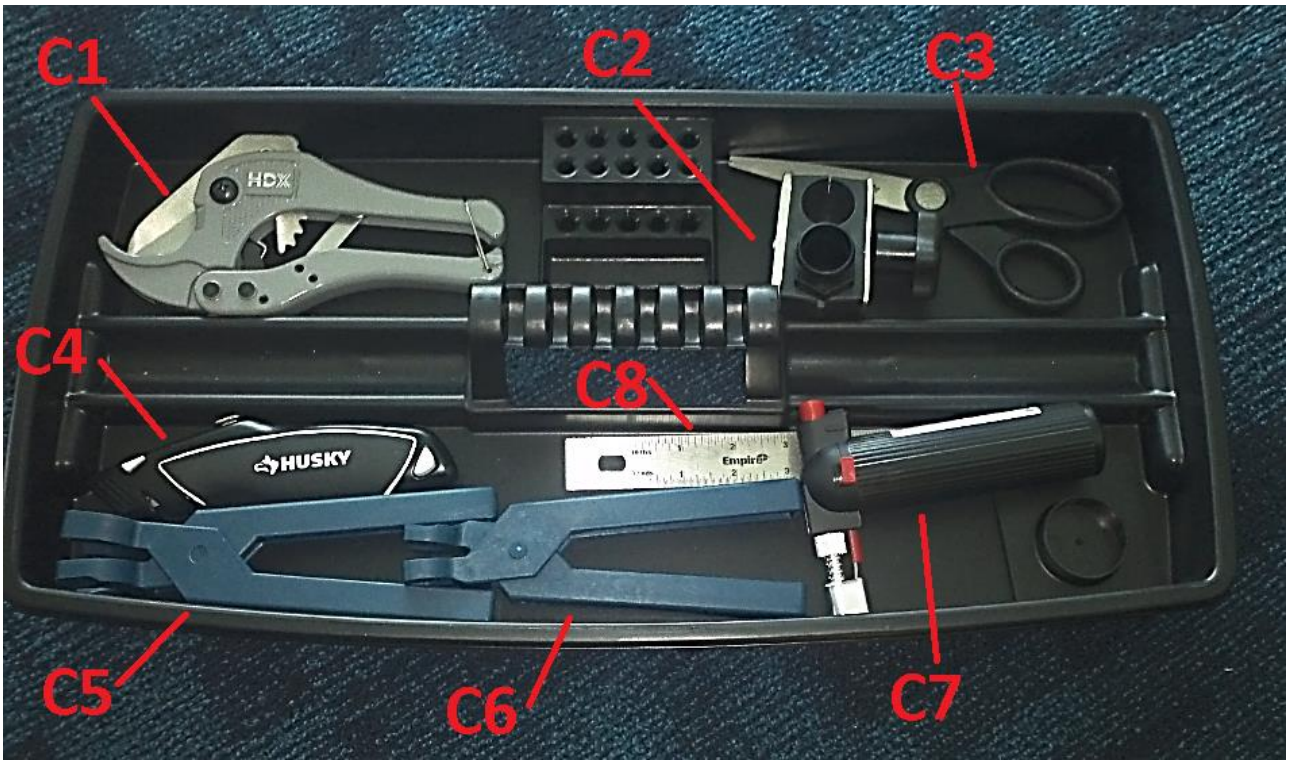


These compartments includes

- Black Self-fusing Silicone Tape **(B1)**
- Mounting Tape **(B3)**
- 2 Mini LED Flashlights **(B4)**
- Magnum Steel Epoxy Putty **(B2)**
- 4 Spring-loaded Tablecloth Clamps **(A1)**
- UGLU Strips – assorted sizes **(A2)**
- Loc-Line Spacer

We placed the smaller materials in these easy to access compartments. They are removable from the lid of the toolbox. We recommend putting the smaller, frequently used materials here. It is important to note that these compartments cannot be master locked. The more dangerous tools and materials such as the mini blow torch should not be stored here.

Top Layer of AT Kit

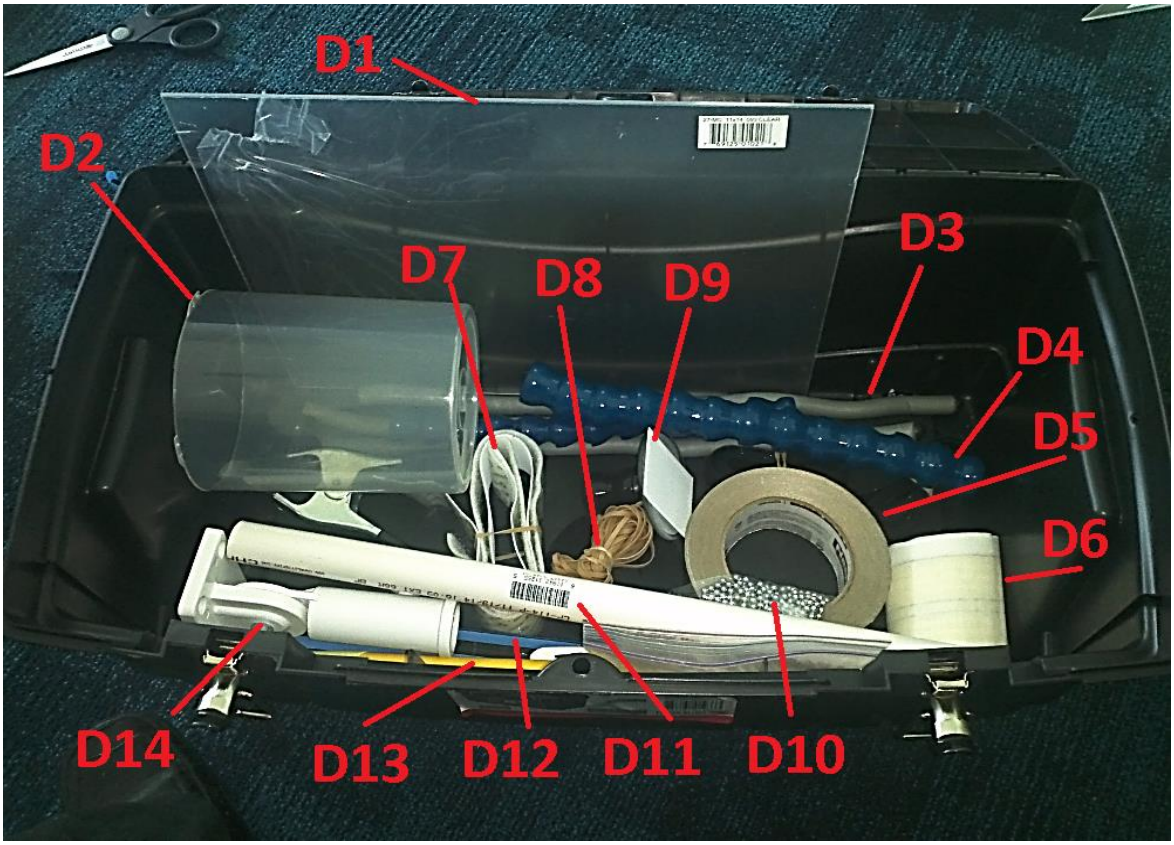


The top layer of the kit includes various tools:

- Micro Blow Torch & Base **(C7)**
- Tubular Wheel Chair Clamp **(C2)**
- Utility Knife **(C4)**
- 6" Ruler **(C8)**
- Ratcheting PVC Cutter **(C1)**
- Loc-Line Pliers (for 1/4 inch loc-line) **(C6)**
    - We recommend these be replaced with ¾" loc-line pliers.
- Loc-Line Pliers (for 1/2 inch loc-line) **(C7)**

This tray is removable from the kit. We recommend that all tools being included in the production of a kit being placed on this tray. This will keep any dangerous tools locked inside of the kit. It is also easier to organize and see each tool. Using the tray will prevent tools from being mixed in with materials and help avoid injuries to the staff or participants.

Bottom Layer of Tool Kit



The bottom layer of the kit includes:

- 3 Twist Ties **(D3)**
- ¾” & ½” Loc-Line Hoses **(D4)**
- 1 Roll of Foil Tape **(D5)**
- 1 Swiffer Duster Handle **(D13)**
    - Yellow object towards bottom of the picture
- 1 Flagpole Bracket **(D14)**
- 1 Mounting Disc (for ¾ inch loc-line) **(D9)**
- 1 Roll of Velcro (one-wrap)
    - Underneath the Loc-Line hose
- 1 Loc-line Clamp (for ¾ inch loc-line)
    - Underneath the DVD spindle
- 1 HOLDit! Pack (25 ring binder insert strips)
    - Not visible in image
- 1 DVD Spindle **(D2)**
- 1 Book (Assistive Technology Solutions in Minutes Book II by Dr. Willkomm)

- 1 Training Manual
- 1 Kit Assembly Manual

The materials listed in the table below will also be included in the kit. However, these materials will need to be cut from their original sizes because their quantities are more than necessary for one kit or because they do not physically fit into the kit.

Materials to be put in Kit	**Size of Stock Material**
2 ft of ¾ inch loc-line **(D4)**	1, 5, 25, or 50 ft of ¾ inch loc-line
2 ft of ½ inch loc-line **(D4)**	1, 5, 25, or 50 ft of ½ inch loc-line
2 rolls of 3 ft ULINE Hook and Loop Tape	2 rolls of 75 ft ULINE Hook and Loop Tape
2 pieces of 1 ft long corner guard **(D12)**	2 pieces of 4 ft long corner guard
2 ft of VELCRO Industrial Tape **(D7)**	5 ft of VELCRO Industrial Tape
400 BB Gun bullets in a ziplock bag **(D10)**	4,000 BB Gun bullets
50 Rubber bands **(D8)**	950 Rubber bands
1.5 ft of PVC **(D11)**	4 ft of PVC
2 rectangular pieces of acrylic (14” x 10”) **(D1)**	2 pieces of acrylic (14” x 11”)
2 rectangle pieces of corrugated plastic (8” x 12”)	2 rectangle pieces of corrugated plastic (18” x 24”)
1 ft of double-sided carpet tape	15 feet

Note: The stock size of materials is not the only size in which these items can be bought. These are simply the stock sizes available at the vendors which we purchased these items from. Always follow the left column of the above table when deciding how much of the above materials to include in the kit.

APPENDIX E: INSTRUCTION MANUAL – TOOLS AND MATERIALS

We recommend that the Low-Tech Assistive Technology Kit be locked using a key-locked Master Lock. There are a few tools and materials in this kit that need safety supervision. However, most tools can are safe to use with minor supervision.

It is important to note that this set of materials and tools are not all that are contained in the book, *Assistive Technology Solutions in Minutes: Book II*. The book and DVD detail advice to use all of these materials as well as many more. Below we show pictures of the materials and tools included in our kit, short advice about each material/tool, and the corresponding page for more information for use and tips. We then provide a list of solutions that can be built with the page number for instructions as well as any additional comments about each solution. It is a list of some solutions

Tools and Materials

- **PVC cutter** – How to use, pg. 107
  - Handle this tool with **CAUTION**
  - We suggest staff use only

- **Blow Torch** – How to use, pg. 99
  - Handle this tool with **CAUTION**
  - We suggest staff use only

- **Box Cutter** – How to use, pg. 81-86
  - Handle this tool with **CAUTION**
  - We suggest staff use only

- **Loc-Line** – How to use, Chapter 9, pg. 118
  - Able to clamp to most tables or chairs
  - 2 different sizes, ½" and ¾"

- **Loc-Line Pliers** – How to use, pg. 119
  - Pliers used to attached and detached Loc-Line

- **Loc-Line Tubular Clamp** – How to use, pg. 121
  - Clamp attaches too wheelchairs
  - Then attaches to Loc-Line

- **Reflectix Foil T**ape – How to use, pg. 149-152
  - This tape is used for electrical switches

- **Silicone Tape (Tommy Tape)** – How to use, pg. 53, 73

- Used for eating utensils or writing utensils
- Dishwasher friendly/ non-toxic
- Remains sticky/rubbery feel for years

- **Magnum Steel Epoxy** – How to use, pg. 69-74
  - 4000lb tensile strength!
  - Let putty sit for 5 mins – 24hrs max strength
  - Use vinyl gloves

- **UGlu** – How to use, pg. 45, 49-52
  - 1" will hold 2lb of weight, up to 200˚F
  - UGlu can be used to make sticky boogers

- **Double-sided Carpet Tape** – How to use, pg. 25,44
  - Attach to concrete, PVC pipe, foam pieces

- **Buckshot (BB's)** – How to use, pg. 73-74
  - Use buck shot or BB gun BB's

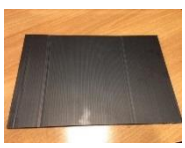
- **Swiffer Duster** – How to use, pg. 23-25, 213-214
  - Used for multiple telescoping solutions
  - Help put shoes on/ reaches

- **PVC Piping** – How to use, pg. 106-114
  - Buy in several different diameters
  - Very strong, use Cutters to make different lengths

- **Twist-Tie** – How to use, pg. 134-144
  - Soft outside, rubbery inside that bends anyway
  - Extremely versatile

- **Spring-loaded Tablecloth clamp** – How to use, pg. 21
  - Simple, cheap easy to put back together

- **Corrugated Plastic** – How to use, pg. 80-95
  - Also use campaign signs
  - Easy to cut and fold



- **¾" Corner Guard** – How to use, pg. 93
    - Protects the corners of corrugated plastic

- **Velcro** – How to use, pg. 55-60
    - Several different types of Velcro

- **DVD Spindle** – How to use, pg. 51-52
    - Cut with scissors
    - Sturdy

- **Flag Pole Bracket** – How to use, pg. 15 -18, 33
    - Adjustable
    - Can be taped to different surfaces

List of AT Solution Examples

This is a list of solutions from Dr. Therese Willkomm's book that can be assembled using the materials and tools mentioned above. We highly recommend that solutions 1 and 2 should be assembled first in order to practice as these are the easiest to assemble.

1. Twist-Tie iPad Stand (pg. 173)
2. Modified Marker Grip (pg. 139)
3. Flashlight "Necklace" (pg. 27)
4. Plate Guard (pg. 51)
5. Table-top Cane Holder (pg. 21)
6. Weighted Utensils (pg. 73)
7. Card Holder (pg. 93)
8. Reacher Attachment (pg. 25)
9. Wheelchair Mounting Solutions (pg. 131)
    a. Various ideas for mounting stuff to wheelchairs
10. iPad Mounting Solutions (pg. 167)
    a. Multiple ways to mount an iPad for different participants.
11. Portable Pocket Poster Stand (pg. 20)
12. Flashlight Cane Attachment (pg. 27)
13. Eye-Gaze Board (pg. 95)