

Accessibility of Elementary School-Based Assistive Technology: A Descriptive and Associational Survey

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Abstract: The purpose of this quantitative survey design study was to better understand the perceived barriers of accessibility of elementary school-based assistive technology (AT) from the perspective of parents, teachers and occupational therapists. Furthermore, the purpose of this study was to quantify parent, teacher and occupational therapist perceptions on the benefit of AT training, frequency of AT use, and the efficacy of AT use in the school and home environments. This 13 question survey collected a combination of nominal and ordinal data on participant profession, benefit of AT training, frequency of AT use, level of support by elementary school institution, method of payment for acquiring AT, and the efficacy of AT use in the school and home environments. 33 participants responded to the survey, however only 27 met inclusion criteria ($n = 27$). Participants reported the frequencies of which specific forms of AT they observe children using in both the school and home environments. The amount of training one received on operating AT was moderately correlated with feelings of support for the child from the IEP team regarding AT, $rs(27) = .429$, $p = .013$, Fisher's $z = .459$, CI 95% [0.12, 1.00], VS-MPR = 6.64. The frequency of use of AT by a child was moderately correlated with feelings of support for the child from the IEP team regarding AT, $rs(27) = .392$, $p = .022$, Fisher's $z = .414$, CI 95% [0.08, 1.00], VS-MPR = 4.38. The perceived benefits from AT for students were moderately correlated with the feelings of support for the child from the IEP team regarding AT, $rs(27) = .438$, $p = .011$, Fisher's $z = .470$, CI 95% [0.13, 1.00], VS-MPR = 7.35. The level of support one feels from their IEP team can significantly predict perceived benefit from AT, $F(3, 23) = 3.897$, $p = .022$. The results of this study indicate that participants universally believe that for AT to be at its most beneficial, training is vital for teachers, parents, and therapists to become confident in utilizing AT, alongside strong elementary education institutional support. Further research is indicated to improve understanding of AT access and AT compliance strategies in the elementary education setting.

Keywords: Assistive Technology, Pediatrics, Elementary, Occupational Therapy, Access, Barriers, IEP

1. Introduction

1.1. Assistive Technology

Assistive technology (AT) can be characterized as equipment, devices, or programs that aid individuals in engaging in daily activities to promote independence and improve functionality. This technology applies to various populations and serves the purpose of promoting inclusion and usability for individuals of all abilities. According to the World Health Organization [1], AT can be implemented to

“enable people to live healthy, productive, independent and dignified lives, and to participate in education, the labor market and civic life” (para. 1). The benefits of AT are apparent in research and practice for school-aged children, although barriers regarding access to AT acquisition and ability to utilize them are often overlooked. Frequently in pediatric clinical practice, occupational therapists are responsible for the prescription and administration of AT.

The American Occupational Therapy Association (AOTA) [2] defines the function of occupational therapy as a profession that “maximizes health, well-being, and quality of

life for all people, populations, and communities, through effective solutions that facilitate participation in everyday living". Through observation assessments and interventions, occupational therapists strive to increase independence and quality of life through the use of AT. A common misconception about AT is that it cannot be used in environments outside of the school setting. This myth can be influenced by implicit bias or preconceived notions which can be mitigated through understanding "prominent issues, research trends, and AT applications with minimal bias" [3]. It is pertinent to ensure that AT is being utilized within multiple settings, such as in the child's home environment and school environment as to enhance quality of life and enable functional independence. AT used in more than one setting has been shown to increase opportunities for children, leading to an overall increase in levels of proficiency in daily activities [4]. Individuals utilizing AT demonstrate improvements in engagement in daily activities, functional mobility, complex instrumental activities of daily life, and complex IADLs through the use of orthotics, prosthetics, environmental modification tools, and postural seating devices [5]. However, more often than not, children within the school system face barriers that hinder their engagement in occupations necessary for successful development.

1.2. Barriers

1.2.1. Legislation

A barrier that consistently affects the groundwork for AT is due to ever-evolving legislation. There is a wide variety of acts that have been passed to aid with the distribution and access of assistive devices. Firstly, the Rehabilitation Act of 1973, Section 504, required that children with disabilities have access to AT devices and other services concerning education [5]. Overall, Section 504 helps students with accommodations within their education. It also extended rights regarding housing, employment, and the creation of accessible technology for people with disabilities.

In 1988, the Technology-Related Assistance for Individuals with Disabilities Act or the Tech Act was introduced, expanding the reach for assistive devices through multiple sections to provide a new definition of AT. This Act states any article, however, it is obtained, increases the "functional capabilities of individuals with disabilities" [5]. Additionally, statewide programs were created to provide AT by completing research, creating committees, and sharing data with the federal government. Part B of the Tech Act stated that a national information and program referral network must be created in each state by order of the secretary [6]. Part C provided direction for training and public awareness projects. In 2008, the Tech Act assisted "252,647 individuals, and trained 62,344 professionals, users, and family members" [7]. Although OTs feel that the Tech Act does not provide enough training for practitioners or providers, it did extend the ability of the state to provide AT [6].

The Americans with Disabilities Act (ADA) of 1990 provided further protection to adults with disabilities by assuring equal opportunities and adaptations in employment, transportation, and communication. The purpose of the ADA

act was to diminish the discrimination brought upon individuals with disabilities and provide the possibility for furthering equity and justice [8]. The ADA specified that AT does not limit an individual's ability to participate in life and cannot restrict them from employment or credentialing process.

In 2004, the Individuals with Disabilities Education Act (IDEA) was enacted to provide education free of charge to children with disabilities that meet their unique needs and prepares them for the future [7]. The Act provides financial aid to states and school districts to supply appropriate resources. It also mandates that AT is acknowledged in each Individualized Education Program (IEP). This provided the opportunity for school districts to provide AT for children to meet their curriculum-based goals and be successful.

Overall, legislation has helped increase rights and regulations for people who need AT. The Rehabilitation Act, Tech Act, ADA Act, and IDEA have assisted with creating equal opportunities for all. However, many OTs have historically not been confident in legislation providing enough of an impact in breaking down the barriers to access and use of AT [6].

1.2.2. Insurance

Legislation has provided opportunities for children with disabilities to access AT if they meet the requirements within their IEP [6]. If the technology is supplied by the school and the technology is deemed necessary to complete homework outside of school, it can then be used in the child's school and home environments. If the technology is not required for schoolwork at home, or the children are not of school age, then children do not have access to technology at home [7].

To be covered by Medicaid, AT must be deemed necessary to improve the function of the individual under the strict regulations to be used at home. It is specified in the legislation that AT must be for in-home use if it falls under the definition of durable medical equipment, which creates a large barrier in terms of access [10]. These are judged on a case-by-case basis; dispersal is highly dependent on the documentation and letter of medical necessity provided by the providers. Additionally, the Institute of Medicine (US) Committee on Disability in America [10] asserts that insufficient research and evidence supporting the use of AT contributes to the lack of supply of devices. Individuals on private health insurance face many of the same barriers. Federal law mandates that states cannot require private health insurance to cover certain items or devices [10]. In 2001, 40 percent of individuals were required to pay out of pocket for these devices [10]. Insurance creates a large, time-consuming barrier that many individuals are unable to break, requiring them to go without AT or pay for the devices themselves.

1.2.3. Lack of Education

Once children receive AT, there are still many barriers that can prevent them from accessing the technology fully, or even at all. Barriers in the literature often include a lack of education, training, and carryover in the implementation of technology [11]. The reasons behind why barriers associated

with a lack of education and training occur appear to be products of limited access to training and negative perceptions of AT [12-13].

One of the largest reasons behind the lack of education for AT is limited access to training. Working with AT is often seen as a specialization, but as AT is becoming more mainstream, the professional administered training for AT has not become more readily available to consumers and patients [12]. A study done by Long *et al.* [12] investigating the needs of pediatric OTs in AT found that 40-73 percent of their 272 participants reported inadequate or no training in five categories of training: "working with clients with disabilities and assistive technology/assistive technology services, service delivery systems regarding assistive technology/assistive technology services, working with families regarding assistive technology/assistive technology service, collaborating with other service providers, legislation, regulation, and policy related to assistive technology services" (p. 348-349). This study highlights the severity of the lack of education for those who are implementing AT to children; if an OT who is implementing AT is undertrained, then the child is automatically put at a disadvantage to access the AT correctly. Ray *et al.* [14] found that when training was provided to a group of teachers there was a 42% decrease in the percentage of teachers reporting unfamiliarity with AT, generally supporting the value of proper training for the administration of AT for both providers and their clientele. It is crucial to prioritize and generalize the education of OTs and other professionals in the implementation of AT so the child can fully utilize their devices.

Attitudes and perceptions of AT can also create a lack of education, training, and carryover of AT by professionals for their pediatric clients. According to Onivehu *et al.* [13], attitude is one of the main factors that influences occupational performance and participation of an individual. Teachers that displayed positive perceptions towards the use of AT were more inclined to implement such devices within their classrooms. On the other hand, teachers with negative perceptions of AT and the implementation of such devices were much less likely to include these devices within their classroom amongst students [13].

1.2.4. Students

A student's lack of opportunity to utilize AT also serves as a major accessibility barrier. Due to school-based activities being a key occupation in children with disabilities, AT is essential to enable them to participate in learning activities meaningfully. AT improves the functioning of children with disabilities in school environments while also encouraging learning within the classroom [15]. Students with visual impairments are more prone to using the provided AT in special education classrooms when compared to their hearing-impaired or physically disabled counterparts when looking at the specifics of children with disabilities. While students with physical disabilities may rely on mobility aids, visually impaired students may need more frequent aid from AT to enhance participation and communication in social environments [15]. Children with developmental disabilities

are also less likely to meet their vision and hearing needs due to a lack of correctional treatment, which may further impact their learning and motor skill development [16].

AT training must oftentimes be carried over into the home of the student in addition to the classroom. Families of students with disabilities are an integral part of the student's educational experience and collaboration with the family on how to use AT in the home is a key component of increasing participation in the school setting [17]. Proper training of the families on how to use AT in the home requires a high level of collaboration between family and service providers. To prevent the abandonment of AT, service providers must put the needs of the family as the top priority of their agenda when thinking about the selection of devices and utilization of AT for their students [17]. AT is used inside and outside the classroom to give children opportunities to thrive in various activities. Every child who receives an IEP must be considered for AT, and many students have positive results with using AT to meet their individualized goals [18]. When AT is used within the classroom, it allows children to comprehend and access curricula content independently [11]. Researchers found that AT is more effective when introduced and given in a more client-centered environment, as well as when there were educational resources to teach children how to use the technology [19].

1.3. Increase in Productive Activities

Productive occupations are activities in which an individual acquires and obtains meaning from [20]. Play, followed by leisure, are widely considered to be the most important occupations for developing children [6]. According to Isabelle *et al.* [6], AT and devices provide children with disabilities the opportunity to "play, move, communicate, and control their world like other children their age". Not only does this allow children to experience a sense of autonomy and independence, but it increases their motivation and occupational performance. Play is an essential occupation of a child and allows them to explore and socialize with family, teachers, and classmates. However, for children to have the opportunity for these experiences, it is necessary that proper training in methods and techniques are implemented to provide appropriate and adequate services of AT and devices amongst teachers, families, or caregivers. Lastly, within the education system, one of the main skills that children are learning to engage in is reading and writing. According to Svensson *et al.* [21], with the use of AT, children can engage in learning activities amongst their peers through "an alternative to the traditional way of reading and writing".

2. Methods

2.1. Study Purpose

The purpose of this quantitative survey design study was to better understand the perceived barriers of accessibility of elementary school-based AT from the perspective of parents, teachers and OTs. Furthermore, the purpose of this study was to quantify parent, teacher and OT perceptions on the benefit of AT training, frequency of AT use, and the efficacy of AT

use in the school and home environments.

2.2. Procedures

Inclusion criteria for this study included the teachers, parents and therapists of elementary aged students who utilize AT in the school setting, and also the home setting if applicable. Exclusion criteria included pre-school, middle and high school teachers, as well as any teacher, parent or therapist of a child who does not utilize AT. The sampling method of this study was purposive sampling and snowball sampling. Participants were recruited through social media, word-of-mouth, texting, and calling. The survey was virtually distributed through Google Forms, and participants signed a digital informed consent prior to starting the survey, and all participant responses were stored on a password protected laptop.

This 13 question survey was developed based on the model of Occupational Adaptation (OA). This conceptual model highlights the importance of the individual's cognitive, sensorimotor, and psychosocial body function systems, which can be enhanced by AT implemented throughout their lifespan. Principles of OA such as the demand for mastery, desire for mastery, and the interaction between these two components resulting in the press for mastery, allow for an increase in understanding of personal experiences and perceptions [22]. Questions were developed upon OA concepts, such as training received on AT, benefits parents observe, benefits of AT child experiences, barriers children face, and support towards gaining mastery. The questions in this survey collected a combination of nominal and ordinal data on participant profession, benefit of AT training, frequency of AT use, level of support by elementary school institution, method of payment for acquiring AT, and the efficacy of AT use in the school and home environments.

2.3. Data Analysis

All statistical analyses were performed using JASP, a quantitative statistical analysis engine. Descriptive statistics and frequency analyses were performed to quantify ordinal participant responses. The Shapiro-Wilk Test of Normality was used prior to all associational analyses to assess for the presence of non-normal distributions. Throughout this study, Spearman's rho was administered to analyze for correlation between OTs, teachers, and parents' perspectives on AT in the classroom, with Fisher's z reported for regression effect size. A linear regression model was utilized to make predictions of participant ordinal responses where applicable. Finally, Volk-Sellke Maximum p Ratios (VS-MPR) were reported for all regression analyses to provide Bayes Factor bound probabilities of reported outcomes in support of H_1 over H_0 .

3. Results

A total number of 33 participants completed the survey, however only 27 met inclusion criteria ($n = 27$). 27 participants reported the current level of education of their students in elementary school. The sample as a whole was, by majority, elementary school teachers or therapists (see Figure 1).

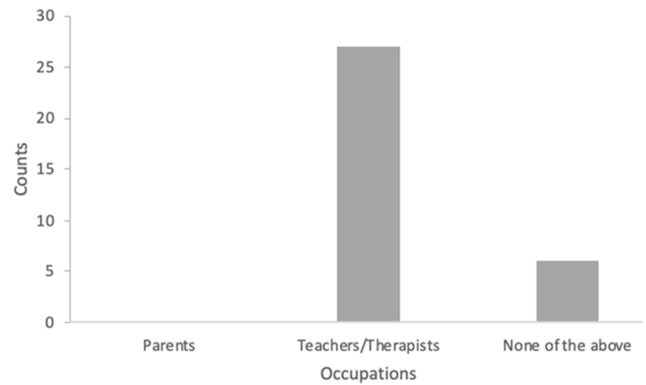


Figure 1. Participants by professional occupation.

27 participants reported that their child utilized one or more types of AT. Of the 27 participants, 42.5% reported the child used speech and communication devices, 15.0% reported the child used mobility, seating, and positioning devices, 12.5% reported the child used hearing devices, 10.0% reported the child used vision devices, 10.0% reported the child used learning, cognition, and developmental devices, 5.0% reported the child used computer related devices, 2.5% reported the child used Ipads, and 2.5% reported the child used a timer.

Regarding reported barriers, 55.0% of participants reported that training/education was the biggest barrier their child or children face. Additionally, 40.7% reported that access to AT was the biggest barrier their child or children face, and 33.0% reported that payment was the biggest barrier their child or children face (please see Figure 2).

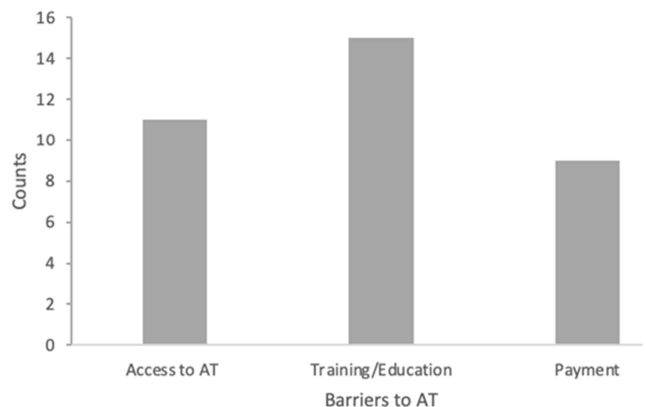


Figure 2. Barriers that a child faces in terms of AT.

Training/Education. 15 of 27 participants responded that training and education was a barrier to AT. 53.0% of participants who responded that training was a barrier also responded that they did not receive training. Two out of 15 participants who responded that training was a barrier responded that they received training but do not feel competent. Lastly, 33.0% of participants received training and did feel competent after listing training and education as a barrier (see Figure 3). The amount of training one received on operating AT was moderately correlated with feelings of support for the child from the IEP team regarding AT, $r_s(27) = .429$, $p = .013$, Fisher's $z = .459$, CI 95% [0.12, 1.00], where VS-MPR analysis indicates that the maximum possible odds in favor of H_1 over H_0 equals 6.64 times more likely for $p = .013$.

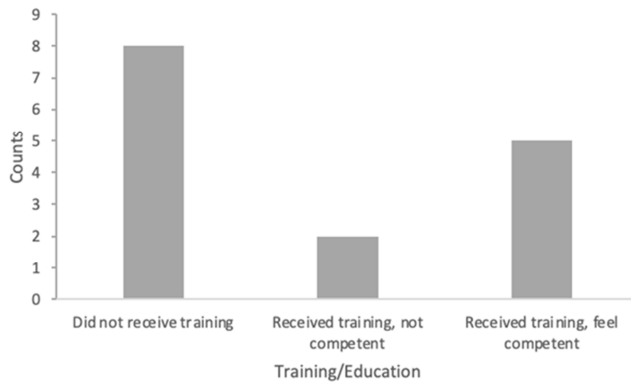


Figure 3. *If the participant received training for AT.*

11 of 27 participants reported access to AT being a barrier their child faces. Of the 11 participants who reported access to AT as a barrier their child faces, 9.09% reported the location of use of AT as a school, 9.09% reported the location of use of AT as a home, and 81.82% reported location of use of AT as both school and home. Of the 11 participants who reported access to AT as a barrier their child faces, 63.63% reported their child used AT as needed, 27.27% reported their child used AT less than needed, and 9.09% reported their child used AT more than needed. The frequency of use of AT by a child was moderately correlated with feelings of support for the child from the IEP team regarding AT, $rs(27) = .392$, $p = .022$, Fisher's $z = .414$, CI 95% [0.08, 1.00], where VS-MPR analysis indicates that the maximum possible odds in favor of H_1 over H_0 equals 4.38 times more likely for $p = .022$.

All 11 participants who responded to access to AT as a barrier also reported benefits to the use of AT for their child. Regarding the location of use in the home versus in the school, 9.09% with the primary use of AT in the home reported increased engagement in learning activities and 9.09% with the primary use of AT in the school reported increased engagement in learning activities. Regarding participants who reported the location of use of AT both at home and school, 36.36% reported increased engagement in learning activities, and 45.45% reported increased engagement in learning. The perceived benefits from AT for students were moderately correlated with the feelings of support for the child from the IEP team regarding AT, $rs(27) = .438$, $p = .011$, Fisher's $z = .470$, CI 95% [0.13, 1.00], where VS-MPR analysis indicates that the maximum possible odds in favor of H_1 over H_0 equals 7.35 times more likely for $p = .011$. Given the level of influence that supports from an IEP has on the perceived benefit of AT, a multiple linear regression model using a forced entry method shows that the level of support one feels from their IEP team can significantly predict perceived benefit from AT, $F(3, 23) = 3.897$, $p = .022$, where VS-MPR analysis indicates that the maximum possible odds in favor of H_1 over H_0 equals 4.38 times more likely for $p = .022$, using a regression equation of:

$$2.759 + (\text{Support Score} * 0.292)$$

Out of twenty-seven survey participants, nine participants responded that payment was the biggest barrier to the child's use of AT. Of those nine people, 77% answered that their

form of payment is through the school, 11% answered that their payment method was out-of-pocket, and the remaining 11% were uncertain.

4. Discussion

An online survey was distributed to assess the perceived barriers to accessibility of elementary school-based AT of parents, teachers, and therapists. The findings highlight that the majority of participants were teachers and/or therapists, with no parents responding to the survey. The lack of parent responses aligns with the lack of research available. As for therapists and teachers, OTs have specific role expectations which can result in a press for mastery [22]. This aligns with the survey results, as OTs and teachers reported their knowledge or gaps of knowledge regarding AT competency. OTs are a vital component in order to increase AT users' independence, as well as educate others on issues relating to AT. For example, research has shown that there is a trend of biases toward AT being used outside of the school system [3]. OTs have the role of not only educating students on how to utilize AT, but also teachers, parents, and other educators on the importance of using AT to address these particular biases.

Literature has shown that teachers act as an advocate for children and the child's self-determination, as they are the ones who see if AT is a good fit or how to adapt to the environment [11]. Many teachers have a positive attitude toward the use of AT within their classroom and are open to students utilizing them. However, there are also teachers that have negative attitudes toward AT which can decrease carry-over into the classroom [11]. Teachers and therapists must be aware that children who experience a disruption in their engagement need guidance in creating adaptive responses. Having an environment that is positive, easily adapts to the child's needs, and is supported by the IEP team shows that teachers and therapists in the school system understand that engaging in daily occupations and understanding potential challenges can lead to occupational functioning and press for mastery [22].

The survey found that the most commonly used AT devices were speech and communication devices. Existing literature on this topic is limited and states that students with visual impairments are more prone to using provided AT in special education classrooms [15]. This finding highlights that the majority of participants have children that use speech and communication devices. AT is a direct part of a child's classroom environment, as shown by the proper implementation of these devices including benefits and barriers directly affecting the child's ability to participate in the occupation of school. With the high representation of speech and communication devices in this study, more research should be done in order to understand the benefits and barriers speech and communication devices hold to provide the best possible interaction between the student and their classroom environment to meet the press for mastery [22].

Some participants, 33%, that received training felt competent in utilizing AT. 13% of participants who responded to received training chose that they did not feel confident after they completed the training. The remaining

participants did not receive training and researchers assumed they were not offered training. These statistics align with a research study done by Long et al. [12], stating that 40-70% of pediatric OTs did not receive training. This supports the notion that training is a barrier to AT use [6]. Floyd et al. [11] agree that the main barrier to AT is a lack of education and training. With AT becoming more common, it is imperative that training is more accessible. For example, the Tech Act has played a valuable impact in the accessibility of training. Part C of the Tech Act provided assistance to hundreds of thousands of individuals including training for all users, their family members, and certified professionals [8]. When facing challenges in the occupational role, parents, teachers, and therapists need to create an adaptive response to using technology [22]. This includes providing education and training to fulfill role expectations.

The findings highlight that students benefit from increased access to AT. Specifically, the findings demonstrate that users who had access to AT at home and within the school setting report experiencing benefits from their AT such as increased engagement in learning and levels of independence. These findings align with previous research that demonstrates an increased use of AT results in increased engagement in occupations [6].

The survey results show that the majority of participants found payment to be the third largest barrier to their child's use of AT. The Individuals with Disabilities Education Act provides financial aid to states and school districts to supply the appropriate AT to children in the school system; this corresponds with our findings that the majority of people pay for their AT through the school system [7]. Additionally, some individuals were required to pay for assistive devices for school use with personal funds. This is consistent with the research findings stating that a small percent of our participants reported that they paid for their devices out of pocket [10].

5. Limitations

The sample size of this study could contribute to a lack of external validity for all elementary school therapists, teachers, and parents. The survey was advertised to parents, teachers, and therapists, yet there were no parent responses. Another limitation is the structure of some survey questions which led to uncertainty among participants. For example, the first question did not have a delineation between therapist and teacher, which may have influenced aspects of face validity within the survey. Finally, the survey limited the participant's ability to choose numerous answers in order to get an accurate picture of the children they serve.

6. Recommendations for Future Research

The current study can be interpreted as a first step in researching the perceived barriers to accessibility of elementary school-based AT of parents, teachers, and therapists. Therefore, this study provides guidance on recommendations for future research. On this basis, future

research should examine the psychometric properties to improve the validity and reliability of the survey as an instrument tool. It is also recommended that future research reproduces this study with a larger sample size using a mixed methods design to gather data tailored towards the populations perceptions, attitudes, and beliefs.

7. Conclusion

Potential practice implications from this study include the need to decrease barriers for parents, teachers, and therapists of AT users in elementary school. This includes creating accessibility for parents to become more comfortable with learning, using, and implementing AT at home. Additionally, competency toward AT should be generalized and more accessible for implementation in the classroom. The survey findings help advocate for future research in the area of speech and communication devices and the specific barriers these devices hold due to the high percentage of survey respondents citing this AT as the most commonly used. To ensure adequate use of AT between different settings, it is necessary to encourage carry-over amongst the therapists, teachers, and parents of AT users for increased levels of independence. It is crucial to make AT financially accessible to encourage accessibility and usage of AT within the classroom and in the home. Lastly, training is vital for teachers, parents, and therapists to become confident in utilizing AT.

Conflict of Interests

The authors declare that they have no competing interests.

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