ETHICAL ENGINEERING OF ASSISTIVE TECHNOLOGY FOR THE LEARNING DISABLED

Mckenzie Kallquist (mak270@pitt.edu)

INTRODUCTION: MORALLY SUPPORTING THE GROWTH OF TECHNOLOGY NEEDS

As an industrial engineer at a software development company, I have witnessed an increasing number of people looking for technology to benefit themselves or their families. One such technology that these clients are looking for is assistive technology devices to compensate for learning disabilities. In order to prevent wasting resources and to optimize the profit of our company, it is my job to figure out exactly what our client is looking for in their program. If we create a personalized and effective software the first time around, we avoid the costly trial and error process while increasing our reputability.

Considering that the majority of the people who come in looking for a specialized program do not necessarily have technology experience, it could be very easy to convince them that they need a more expensive and overall more complicated program than what would actually suit their needs. Although deluding the client into choosing a more complex design would increase our company profit, it would not be an ethical decision.

For example, we currently have the opportunity to start a project with a woman who has a child with a learning disability. She does not want her child to fall any further behind in school due to something he cannot control, and the school administrators recommended assistive technology as one of her options. She is inquiring about the different programs that we could make to aid in the struggles faced by those with learning disabilities, and interested in making the investment if we can help her son. It would be easy to respond instantly claiming that we could sell her a product that would lessen her son’s fight to keep up with his peers in the classroom. But what if technology is not an ethical solution to her son’s problem? What if we burden her son with an overly complex program solely to make a larger profit? What if the technology implemented is actually a deficit to his overall learning experience? These are some of the questions I will have to keep in mind while working with the software engineers to best meet the needs of the client.

BECOMING FAMILIAR WITH LEARNING DISABILITIES AND ASSISTIVE TECHNOLOGY

As a professional engineer, I am bound to the National Society of Professional Engineers Code of Ethics. One of the major principles of that code of ethics is that “Engineers shall perform services only in the areas of their competence” [1]. Therefore, before I could begin to decide between right and wrong, I had to become more knowledgeable on learning disabilities, and what assistive technology options could benefit children with learning disabilities. Consulting the National Center for Children with Disabilities, I found that over six million children, ages three to twenty-two, have some sort of learning disability [2]. This does not mean that they are incapable of learning; however, it does indicate that their brains process information differently than a child without a learning disability [3]. Our client indicated that her son has a form of dysgraphia, which means that he struggles with writing and becomes frustrated while trying to express his thoughts on paper [3].

I also became aware that one of the biggest challenges of helping children with learning disabilities is that each individual is affected differently [3]. Therefore, it is impossible to develop one “solution”. In order to help our client’s son we would not only have to familiarize ourselves with his specific struggles, we would also have to acquaint ourselves with assistive technology and the different options it has to offer.

In order to make an ethical decision, I have to understand what exactly assistive technology is, and its purpose for those with learning disabilities. The Assistive Technology Act of 2004 defined assistive technology as being “any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities [2]”. Specific to our client’s son, assistive technology is implemented in order to “let the student with writing difficulties use a computer with specialized software that spell checks, grammar checks, or recognizes speech” [3].

HOW ASSISTIVE TECHNOLOGY CAN HELP THE LEARNING DISABLED

I must not solely rely on my moral values for this project, as the Society of Professional Engineers also contractually binds me to a code of ethics. The first fundamental canon of the code of ethics is to “hold paramount the safety, health, and welfare of the public” [1]. This left me with the question, “If we make this child an assistive technology program, how will it help him?”

Consulting a research article on the impact of assistive technology on learning disabled children, I found that most affected individuals, including our client’s son, become
frightened easily due to their inability to communicate their knowledge. Reports, however, have been identifying that assistive technology devices increase students’ enthusiasm to learn [4]. Not only do they give them feedback on what they are doing well and what they could use more practice on, it also provides a more interactive domain for the students to learn. Multimedia projects even encourage students to pay closer attention to detail [4]. We could potentially develop a program that would motivate our client’s son to develop habits that would improve his academic experience as a whole. Beyond giving the learning disabled students an incentive to engage in their struggles, assistive technology also allows the students to work more effectively and efficiently by providing feedback, reflection, and revision [4].

Seeing as our client’s son has a form of dysgraphia, the two most effective options would be to either design a word prediction program or a speech-to-text program. The difference between the two is that the client’s son would type on a computer to use the word prediction program, and talk into a headset connected to a computer for the speech-to-text program.

A study was conducted to measure the effectiveness of various word prediction programs when used by children with learning disabilities. Compared to their abilities without using one of the word prediction programs, the results of the students using the software were significantly better. As the researchers noted, “On average students increased their spelling accuracy from 58 percent to 96 percent. In addition, with the composition rate, students wrote relatively faster with all the programs” [5]. In addition to getting more words written in less time, one of the studies’ subjects also reported that word prediction made him “think faster” [5]. It would make sense to think that this type of program would benefit our client’s son considering the fact that his writing abilities are slowing him down to the point where he is behind the rest of his classmates.

One of our clients concerns, however, is that her son’s education will outgrow the software. In other words, she is concerned that, since her son will struggle with dysgraphia for his entire academic career, her investment will not be able to assist him as he matures through the different levels of schooling. To alleviate her concern, I did some research on Linguistic Word Prediction Intelligence, which is being used in word prediction programs to make appropriate suggestions based on context [5]. For example, by identifying whether the nouns in the sentence are plural or singular, the program can suggest the correct tense of the verb that the student is trying to utilize. The Linguistic Word Prediction Intelligence is able to compensate for other grammar functions such as subject-verb agreement, proper spelling, capitalization, and appropriate pronoun and article use [5]. Therefore, this technology could accommodate her son’s advancing curriculum.

Studies have also shown that speech-to-text software can increase learning disabled students’ writing production, writing mechanics, sense of independence, and reading and writing abilities while decreasing their anxiety around writing [6]. The researcher noted, “For students with learning disabilities, speech recognition technology can encourage writing that is more thoughtful and deliberate” [6]. By taking the issue of handwriting, spelling, and grammar capabilities out of the equation, middle and high school learning disabled students were able to produce longer and better quality papers when they used speech recognition software [6]. What is interesting about speech-to-text programs is that they have the capability to improve a student’s reading and spelling abilities along with helping them overcome their writing difficulties [6]. As the student dictates to the program, their words appear on the screen. This allows the student to associate what they are saying with what the words and grammatical structure look like [6]. Therefore, we could not only help our client’s son get back on the same playing field as his peers, we could also help enhance other aspects of his education.

**THE ETHICS OF ASSISTIVE TECHNOLOGY FOR THE LEARNING DISABLED**

While making the decision of taking on the assistive technology project or not, it is crucial to ensure that I adhere to the code of ethics installed by the Institute of Industrial Engineers. Another vital aspect of the project is making sure that the team of software engineers does not violate their departmental code of ethics either.

One of the fundamental canons of the Industrial Engineers Code of Ethics is that engineers must be “honest and impartial, and serve with fidelity the public, their employers and clients” [7]. This canon is very relevant in the case of my client because she does not have a knowledgeable background in the realm of assistive technology. So, she trusts me to guide her to a solution that I honestly think will benefit her son. I turned to the book Design and Use of Assistive Technology: Social, Technical, Ethical, and Economic Challenges to seek guidance on how to fulfill this canon of the code of ethics. Anita Silvers authored the first chapter of the book titled “Better Than New! Ethics for Assistive Technologists,” which was very enlightening in my search for the ethical answer for my client. Silvers emphasized that the only ethical option was to raise the goal from assistive technology restoring the users abilities back to normal to restoring their abilities to “better than new” [8]. Why, Silvers argued, would assistive technologists conclude the development of a program before implementing the program’s fullest potential [8]? This chapter helped me realize how developing a program for our client’s son could ethically help him lessen the struggles he experiences every day. Especially considering the research that proves certain speech-to-text programs also improve users reading and spelling abilities [6]. Helping our client’s son strengthen other academic abilities along with helping
him overcome his writing disability would exemplify Silvers testament to use assistive technology to restore assistive technology users to ‘better than new’.

Another one of the fundamental cannons of the Industrial Engineers Code of Ethics is that “Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest” [7]. The evident conflict of interest that we could experience in the scenario of my client and her son would be to sacrifice consumer satisfaction for company profit. I could convince my client that an unnecessarily expensive and complex program would best suit her son’s needs and end up with a larger paycheck. Or, I could legitimately derive the most beneficial solution and give her a reasonable quote. In order to receive some insight on perspective, I looked to chapter three of Design and Use of Assistive Technology: Social, Technical, Ethical, and Economic Challenges, which is titled “Accessible Technology and Models of Disability” and authored by Richard E. Ladner [8]. Ladner discusses a social model of assistive technology that typically includes technologies that are paid for by the government, such as closed captioned television [8]. Ladner says, “In the social model, the term ‘accessible technology’ seems to fit better than ‘assistive technology’ because it focuses on alternative approaches to achieving goals [8].” This lead me to think, since a word prediction or speech-to-text program would provide our client’s son with an “alternative approach to achieving a goal” [8], would it fall under the social model of assistive technology? And if that is the case it should be provided at a minimal cost, certainly not an inflated one.

Considering that I would have a team of software engineers working on this assistive technology project as well, I would also have to be cognizant of the code of ethics that they are contractually bound to. One of the principles of the Software Engineering Code of Ethics and Professional Practice is that “Software engineers shall approve software only if they have a well-founded belief that it is safe, meets specifications, passes appropriate tests, and does not diminish quality of life, diminish privacy or harm the environment. The ultimate effect of the work should be to the public good” [9]. In order for them to approve the software that they would be developing for our client, they have to be assured, by myself, that the software would honestly benefit our client’s son. Therefore, if I violate the code of ethics that binds me to honesty and avoiding conflicts of interest, I am also causing the team of software engineers to violate their code of ethics.

As another aspect of fulfilling the Society of Industrial Engineers’ fundamental canon of being “honest and impartial,” I have to inform my client about the potential disadvantages of assistive technology [7]. If not, I would not be honestly conveying the product to her. Researching some of the drawbacks to assistive technology particular to those with learning disabilities, I found a few points that I thought would be crucial for my client to know.

For example, if we develop a speech-to-text program for her son, it will not be an instant fix. This kind of software requires the student to go through training in order for the program to work in a beneficial manner. According to Anne Vize of Bright Hub Education Incorporated, “It takes time to 'teach' the program your voice style, and to help it recognize how you say certain words, which can be a frustrating experience for some students” [10]. Going along with this point, our client will also have to be willing to honestly judge whether her son understands the difference between speaking to converse socially and speaking to write with the program [6].

More general problems that our client could run into with either speech-to-text or word processing software include frustration, complexity, and the need for revisions. An assistive technology information webpage indicated that assistive technology devices could make things overly complicated by using methods that are beyond the abilities of the user [11]. Although the technology needs to be able to advance into accommodating higher levels of education, it needs to start at a simple enough level for our client’s son to grasp it. Another common problem with assistive technology is that it has the tendency to overcompensate for the user’s disabilities [11]. This can become a source of frustration for a user who is already sensitive about what he is capable of. Another source of frustration for the user could come from the need to revise the work created using the assistive technology program [10]. Although we can try, it is impossible to make a perfect program. So, our client’s son would have to learn to check for incorrect word choices made by the program.

If our client can’t see her son overcoming these negative attributes of assistive technology, then developing a program for him would not be an ethical decision. Instead of helping him overcome the problems his learning disability imposes on him, we would just end up creating another source of frustration for him. These additional frustrations could cause our client’s son to lose his enthusiasm for learning and fall even further behind his peers.

CONCLUSION: ETHICALLY INCORPORATING ASSISTIVE TECHNOLOGY TO BENEFIT THE LEARNING DISABLED

Assistive technology makes normalcy a possibility for those with learning disabilities. It is for that reason why I think that we should agree to design a program for our client’s son. After researching both the benefits and drawbacks of assistive technology for the learning disabled, and consulting articles and books to give an ethical perspective on assistive technology, I believe that we can develop a program for our client’s son while adhering to the National Society of Professional Engineers Code of Ethics, Institute of Industrial Engineers Code of Ethics, and
Mckenzie Kallquist

Software Engineering Code of Ethics and Professional Practice. After clearing the potential drawbacks of word processors and speech-to-text with our client, we will pinpoint her son’s specific struggles and do our best to alleviate them via our program. I will make it my mission to work with the software engineers to make the most efficient version of the software that will not unnecessarily inflate the cost to the client, while still incorporating enough technology to allow the program to grow with her son.

REFERENCES


ACKNOWLEDGMENTS

I would like to thank Dan McMillan for coming into my ENGR0011 class and offering guidance on this assignment. Without his generous time and instruction, this project would not have been possible. I’d also like to acknowledge Beth Newborg for sending us helpful links and suggestions for this assignment. I am very grateful for the time Steven Boyd and Kristin Vermilya worked with me at the Writing Center. Their revisions and suggestions are appreciated very much. Finally, I’d like to thank Katarina Klett for continuously motivating me through the process and offering revision suggestions.