Desk Seat Modification

Abstract

Students with disabilities have expressed a desire to sit in the same chairs as their peers. The goal of this project is to create a product that will allow students, with participation restrictions, to sit in standard school chairs. This device is designed for middle school students, and gives full support to their lower body and some support to their upper body. It is designed to provide support to children between 3’5” and 5’5” and under 120 pounds. The device can fit on a standard middle school chair. It is lightweight and compact, and contains quick attachment features for easy transportation and setup. The device has detachable and rotatable armrests for use at the user’s discretion. Finally, this device is comfortable and discreet enough to remove physical barriers between the user and other students.

In America, more schools are integrating their classrooms with students with and without disabilities. It is important for these schools to ensure that the students with disabilities feel comfortable and included. One step in achieving this goal is to provide a way for all students to sit in the same standard chair. The classroom environment in which students with disabilities experience, is as important as their physical health and mental wellbeing. This product is intended to support its users without drawing attention to help create a more inclusive environment without barriers between students with disabilities and their peers. Inspiration for this design was pulled from existing products that are similar in nature. Many of these products were designed to provide support for its users, but were bulky and intrusive neglecting the environmental factors surrounding the user. These designs incorporated adjustable features, support in critical areas and user versatility. However, these designs did not align with the objective of this project.

Fifteen categories make up the requirements that the final product must meet, including product weight, storage volume, and setup and teardown time. A big concern was ensuring that the device would be easily transportable. With this in mind, the overall weight, storage length, width and height were determined by talking to student aids and the parents of the user. It was determined that anything more than seven pounds would begin to be difficult to carry across campus. In addition it was determined that the storage capacity should take up no more than 24 by 15 by 10 inches. Another concern was the overall time it took to setup and tear down the device. The time between each class is three minutes, therefore ensuring that the user has enough time to setup and tear down the device within a short period was important, therefore the product can be set up and torn down in a minute and a half. Another requirement was the versatility of the final product. Although these design requirements are based off the needs of one student, the device needs to be able to function on a variety of seats. It is not guaranteed that every classroom will have the same seat shape and dimensions therefore the device must be able to adapt to any standard chair. The Health Insurance Portability and Accountability Act of 1996 (HIPAA) states that the device must not cut off circulation to the user and that it has no sharp edges or corners. The user comfort was determined by adhering to the HIPAA standards as well as allowing the student stakeholder to test the prototype.

Nine categories were used as selection criteria in the concept screening process: setup/teardown time, durability, comfort, support, chair versatility, ease of transit, user versatility, discretion, and weight. Setup/teardown time refers to the amount of time that it would take to install and uninstall the device. Durability refers to the device's resistance to breaking down through wear and tear or other stresses. Comfort means that the user's circulation is not cut off, and that there is no added pressure points to the user. Chair versatility indicates the device's ability to function properly with a wide range of different chairs. Ease of transit denotes how easy it is for the device to be moved from one location to another including carrying the device by hand and storing it in a motor vehicle. User versatility ranks the degree by which the device can accommodate different users. discretion is the degree to which the device can go unnoticed by outside observers while it is in use. Weight is the total mass of the device when it is fully assembled. These selection criteria were assessed and weighed based on their value to the recipients and used in discerning the effectiveness of various design concepts. Each of the four main design concepts were ranked in each category giving them an overall score. The one with the highest score was ultimately chosen and prototyped.

The final prototype was made mostly of an aluminum base that was the attachment point for each of the other parts. The base has slits to attach straps that will lock the device in place to any chair. Velcro is used to attach the Special Tomato cushion to the base. This function is not for in use stability, rather is a mechanism to help keep the cushion attached to the base during transportation. The straps used to attach the device to the chair also assist in keeping the cushion and base all connected during transportation. The aluminum base also has attachment parts for the adjustable armrests. The arm rests utilize a quick release button system to allow for the armrests to be attached and adjusted quickly and easily. **Figure 1** shows the position of the arm that can be used to allow the user to easily slide in and out of the seat, without moving the chair itself. **Figure 2** is a close up of the arm attachment feature to the base. This part allows the armrest to have multiple positions that allow for ease of use and transport. Finally, **Figure 3** shows the transportation position of the device. The arms are rotated forward so that the volume is as flat as possible. The straps were also wrapped around the seat cushion so that it would not separate from the base.

Figure 1. Rotated and upright arm for ease of user entry

Figure 2. Displays arm connected to base arm attachment

Figure 3. Folded up in transportation position

Based off of preliminary performance testing, drastic design changes were made as follows. A basic prototype was assembled using wood and PVC pipe to understand how well the subfunctions worked. This prototype was focused on learning about the best ways to interface with the chairs and the modularity of the parts. It was found that the original design was too bulky, and many components were not needed due to the original requirements changing. A new prototype was built with as minimal parts as possible. Once the second prototype was built it was found that it did not provide adequate support because the base was pushed too far forward on the chair. The final prototype's design incorporated components from the first two prototypes while also providing enough support and being discreet.

The design when through an iterative process. Feedback from the end users was integral to this process. For a period of two weeks the student, his family, and aides had access to the final prototype. During this time, they made regular use of the device. At intermittent points during this testing phase the design team gathered feedback from the users. This feedback included answers to questions given by the design team as well as general comments. The feedback gained from this process influenced the changes between the final prototype and the final design.

A final cost estimate for one prototype was calculated, as seen in **Table I**, based off of material, machining, and welding. Machining was actually done in house, but an estimate from a professional was given for budget purposes. Based on the cost to produce one device prototype, once in mass production, it is expected that these devices would be sold for $1,196.

Table 1. Cost to produce one prototype

Description	Sub-Total
Multipurpose 6061 Aluminum	
Sheets/Blocks	$180.00
Telescopic Tubing	$40.00
Arm Padding	$33.00

Seat Cushion	$110.00
Snap Button	$13.00
Welding	$400.00
Machining	$400.00
Straps	$20.00
Total	$1,196

The overall concept of the project is innovative because there are currently no other products similar to this design. Many seat adapting technologies are large and cumbersome, as well as indiscreet. One of the goals of this design was to make a device that was discreet, unlike many of the other products on the market, while not losing functionality. The design utilizes a lightweight and simple base where the armrests and seat cushion could attach. The seat cushion is easily attached to the central base through the use of straps. These straps make for quick and easy setup and teardown. The arm rests utilize push buttons that allow the arms to be rotated, either to allow the user to slide into the chair or for compact storage and transport. The arms can also be removed altogether using the same function. While the design was intended for a classroom setting, the device could be used in many settings outside the classroom, such as at home or the workplace, as long as the seat has a backrest and fits the chair seat compatibility requirements. The conditions addressed were the transportability, the setup and teardown time, versatility, HIPAA standards and the physical limitations of the user.