

A Case Study on the Efficacy and Usage of Assistive Technologies in Howard County Schools, MD

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ABSTRACT

Assistive technology is equipment that is designed to improve the capabilities of students with disabilities. For many students with disabilities, these technologies enable essential life skills such as daily communication and independence inside and outside of the classroom. This study assesses the efficacy, usage, and implementation of assistive technology in Howard County Public Schools (HCPSS) in Maryland, in order to determine any potential barriers and deficiencies towards the effective implementation of the said devices. A voluntary sample of 59 members of 1200 HCPSS staff was asked questions about the assistive technologies used in the county, their effectiveness, potential barriers towards implementation, training given, and available resources. Responses generally indicated that assistive technologies were beneficial, with the 83% of respondents selecting 4 or 5 out of 5 for the effectiveness of assistive technologies in academic and social contexts. Respondents elaborated that technologies allowed students with severe disabilities to communicate, socialize, work independently, and improve reading and writing skills. On the other hand, drawbacks such as distractions and dependencies created by the technologies were noted. Respondents felt confident towards the resources and support provided by the county, noting an assistive technology department and specialists available for support. However, respondents commonly reported that they were under-trained, received only occasional, limited workshop sessions, and were constantly behind on training. Thus, recommendations were drafted to improve training and staff awareness towards assistive technologies, such as required comprehensive training sessions for special education staff and a universal assistive technology guide to be provided.

Introduction

According to the Technology-Related Assistance for Individuals with Disabilities Act of 1990 (Public Law 100-407), assistive technologies are defined as “any item, piece of equipment, or product system, whether acquired commercially, off-the-shelf, modified or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities.” In short, assistive technologies are a broad term used to define any item which improves the lives of people with disabilities. These technologies can be separated into two categories: ‘high-tech’ and ‘low-tech.’ High-tech assistive technologies encompasses equipment that requires electricity to use, including computers, speech generating devices, specialized software, and more. Low-tech devices, on the other hand, include equipment which does not require electricity, such as manual wheelchairs, page holders, and reminder boards. As a result, high-tech devices tend to be more expensive and complicated to use compared to low-tech devices (Koch).

Benefits & Effects of Assistive Technology

“Assistive technology can help in meeting these ‘disabling’ needs by addressing the ‘functional barriers’ confronted by individuals with disabilities, including the sensory, cognitive, learning and physical disabilities (Ahmad).” For

students with severe disabilities, assistive technologies can be critical to daily life, from enabling essential communication to engaging in a classroom.

These technologies are able to facilitate essential communication and social capability for students with severe disabilities, allowing them to engage in daily communication (Judge & Lahm 1998). Assistive technologies which facilitate this function include software applications like Boardmaker, Writing with Symbols, and Intellitools (Judge). Without assistive technologies, people with severe disabilities would suffer detrimental effects in life, losing access to education, social opportunities, employment, and general activities of daily living (Hoppestad). Visual assistive technologies have also been described to be successful in supporting children with problematic behaviors after using assistive technologies (Parette, Stoner, & Watts). Visual schedules, charts, and cue cards, available with assistive technologies like Boardmaker, help students adhere to classroom rules and organize behaviors (Center on the Social and Emotional Foundations for Early Learning).

Assistive technology is able to also level the playing field for students with less severe disabilities with their neurotypical and non-disabled peers in academics. According to a study by Bausch & Hasselbring in 2006, “Students with learning disabilities are able to gain the same benefits as peers,” thanks to the use of assistive technologies. The “Compensatory nature of assistive technologies” makes up for the difficulties students with disabilities face in learning and academics (Parette & Peterson-Karlan).

All of these benefits translate to improved social and academic skills of students with severe special needs. A study measured the effectiveness which using CompuThera, an assistive reading and writing education program, had on students with autism in language skill tests. Two trials were run on four different students each, testing skills including matching, receptive language, verbal imitation, and expressive language. A statistically significant result was achieved in favor of the assistive technology, with rank averages of improvement scoring 9.75 and 7.25 using the Kruskal-Wallis test for the two trials. The p-value was reported as 0.015, indicating that the assistive technology managed to improve the language skills of students. The conclusion showed that “computerized programs showed effectiveness in improving the reading and communication skills of children” (Fteiha).

Empirically, the effectiveness of assistive technologies is rather vague compared to statements and testimonies. The lack of standardized methods and reliable measurement tools to assess the effectiveness of assistive technologies could be responsible for this (Nordström, Nilsson, Gustafson & Svensson). Although the effectiveness of these devices has not been researched thoroughly, some studies indicate positive results. The majority of Grade 4 and Grade 8 teachers surveyed indicated positive perceptions of assistive technology in improving student motivation and learning. Grade 4 students held positive views about the impact of assistive technologies in reading performance, with 72% positive responses about assistive technologies in reading performance, 82% positive responses in compensating for difficulties, and 68% positive responses in improving the amount of text assimilated (Nordström, Nilsson, Gustafson & Svensson).” Similarly, Grade 8 teachers reported positive perceptions about assistive technology in student learning and motivation, reporting very similar figures to the Grade 4 teachers, differing significantly only in the categories for motivation and improving traditional reading skills, reporting figures up to 20% lower than that of Grade 4 teachers (Nordström, Nilsson, Gustafson & Svensson).

Assistive Technology Legislation

Throughout history, laws have spearheaded the development and implementation of assistive technologies. A brief overview of these laws is shown here. The earliest of disability laws is the Rehabilitation Act of 1973, which was the first piece of legislation in disability rights. It prohibited discrimination against people with disabilities in all programs or activities receiving federal funding (Day & Huefner). Its most notable component, Section 504, mandated accommodations for people with disabilities and established the Individual Education Program, shortened to IEP. The IEP required that schools provide access to accommodations, including various assistive technologies, to students with disabilities.

Perhaps the best known and most influential of all disability laws was the Americans with Disabilities Act

of 1990, the first comprehensive disability rights law, mandating that entities not discriminate against employees with disabilities and that accommodations be provided in public areas (ADA National Network). It resulted in a cascade of changes, including the first mass implementation of assistive technologies in both public and private sectors. This also made assistive technologies available for people who do not have disabilities (Day & Huefner.).

The multiple Individuals with Disabilities Education Acts were directly connected to the development and implementation of assistive technologies. The Individuals with Disabilities Act of 1990 set forth the definition of assistive technologies, as mentioned earlier in the paper. It required that students with disabilities be included in state standardized tests (Parette & Peterson-Karlan). Federal programs were established, intending to establish programs to notify and educate people with disabilities and those who serve them regarding the availability of assistive technology devices and their use (Russell et al.).

A revision of the act was passed in 1997, named the Individuals with Disabilities Act (IDEA) of 1997. The IDEA act listed out specific types of assistive technologies, formally required that assistive technologies need to be implemented with an Individual Education Program (IEP), and that these technologies be widely available in the education sector. In the IDEA, comprehensive evaluations must be conducted by an experienced person in the field before implementation of assistive technologies (Day & Huefner). The act was further amended later, with the IDEA Improvement of 2004. This amendment required that regulators could give educators discretion on the implementation and use of assistive technologies (Watson, Ito, Smith, & Andersen). Additionally, the Assistive Technology Act of 1998 sought to increase availability of assistive technology and provide easy access and information online (Day & Huefner).

Challenges to Implementation of Assistive Technologies

Despite increased awareness, regulation, and advancements in assistive technologies, many barriers are still in place, which could significantly hamper the implementation and effectiveness of assistive technologies. Among the most significant one of these barriers is the prohibitive costs of assistive technologies, particularly high-tech equipment (Judge). High-tech assistive technologies involve specialized electronics, such as speech generating devices and speech-to-text systems, which can be incredibly expensive. An Apple iPad, a commonly used assistive technology base for students with disabilities, starts at \$329. Furthermore, disability-specific software necessary for assistive technology applications, such as TouchChat, a speech-generating app used on the iPads for non-verbal students, is also expensive, with the app starting at \$299. Altogether, a basic implementation of assistive technology could easily cost hundreds of dollars, posing a significant barrier towards resource-limited school districts. In a study, the majority (over 80%) of participants agreed that socioeconomic status is a hindrance toward the implementation of assistive technologies (Ahmed). Insufficient financial support by the government or school system is often responsible for this, particularly in low-income communities (Copley & Ziviani (2004)).

Another physical barrier to the implementation of assistive technologies is the lack of technical support. 47% of teacher participants in a study about assistive technology abandonment and deficiency claimed that they did not have adequate support for assistive technologies (Sharpe). In another study, insufficient assessment, planning, and difficulty obtaining and managing equipment were found as major barriers as well (Copley & Ziviani (2004)). Technical support is essential to use assistive technologies, since high-tech devices are often complicated and require expert guidance to be used effectively.

Lack of guidance also plays a significant role in the potential deficiency in the implementation of assistive technologies. The United States federal government does not provide guidance about assistive technologies to teachers (Parette & Peterson-Karlan), often leaving teachers with limited to no guidance provided by their school systems. In conjunction with the lack of guidance is the glaring deficiency in training for special education teachers about assistive technologies, with 139 (80.3% of respondents to the question) disagreed with the statement that “I have adequate training in and knowledge of assistive technology for classroom needs” (Sharpe). The lack of uniform guidance towards assistive technologies results in inconsistent and potentially unsatisfactory training for teachers. In a survey of

405 special education teachers, only 78, or 19% of respondents stated that they had adequate assistive technologies (Deter et al.). Since teachers are left largely uninformed about the capabilities of the assistive technologies, they end up not knowing how to utilize them efficiently (Ayon & Dillon), compromising their effectiveness and potentially even causing negative effects. Mishandling of training is also common in some school systems, where insufficient guidance by the county may lead to staff improperly trained to use assistive technologies (Ayon & Dillon).

Additional barriers to implementation include time constraints, technical problems, and negative attitudes (Sharpe, Copley & Ziviani (2004)). These were generally found to be less problematic than the costs and lack of support and training. In the study by Sharpe, time constraints were somewhat a problem, with 48% of respondents stating that time constraints prevented them from using assistive technologies more often. 33% agreed that technical problems substantially reduced the value of assistive technologies in their class, and 35% agreed that the assistive technology often does not work properly (Sharpe).

Howard County

Howard County is located in central Maryland, in the heart of the Washington-Baltimore metropolitan area. The county has a population of 328,000 people, and the largest population center is Columbia, with a population of 104,000 (2020 Census). This also makes it the sixth-largest county in Maryland, out of 24 (2020 Census). The county is the sixth-wealthiest county in the United States by median household income (2020 Census). The Howard County Public School System (HCPSS) is the sole public school system in Howard County, containing a total of 77 schools: 42 elementary, 20 middle, 13 high, and 2 special education centers (HCPSS). Out of approximately 59,000 total students in HCPSS, 11%, or around 6500 students, of the total student body have special needs with an IEP or 504 plan (Howard County Special Education Citizens Advisory Committee). For FY 2023, the county spent \$156,011,247 as expenditures for Special Education Services (HCPSS Adoption of FY 2023 Budgets).

The Howard County Public School System includes a Department of Special Education, which is responsible for all special education programs within the county. The department operates two special-education specific schools, the Cedar Lane School, a center for those with complicated needs and require specialized programs, and the Home-wood Center, a school for those that have difficulties functioning in traditional classrooms. The main special education program offered in general education elementary, middle, and high schools is the Academic Life Skills (ALS) program. Based on a student's individual needs in their IEP program, students receive instruction in special or generalized classes, with access to a specialized curriculum if necessary. If a student is deemed necessary for assistive technologies under an IEP, the county's Instructional Access Team would collaborate with school staff to provide the assistive technologies (HCPSS). Students with visual or hearing impairments receive diagnostic tests courtesy of the county, and thus evaluated through their IEP for potential assistive technologies (HCPSS).

Methodology

In order to investigate the severity and impact of the barriers to the implementation of assistive technologies in Howard County Public Schools, the study was conducted using a survey sent via email to special education staff. The voluntary survey was sent to a total of over 1200 special education teachers, paraeducators, student assistants, Speech-Language Pathologists, and therapists. Staff were randomly selected from all public elementary, middle, and high schools, in addition to the two special education-specific schools in HCPSS. The google form was sent through large email batches to the email addresses of the staff, available on the online directories of HCPSS schools. The survey was administered between March 15th 2023 and May 1st of 2023. After the surveying period ended, 59 public staff members responded to the survey. Each survey was administered using a google form, and consisted of three sections of questions: Basic information, effectiveness of assistive technologies, and the status of assistive technologies.

Teachers were asked to provide basic information, which included name, school, role, and socioeconomic

status. They were also asked for the disabilities that the students that they worked with had, and also the types of assistive technologies used in their classroom.

The second section asked respondents to evaluate the effectiveness of assistive technologies. Four questions were in this section:

- Effectiveness of assistive technologies on social/emotional behavior on a scale from 1-5 (1 - not effective, 5-very effective)
- Effectiveness of the assistive technologies on academic performance on a scale from 1-5 (1 - not effective, 5, very effective)
- Elaborate the positive effects of assistive technologies on students and creating a positive learning environment
- Elaborate the negative effects of assistive technologies on students

The last section assessed the state of assistive technologies in public schools. Respondents were first asked to score the following categories from 1-5:

- The deficiency in assistive technologies (1 - Major deficiency, 5 - No deficiency)
- The ease of access of assistive technologies (1 - Not accessible, 5 - fully accessible)
- How well they are informed about assistive technologies (1 - Not informed at all, 5 - fully informed)
- How well they are trained about assistive technology (1 - Not trained at all, 5 - fully trained)
- Their perception about the resources of assistive technologies (1 - No resources, 5 - Very well equipped with resources)
- The ease of obtaining support for the assistive technology (1 - No support, 5 - Easily accessible support)

Respondents were also asked to elaborate on and explain the following questions:

- any significant barriers to obtaining assistive technologies
- training and resources for the devices
- how the assistive technologies were used
- How much they would like to learn more about assistive technologies.

In addition, an interview was conducted with a special education teacher, Mr. Roo Salimbeni, from River Hill High School in order to obtain a more specific account of assistive technologies in Howard County. Results from this interview were incorporated into research findings.

Results

Basic Information

Out of the 59 staff members surveyed, the sample collected a diverse variety of staff, consisting of special education teachers, paraeducators, student assistants, Speech-Language Pathologists, administrators, psychologists, transition teachers, and therapists. Staff held specialties in Academic Life Skills (A program in HCPSS which integrates students with special needs into general education classes), safety care certifications, braille, teaching for the blind, and assistive technology education.

Regarding income distribution, the survey gathered a representative sample of low, middle, and high-income conditions. 17 respondents were from low-income schools, 24 were from middle-income schools, and 18 were from high-income schools.

TouchChat, a speech generating app used on iPads, is an assistive technology widely used throughout HCPSS for non-verbal students. The majority of respondents reported using this app, which is mandated by some IEP programs non-verbal students. Other common assistive technologies used included speech to text programs, assistive reading and writing software, and voice amplifiers. Some uncommon assistive technologies used included motorized

wheelchairs, braille note takers, braille displays/keyboards, magnification devices, Picture exchange communication system (PECS), Eye gaze voice output device, and augmentative communication devices.

Effects of Assistive Technologies

The first section of the study concerns the effects and efficacy of assistive technologies on students with special needs. Respondents of the survey first answered two questions about the effectiveness of assistive technologies in improving academic performance and social behavior. The first question asked respondents to rate the effectiveness of assistive technology in improving academic/learning performance of students with disabilities on a scale of 1-5, with 1 being not effective and 5 being very effective. According to Figure 1, with a mean of 4.22 and a median of 4.00, indicating a positive sentiment towards the effects of technologies in improving academic performance. All respondents selected '3' or greater, and 83% of respondents selected '4' or '5.'

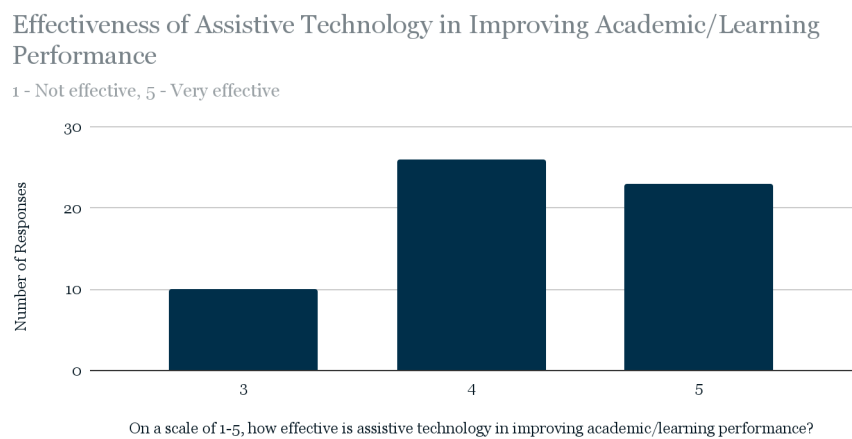


Figure 1. Effectiveness of Assistive Technology in Improving Academic/Learning Performance

A second question asked respondents to rate the effectiveness of assistive technology in improving social and emotional behavior. According to Figure 2, responses towards the effectiveness of technologies in improving behavior varied significantly more than academic effectiveness of assistive technologies shown in Figure 1. The mean rating of assistive technologies improving social behavior was significantly lower at 3.56, and the median was the same at 4.00. Only 56% of respondents selected '4' or '5' out of 5.

Effectiveness of Assistive Technology in Improving Social/Emotional Behavior

1 - Not effective, 5 - Very effective

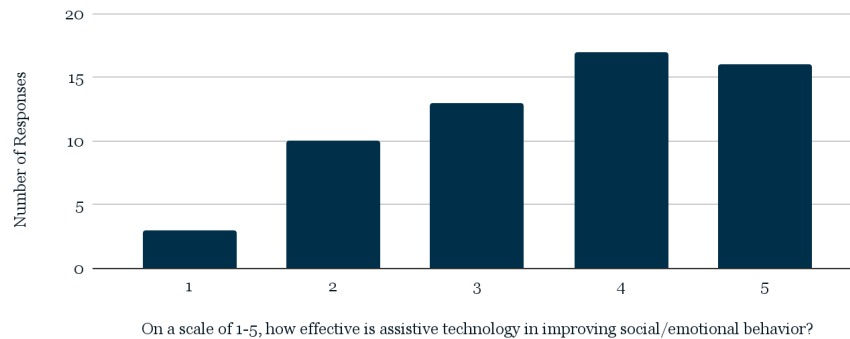


Figure 2. Effectiveness of Assistive Technology in Improving Social/Emotional Behavior

Two optional questions allowed teachers to elaborate on the benefits and drawbacks which the assistive technologies had towards creating a positive learning environment. According to responses, teachers generally had a positive sentiment towards assistive technologies. When asked what positive effects the assistive technologies had on students, twenty said they allowed classroom communication with students with verbal disabilities. Multiple teachers stated that speech generating devices allowed non-verbal students to respond to questions, express their wants and needs, and socialize with others in their classes. This would not have been possible, or very difficult to do, without the assistive technologies, since the students were non-verbal and could not communicate otherwise. As to quote one teacher, the assistive technology “gave students a voice.”

Assistive technologies also facilitated independence inside and outside of the classroom, as stated by three teachers. Speech-generating devices and assistive reading/writing programs allowed students with severe disabilities to interact with others without the assistance of an interpreter or special education teachers, both at school and at home. Improvements are not limited to just social and cognitive disabilities. One teacher stated that electric wheelchairs allowed for much more independent movement of students with severe physical disabilities. Another teacher noted that using “a device that magnified and illuminated non-digital text” rapidly improved a student with visual impairments reading capabilities, and allowed the student to “access the same information his peers did.” Furthermore, teachers stated that assistive technologies like e-readers and a read&write browser extension allowed for academic achievement. Two teachers stated that these technologies improved reading comprehension, and allowed students to increase writing skills and vocabulary.

Mr. Roo Salimbeli, a special education teacher interviewed in this study, described that the use of assistive technology on a student with severe non-verbal autism caused a “major improvement” to the student’s social ability. Through one year of use of touchchat, a speech-generating app available on an iPad which allows one to use buttons to talk, the student advanced from being completely non-verbal to being able to ask questions and engage in conversations. The teachers were able to use the program to effectively communicate with students, overcoming the significant verbal barrier. However, Salembeni also states that the effectiveness of the assistive technologies “varies from student to student,” and that some students “don’t really use it for anything but pushing buttons.”

However, teachers also indicated some aspects which the assistive technologies were not necessarily helpful for creating a positive learning environment. Five teachers indicated that the assistive technologies could be abused for non-educational purposes. Multiple indicated that “students would visit other websites like instagram and social networks” using their assistive iPads and chromebooks, and would cause “unfocusing” and a loss of attention. The constant surrounding of technology was also stated as “distracting”. One response said that “Software such as Photomath and

ChatGPT would be used to shortcut assignments” and impair academic ability instead of supporting it. One teacher even cited that there would be a “potential behavioral escalation” when correcting a distracted student.

Other negative effects included the technologies creating dependencies on them, and replacing real world interactions. According to a teacher, the assistive technologies are used in scenarios where students “would not need them”. Another stated that “the technologies could replace real world interactions” for students which could potentially communicate verbally, and that “Human interaction is more important”.

Six teachers cited the technological drawbacks of assistive technologies, stating that they had technical issues or were hard to use. One specific technologie, the speech-to-text software which was being used, was “awkward to use in large classrooms”, and “unclear speech was unable to be picked up”, according to four responses. One stated that the technology was too complicated for use, and another reported being locked out of their devices.

Status of Implementation of Assistive Technologies

The final section of the survey concerned barriers to, status of, and resources given for the implementation of assistive technologies in HCPSS schools. First, a question asked how assistive technologies are provided, and nearly all members (58) responded that the technologies are provided by the county. 16 responses stated that the technologies are provided by the school, and 10 responses stated that they are provided by parents. Other responses indicated that technologies are also provided by teachers themselves, private insurance, and “outside entities like Johns Hopkins.”

Another question asked respondents about the main barriers to the implementation of assistive technologies. Respondents could select one or multiple of the choices, which included a lack of training, high costs, lack of resources, negative views, insufficient assessment, time, or technical problems. Respondents could also note other barriers as well. According to Figure 3, out of 59 respondents, 40 respondents selected the ‘lack of training option,’ the most significant barrier according to the question. A lack of resources/guidance about assistive technologies (27 respondents) and technical problems (21 respondents) were also significant barriers indicated. Additionally, High costs (16 respondents) and insufficient assessment (12 respondents) were somewhat concerns to staff surveyed. 4 respondents noted that time for implementation of assistive technologies was a concern, and 3 respondents selected that negative views about the assistive technologies were a barrier towards implementation.

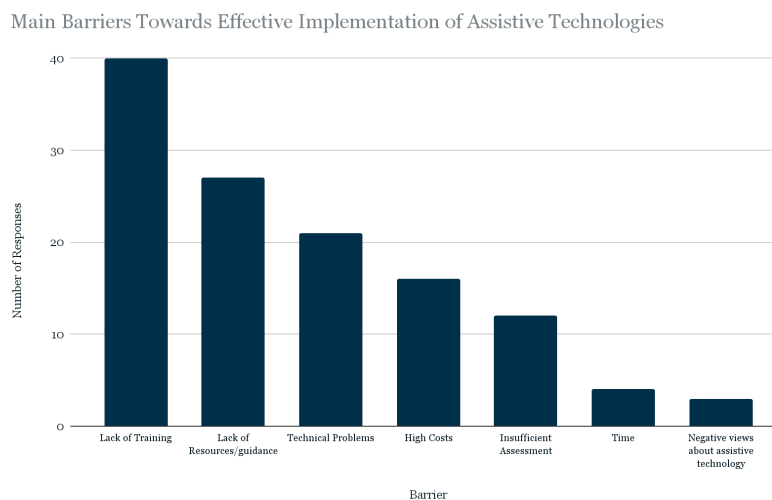


Figure 3. Main Barriers Towards Effective Implementation of Assistive Technologies

To follow up with the previous question, staff were prompted to elaborate on any significant barriers. This question was optional, and gained 18 respondents. Similarly, the vast majority of the responses concerned a lack of training for assistive technologies. 16 responses out of 18 indicated a lack of training. Staff stated that time was an issue towards training, citing that there “was not enough time and training to implement assistive technologies,” “staff are always behind in training,” and the “SLP (Speech Language Pathologist) does not have enough time to train staff and no one else does.” Assisting staff, like paraeducators and student assistants, noted that they are “unable to understand how to use the technologies when main staff are not monitoring”, indicating a complete lack of training for teaching assistants. Furthermore, a student assistant said that “they do not have access to curriculum or assistive technologies.” Main instructional staff also stated that training is a major issue, and could not access some assistive technologies like “PDF annotators or word prediction.” From the interview with Mr. Roo Salimbeni, like many of the respondents to the survey, also indicated that he “would like to be trained more on assistive technologies.”

Three staff members reported that staff “learn as [they] go”, and “learn things through word of mouth, not formal instruction.” This is consistent with the preliminary interview with Salimbeni, where he stated that “teachers are forced to find assistive technologies in the classroom for themselves.”

In order to obtain specific details about the training given to staff, a question asked respondents to elaborate on the training they are given towards assistive technologies. 22 respondents noted the presence of professional learning sessions, in person workshops to train staff on technologies. These optional workshops are requested by staff as needed, and are scheduled several times throughout the year. However, according to multiple responses, they are “rudimentary” and “hard to attend along with school schedules and meetings.” The meetings are “limited”, and only last for “about an hour each”. To explain the deficiency in the training sessions even further, 9 respondents were not even aware of any training given. According to the interview with Salimbeni, the professional learning sessions, the only training provided, only covers the touchchat speech generating app. 7 responses indicated that the Speech Language Pathologist and therapists train teachers about assistive technologies as well, but according to previous responses, the SLP often does not have enough time to carry out training sessions and thus provides insufficient training.

How Well Trained are Teachers with Assistive Technologies?

1 - No training, 5 - Full, comprehensive training

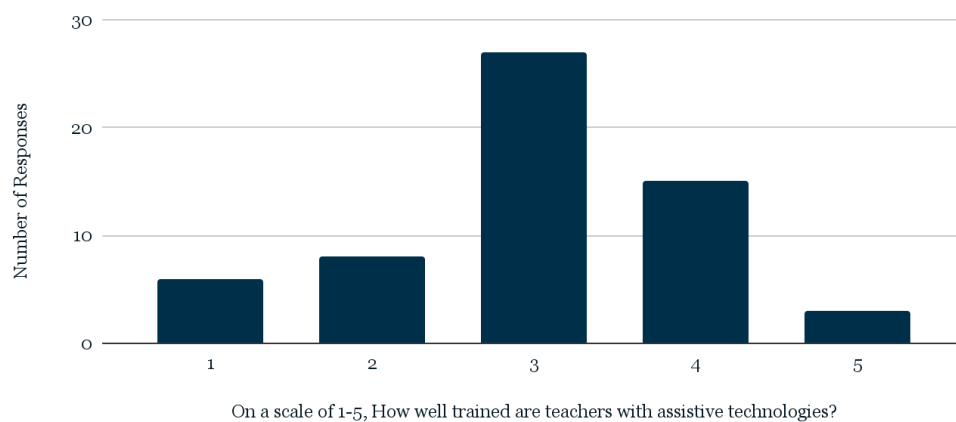


Figure 4. How Well Trained are Teachers with Assistive Technologies?

The lack of training is clearly evidenced in Figure 4 - a question that asks how well are teachers trained about assistive technologies. The question asks respondents to rate the training teachers receive about assistive technologies on a scale from 1-5. The data from this question follows a clear normal distribution, with a mean of 3.02 and a median of 3.00.

How Well Informed are Teachers with Assistive Technologies?

1 - Not informed at all, 5 - Very well informed

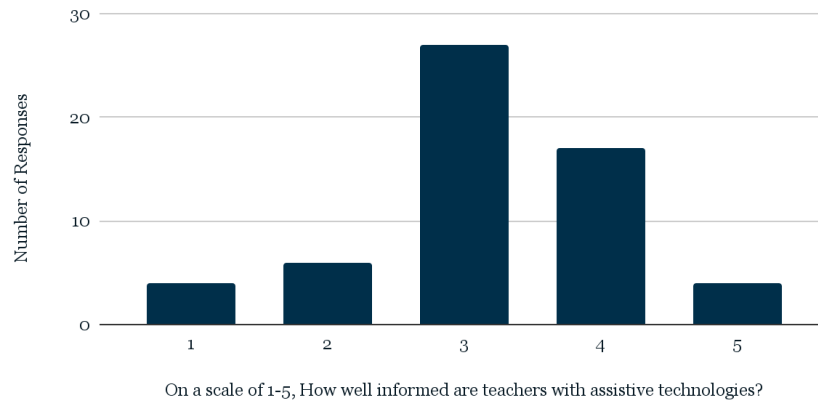


Figure 5. How Well Informed are Teachers with Assistive Technologies?

Similarly, the extent to which teachers are informed about assistive technologies follows a similar distribution and center with the training of staff with assistive technologies, as evidenced in Figure 5. Compared to data from Figure 4, the mean is slightly higher at 3.19, and the median is the same at 3.00.

How are Students Instructed on the Use of Assistive Technologies?

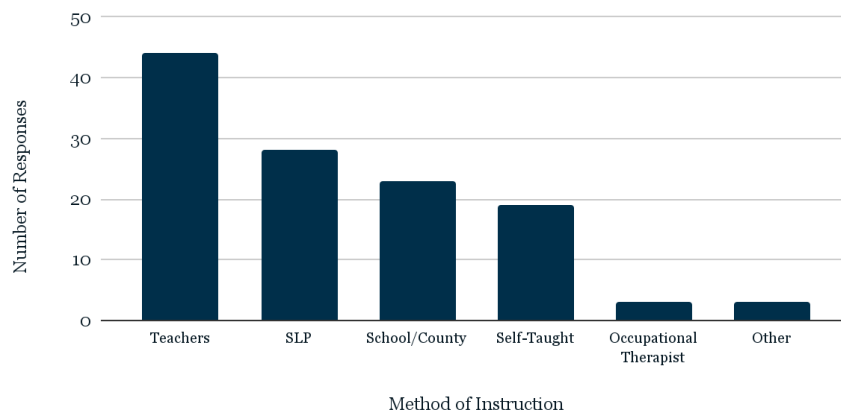


Figure 6. How are Students Instructed on the Use of Assistive Technologies?

The training of staff is critical in the implementation of assistive technologies, since students are largely instructed by teachers to use assistive technologies, according to Figure 6. The majority of respondents (44) said that students are instructed by teachers, and a significant amount said that they are instructed by the SLP and themselves (self-taught).

In addition to training, the survey also evaluated the resources and support of assistive technologies within HCPSS. Two questions asked respondents to rate the resources of assistive technologies and the ease of obtaining

support for the assistive technologies on a scale from 1-5.

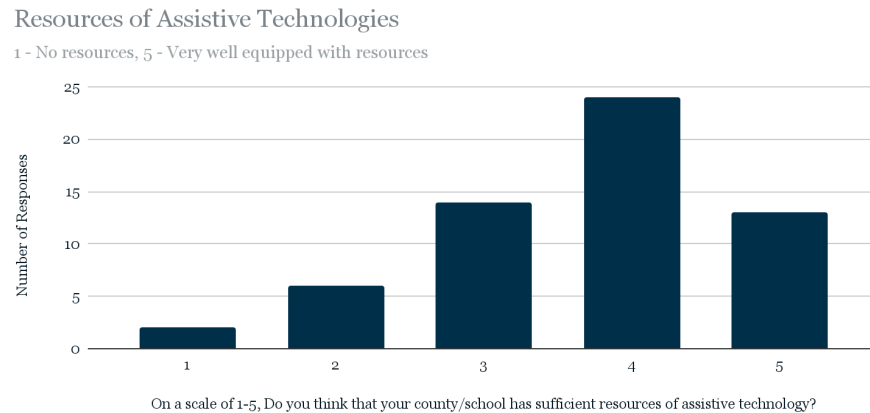


Figure 7. Resources of Assistive Technologies

According to Figure 7, respondents generally believed that their school had sufficient resources for assistive technologies. The distribution of the data followed a left-skew, and had a mean of 3.68 and a median of 4.00. 62.7 percent of respondents selected a score of ‘4’ or ‘5’.

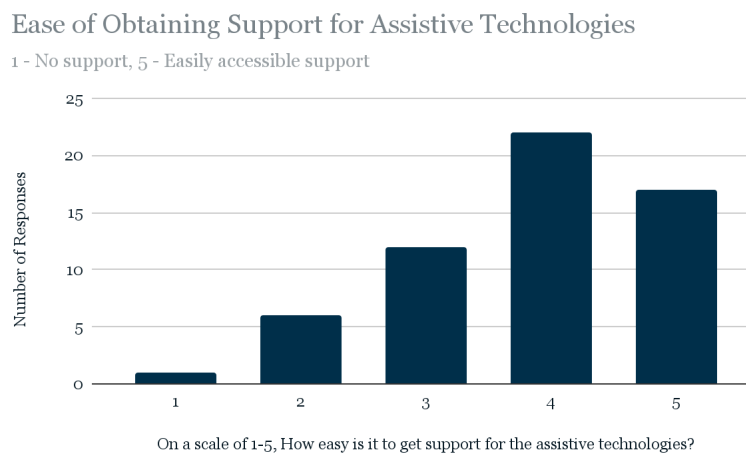


Figure 8. Ease of Obtaining Support for Assistive Technologies

The results from the question asking about the ease of obtaining support had a similar left-skewed distribution, according to Figure 8. The mean was slightly higher at 3.83 and the median was the same at 4.00. 67.2 percent of respondents selected a score of ‘4’ or ‘5’.

The survey then asked respondents to elaborate on the specific resources and support available for HCPSS staff from the county. A canvas (online academic portal used throughout HCPSS) page contains information about assistive technologies, and provides self-paced modules to complete for training. Also, according to one response, “the media specialist also acts as an impromptu technology resource,” and the “media center” is available for in-school support. A county-wide assistive technology department run by the HCPSS Department of Special Education is also available, according to 10 responses. It is available “when necessary”, but is located off-site and thus could be a challenge for some staff to seek support. Other resources available included “information from the manufacturer of the assistive technology.”

Another question asked respondents whether there was a comprehensive assistive technology guide, and the vast majority of respondents indicated that there was none or they are unsure of one. More than half (30) of respondents indicated that they are unsure or unaware of such a guide, and 19 stated that there was no guide in existence. 9 respondents noted that there was some limited guidance in choosing assistive technologies. This clearly indicates a lack of structured and concrete guidance, leaving special education staff without a clear set of assistive technologies available for the classroom. Salimbeni, the teacher interviewed for this study, stated that “It would be a good idea for the county to recommend assistive technologies for students with various needs”.

Is There a Comprehensive Assistive Technology Guide Available for Staff?

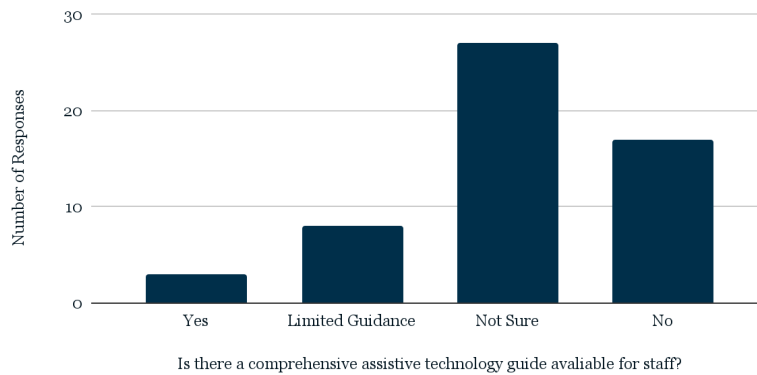


Figure 9. Is there a Comprehensive Assistive Technology Guide Available for Staff?

The quality of assistive technologies was also perceived as a barrier, with responses stating that “devices often break or need to be charged” and that “technology does not work or glitches.” Other significant barriers include the lack of “COVID funding, meaning that many students don’t have a device anymore”, the time spent on “requesting a device” and “exploring assistive technology options”. The amount of “legal requirements in order to give students necessary assistive technologies” was also mentioned, likely due to the time-consuming IEP evaluation process necessary to prescribe assistive technologies.

In order to gauge the overall accessibility of assistive technologies, a question asked respondents to rate the ease of access to assistive technologies on a scale from 1-5. According to Figure 10, assistive technologies were generally perceived as somewhat accessible, with the mean score of 3.66 and a median of 4.00. 80% of respondents selected ‘No’ or ‘Not sure.’

Ease of Access to Assistive Technologies

1 - Not accessible, 5 - Fully accessible

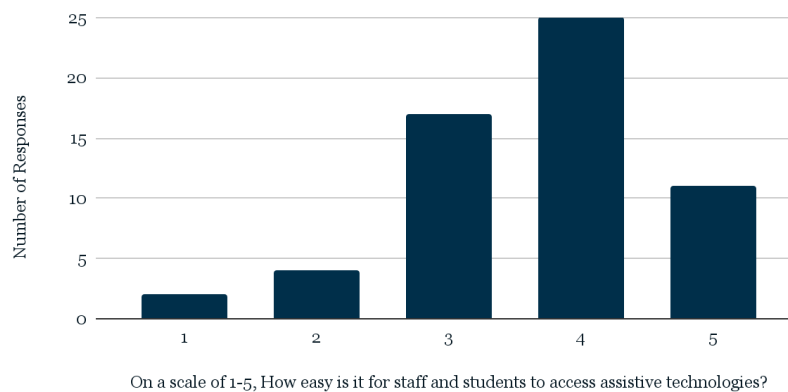


Figure 10. Ease of Access to Assistive Technologies

Finally, teachers were asked about the extent of the deficiency in the implementation of assistive technologies and their interest in learning more about them. According to Figure 11, staff were generally fairly confident on the implementation of assistive technologies, with most responses selecting 4 on a scale from 1-5, indicating that the current implementation of assistive technologies largely meets the needs of students and staff. The average rating for the extent of the deficiency was 3.49. 61.0 percent of respondents selected a score of ‘4’ or ‘5’.

Extent of the Deficiency in the Implementation of Assistive Technologies

1 - No AT used, 5 - Fully meets needs of students and staff

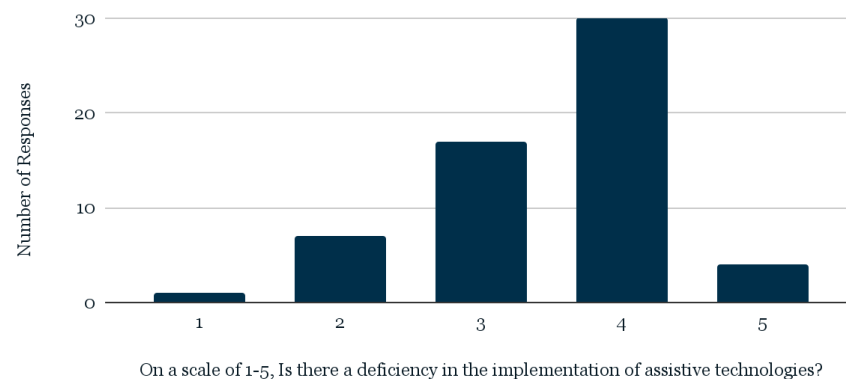


Figure 11. Extent of the Deficiency in the Implementation of Assistive Technologies

Staff also showed interest in learning more about assistive technologies. At the end of the survey, a question allowed respondents to indicate their interest in learning more. According to Figure 12, the results showed a strongly left-skewed distribution, with a mean rating of 3.95.

Interest in Learning More about Assistive Technologies

1 - Not interested, 5 - Very interested

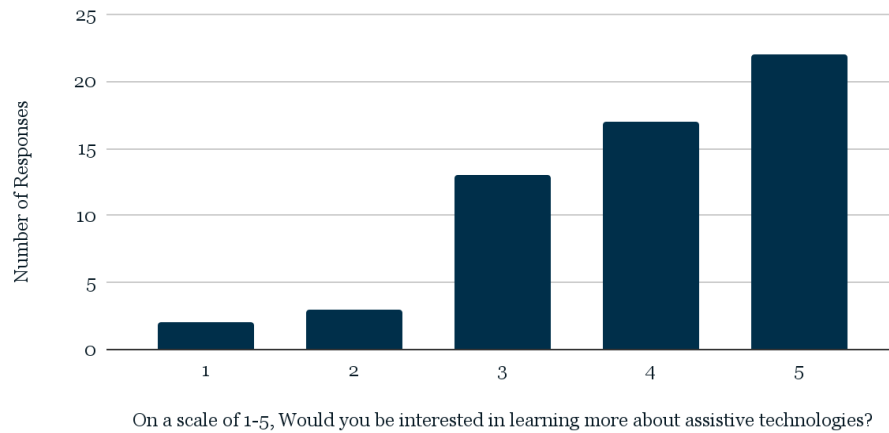


Figure 12. Interest in Learning More about Assistive Technologies

Socioeconomic Status vs. Respondent scores

The study also aims to determine if socioeconomic status is a barrier towards effective usage of assistive technologies within Howard County. To analyze this factor, the level of access, training, resources, and support was considered and stratified with low, mid, and high income levels. One question asked respondents to provide their school’s income level, out of low, mid, and high levels. For each question, the means for respondents who selected low-income, mid-income, and high-income were calculated and compared. A chi-squared test for independence was run with the data and 8 degrees of freedom for each question, and the Chi-squared test values and p-values were recorded. Both the chi-squared results and the means were recorded in Table 1. No statistically significant relationship was found between income level and response score for any of the four questions, with p-values well over the alpha-value of 0.05.

Table 1. Socioeconomic Status vs Respondent Scores Statistical Test and Summary

	Ease of Access	Training Provided	Resources Available	Support Available
Low-income mean	3.59	3.24	3.71	4.18
Mid-income mean	3.79	3.13	3.79	3.58
High-income mean	3.55	2.67	3.50	3.78
Chi-square test value	7.984	7.382	4.636	5.620
P-value	0.435	0.496	0.796	0.690

Conclusion

After a comprehensive analysis of study results, one could conclude that assistive technologies are largely perceived as beneficial for students with disabilities, the school system is well-resourced with assistive technologies, but staff training for assistive technologies is significantly lacking and would need improvement.

Assistive technologies were proven to be effective at creating a positive learning environment, improve academic performance, and benefit social behavior. According to Figure 1, Figure 2, assistive technologies were shown as beneficial toward student performance and behavior, with improvements towards academic performance more notable than improvements in social/emotional behavior. Assistive technologies were perceived by respondents as very effective in improving academic performance on a scale from 1-5, since all respondents selected '3' or greater, and 83% of respondents selected '4' or '5.' Regarding improvements in social and emotional behavior, results were less clear, with only 56% of respondents selecting '4' or '5' out of 5. However, individual explanations did indicate positive social benefits of assistive technologies. Speech-generating devices were described by multiple results as significantly improving social behavior for non-verbal students, allowing them to communicate, socialize, and work largely independently. These findings are in accordance with findings from Hoppestad, Hodon, Judge, and Lahm, which stated that assistive technologies allowed communication and "general activities of daily living." Assistive reading and writing programs improved the academic performances, allowing students with cognitive disabilities to comprehend reading, and also improved writing skills. Despite the numerous advantages of assistive technologies, they also had several drawbacks, including distracting students and creating dependencies, as described by multiple responses. The technologies were sometimes abused by students and used for non-academic purposes, hampering their academic performance, and were sometimes used for students which would not necessarily need the assistive technologies.

The Howard County Public School System is also fairly well-resourced with assistive technologies, with resources, support, and help readily available from the county. According to Figure 7 and Figure 8, respondents were generally positive towards the available resources of assistive technologies and the ease of obtaining support for assistive technologies, reporting a mean of 3.68 and 3.83 respectively. The majority of respondents reported scores of '4' or '5' out of 5, with 62.7% and 67.2% of respondents selecting scores of '4' or '5' for resources and support provided respectively. Readily available support was present, with in-school help from the media center and an off-site assistive technology department for any further support. Respondents noted that the department is readily available, and willing to help with any technical issues. In addition, socioeconomic status was not shown as a barrier towards the implementation of assistive technologies in HCPSS, contrary to preliminary studies by Ahmed, Judge, Copley and Ziviani, all who noted that cost and finances were a major barrier towards assistive technologies. In this study, though, there was no statistically significant relationship found between socioeconomic status and reported levels of access, training, resources, and support for assistive technologies. After running a chi-squared test for independence between income level and scores for the aforementioned four questions on scales from 1-5, the p-values for all four questions were over 0.4 and well over the generally accepted alpha-value of 0.05, indicating no relationship between income and respondent scores. This was likely the case due to a standardized IEP procedure and assistive technology department available for all schools to access throughout the county, and the school system's well funded budget of over \$150 million (HCPSS).

However, concrete guidance for staff is also lacking, with Figure 9 indicating the absence of a comprehensive assistive technology guide. 80% of respondents to the question indicated that there was none or they were unaware of such a guide existing. The lack of structured and concrete guidance for teachers to choose assistive technologies would likely lead to a lack of staff awareness towards usage and implementation of assistive technologies, in spite of available technical support.

On the other side, there is still a deficiency in the training of staff for use of assistive technologies. According to Figure 3, Staff indicated that a lack of training was the most significant barrier towards effective implementation of assistive technologies. Figure 4 and Figure 5 support this claim, as the responses to how well teachers are trained and informed with assistive technologies had low mean and median scores of around 3.00, well below any score from

other questions in the survey. The majority of respondents reported scores of '3' or below out of 5, with 69.5% and 63.8% of respondents selecting scores of '3' or below for training and how well they are informed respectively. These figures are similar, albeit slightly less extreme, than the studies carried out by Sharpe and Deter et. al, both of which reported figures of around 80% of staff stating that they had inadequate training for assistive technologies. Many staff stated that the training was limited to sporadic, optional workshops scheduled several times per year, lasting for about an hour each. The training was described as "limited", "rudimentary", and "minimal" by multiple responses. Such workshops would likely cover only basic details about assistive technology, and would have little time to delve into the more complicated and useful functions of assistive technologies. Several responses stated that there was simply not enough time for comprehensive assistive technology training, due to tight teacher schedules and unavailability of training staff, such as the Speech-Language-Pathologist. Multiple staff indicated that they were constantly behind on assistive technology training. Furthermore, paraeducators and assisting staff are given minimal or no training about assistive technologies, leading them to be unable to use and help students with assistive technologies, which would be especially useful if the main teaching staff is unavailable at times. All of these factors signify a major lack of staff training, and pose a barrier towards effective implementation of assistive technology.

Assistive technologies were generally perceived as somewhat to access, according to Figure 10, with 61% of respondents selecting scores of '4' or '5.' Regarding the implementation of assistive technologies, no major deficiency was perceived, but results did not seem too optimistic, according to Figure 11. 57.6% of respondents selected scores of '4' or '5' out of 5, when asked about how well implemented assistive technologies are. Only 4 respondents selected '5' for this question. The decent implementation of assistive technologies would certainly be aided by sufficient resources and support, as mentioned earlier in the study. However, the training of teachers is crucial for effective implementation in addition to sufficient resources, as assistive technologies could only be effective when properly used to their full ability by well-trained staff. In the end, as shown by Figure 12, the majority of teachers (68.4% selecting '4' or '5' out of 5) showed interest in learning more about assistive technologies, and effective training and guidance would improve teacher awareness and efficacy of assistive technologies.

Limitations

The study, being an observational study, could have multiple potential sources of error. Response bias could have been present, since respondents were asked to provide their own responses and could have changed their answers accordingly. The individual perceptions about deficiency and resources about assistive technologies vary as well due to the subjective nature of responses. What is a major barrier to one teacher may not seem as a major barrier to another, and teachers have varying experiences with assistive technology. Non-response bias also was present, due to the voluntary nature of the study. Out of over 1200 emails sent, only 59 responded, demonstrating a significant amount of people who ignored the email and survey. This was expected, as not all teachers would have had the time or been willing to respond to the 15-minute survey. Some teachers might have not known much about assistive technologies and thus didn't want to answer, leaving the study potentially having underrepresentation of that population. In addition, many staff reported being out of office using an automated reply during the surveying time period due to varying reasons.

Recommendations for Practice

With the results of the study, two changes would be recommended: Adopting a comprehensive assistive technology guide and improving assistive technology training for staff. Since a large number of respondents noted that they were unaware of available assistive technologies which they could use, a comprehensive assistive technology guide would greatly improve staff awareness of available assistive technologies, and thus implementation of the said technologies. It would contain various common assistive technologies available on the market, and the disabilities which they would

assist students with. Thus, teachers would be able to find assistive technologies easier and alleviate the issue of staff largely being unaware of solutions.

Training for staff should be improved with two methods: First, the training sessions should be improved. Instead of sporadic workshops several times per year, all staff working with students with special needs should receive mandatory, comprehensive training consisting of multiple in-person sessions with an assistive technology expert. In addition, the county should hire more assistive technology experts, such as occupational therapists and speech-language pathologists to allow for more staff capable of training, and alleviate the issue of not having enough time for staff training. Furthermore, student assistants and paraeducators should also receive training on assistive technologies to ensure effective usage of the technologies, even when the main staff is not available.

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