Integration of Assistive Technology in Existing Syllabus for Children with Special Needs

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***Abstract*-** Special education, like mainstream education, is equally as important for an inclusive and progressive society where no student is left behind. However, due to lack of research and resource allocation to special education students with special needs do not have access to the same opportunities as compared to a mainstream student. The reason for this is lack of progression in the existing syllabus for children with special needs. This study aims to bridge the gap by providing a framework which integrates use of assistive technologies in the learning process. The study is focused children with hearing disabilities. 7 hearing disability students were sampled through convenience sampling. This study employs a pretest-posttest framework, using speech-to-text tablets and close captioned videos as educational methodology. Questionnaires were used as data collection tools that measured 3 variables, self-efficacy, discovery and information use. Findings suggested that there was significant improvement in two variables, namely self-efficacy and information use, and on the third variable, discovery, no change was observed.

***Index Terms*-** Assistive Technology, Hearing disability, Special Needs, Text-to-speech

I. Introduction

Assistive technology (AT) has played a vital role for increased inclusion in special education. Because of its ever evolving nature, there is always a need for research to improve adaptability for students and teachers alike. In the Pakistani context, there is a need to understand that every day there are a significant number of children with disabilities, that face challenges in accessing education (Malik, 2020; Singal, 2020), because of this very reason, the integration of assistive technology holds immense potential for breaking the barriers to inclusive education.

The Assistance Perspective

Assistance is making the task easier to perform in a better way. A gadget gives the human partner the facility during the human-robot contact. In general, all machines and robots are created with certain objectives in mind, including some form of help.

However, in the context of human computer interaction and human robot interaction is particular, the support perspective mostly relates to enhancing human capacities (Newman et al., 2022a). Regardless of application domain, this viewpoint may be expanded to describe the unique tradeoff and patterns that are present in such assistive frameworks are socially helpful robots.

Assistive Technology

Assistive technologies range from hardware and software tools such as mobility aids, braille machines, visual alert systems, hearing aids, calculators, and spelling programs, all of which contribute to the ease and efficiency of daily tasks (Berndsen, 2012). The benefits that one can achieve from the use of such technologies is the reason for advocacy among parents, teachers and educational institutions alike. This advocacy serves as a means to offer compensatory benefits, address academic issues, foster personal independence, and provide specialized support, from spelling checking techniques to sophisticated speech recognition systems (Berndsen, 2012).

Although the use of Assistive Technology may vary to several ages, like the elderly with chronic illnesses, and those who are disabled are the highest (Smith, 2018). One in ten people who are disabled are kids for whom the use of Assistive Technology can be extremely beneficial. In order to engage in family, community and live a fulfilled personal and professional educational life, people with special needs should have access to resources such as Assistive technologies that can help them lead more fulfilled lives. Unfortunately, due to problems such as lack of affordability, unavailability of resources and lack of acceptance; accessing AT can be challenging for low-resource nations such as Pakistan. Moreover, barriers such as lack of training and resources, poverty, poor management of resources funds, lack of family involvement contribute to the problems that hinder special needs individuals to fully utilize AT for the betterment of their lives.

Assistive Technology in Pakistan

Globally, special education has been given immense attention which has caused increased spending on research and development allowing for newer innovations to help Students with Disabilities. However, Pakistan, because of its lack of resources and awareness still faces huge challenges when it comes to technology of any sort, let alone assistive technology. When it comes to special education, Pakistan faces a challenge in enrolling such children in schools (Malik, 2020; Singal, 2020).

Assistive technology (AT), because of its adaptable nature, has been a transformative force for kids with special needs. One segment of this diverse community is children with hearing disabilities. In the Pakistani context, however, children with hearing disabilities find it hard to access education resources (Malik, 2020; Singal, 2020), the integration of assistive technology, particularly speech-to-text applications, holds great promise.

Educational Assistive Technologies

The use of speech-to-text applications and videos with subtitles are types of educational assistive technologies that are designed to improve communication in classrooms and empower students with hearing disabilities to engage actively in educational activities. Speech-to-text applications, for example, convert spoken language into written text, offering a valuable tool for students with hearing impairments to comprehend and interact with the learning material effectively (Berndsen, 2012). Examples of such applications include real-time transcription services, captioning tools, and speech recognition software.

The importance of the use of speech-to-text applications in education of students with hearing disabilities lies in their ability to provide real-time access to spoken content. This allows these students to participate in classroom discussions, understand lectures and engage with educational content equally with their peers.

The use of such technology not only facilitates communication but also promotes inclusivity in educational environments. While there are increased benefits of the use of Assistive technology (such as speech-to-text applications), the literature within Pakistani context remains limited that has studied the impact of these technologies on academic performance and overall development of students with hearing disabilities. This study seeks to address this gap by exploring the integration of speech-to-text applications in the educational curriculum for children with hearing impairments in Pakistan.

Acceptance

Even with advancements in assistive technology, acceptance is a crucial issue since gadget abandonment is still one of the biggest obstacles (Zipp et al., 2018). For instance, up to 75% of users reject upper-limb prosthesis because they are uncomfortable and ineffective (Smail. et al., 2020). Acceptance studies of diverse assistive technologies reveal common themes, with the user-specific causes for device abandonment underlining the gap between expectations and reality (Sugawara et al., 2018; Holloway & Dawes, 2016). Researcher's attention has shifted to a more user-centered design approach as a result of these worries. It ensures that participation of several stakeholders in order to close the gap between user wants and produced product features and enhance the outcome. Stakeholders include consumers, healthcare workers, business representatives, and lawmakers. Each stakeholder contributes a different point of view. Because the customers are at the heart of the process, the designers may develop empathy and learn from their real-world experiences.

Assistive technology in Existing syllabus for kids with special needs

Students with impairments encounter several obstacles in the educational system that hinder their ability to learn and perform well in various classroom activities. It is crucial that these kids receive the same opportunity as their classmates to engage in society. Digital technologies are used in this situation as a tool to access the curriculum. Evidence in this regard demonstrates how digital technology (computers, laptops, and mobile devices) have altered the lives of several kids (Bond, 2014). Despite these educational improvements, little focus has been placed on how students with disabilities use technology in their daily lives.

This is not unexpected considering that there is little developed research children on children with impairment and that general research frequently leaves out this segment of student population (Connor and stalker, 2007). Ensuring equitable access to and profit from digital technology may be difficult in light of this. Students who are visually impaired are most in need of tools, followed by those who are hearing-impaired and those who are physically challenged (Quinn, 2009). Thus, it can be said that using AT successfully and effectively is essential to ensuring that students with special needs are included in the classroom. Despite the fact that using AT in the classroom has many advantages for all students, there are also difficulties and barriers that must be overcome.

Modern technology has completely changed how we do business, communicate, wage war, cultivate our crops, and treat our patients during the past ten years. Teaching is also undergoing a technological revolution, and no area has seen this change more drastically or successfully than the education of kids with disabilities. Although the benefits of technology for students with disabilities are already well known (Anderson, 1996), future benefits are probably going to be even greater and more pervasive than current practices would lead us to believe that children should use assistive technologies to enrich their own lives.

The development of ease for children with disabilities is greatly aided by assistive technologies. To make any required modifications based on the child's capacities, the efficacy of AT and the child's capabilities must be regularly assessed. Each kid with special needs will rely on AT to a different extent; some may not be able to function academically without it, while others may merely need it for support, according to Council for Children Center research from 2005. Children with SLD have unique strengths, needs, interests, and experiences, thus the AT devices that may be utilized with them differ from kid to child. A device that may be appropriate for one child may not be appropriate for another (Bryant, 1998).

Technology has the ability to improve educational results and aid in preparing students with disabilities for life after graduation (Burgstahler, 2003). It also has the potential to make academic experiences for these students more enjoyable and, in some situations, more useful. A qualitative study on the usability and perceived efficacy of an electronic performance support system created for secondary students with minor impairments was conducted by Mitchem, Kight, Fitzgerald, Koury, and Boonseng in 2007. 39 strategy items are included in this programmer to aid with learning, conduct, and transition in high school and beyond. For one semester, two special education instructors utilized the programmer with their high school kids. The tools, according to the students, had helped them detect their improper reactions as well as select the more suitable ones.

The need to equip inclusive schools with the proper AT tools and to give teachers the training they need to use and employ such tools in teaching and evaluating is present. There are a variety of AT devices available that are designed and used to address the written language, reading, listening, memory, and mathematics problems of children with SLD. This would maximize the benefits of using AT tools and would result in the technology enhancing and enhancing the teaching-learning process.

The MoE is advised to play a key role in increasing the use of AT in inclusion schools and should: give teachers in general extensive training in how to use AT; increase the number of high-quality AT devices in inclusion schools (for instance, by giving them access to developmentally appropriate literacy software); and most importantly, give teachers working in both private and public kindergartens in-service training programmers The MoE has to give public inclusion schools greater consideration by giving them enough money so that they can have the right AT for instructing students with SLD. It is also advised that colleges review the study plans for special education and teaching majors to ensure that these programmers include courses and training on using assistive technology (AT) to teach students with disabilities in inclusive classrooms.

Significance of this study

Despite global acknowledgement of Assistive technology and the potential it has in the area of special education, Pakistan faces constraints that are marked by limited resources and awareness. Within special education, assistive technologies have always played an integral part in facilitating students with disabilities, allowing them to keep up with their peers. When such technologies exist for the betterment of people, the right application and acceptance can be a source of ease for teachers and students alike. There seems to be a gap, however, in existing literature which has studied the impact of technological inclusion. This research aims to bridge these gaps by studying the specific challenges that come with student perception and adaptability of assistive technology such as speech-to-text applications into a classroom with students with hearing disabilities. By doing so, this study aims to contribute to the knowledge base that informs policies and practices, fostering more inclusive and equitable educational opportunities for special needs students.

Objectives

- Study how the use of Assistive Technologies can improve learning experience for kids with special needs.
- Enhance the engagement of Students with Disabilities with Assistive Technologies.
- Study the behavior of Students with Disabilities towards adaptation of Assistive Technologies.
- Measure the effectiveness of speech-to-text applications and visual learning on the students with hearing disabilities.
- Study the readiness of special schools in Pakistan towards the adaptation of Assistive Technologies

II. METHODOLOGY

This chapter is focused on the methodology that was adopted in this study. This includes the research design, sample and sampling techniques and research instrument.

Research Design

This investigation adopted a quantitative research design employing a structured questionnaire to systematically gather data. This method facilitated the objective collection of information, minimizing biases and precluding any form of manipulation in the research process.

Sample and Sampling Techniques

A sample of 7 hearing impaired students were selected for the study. Both male and female students were included in the study. Participants are chosen for the study based on their desire to participate using non-probabilistic convenience sampling. The age range is 9-15 years old, and they are all students at a nearby school in Pakistan's Rawalpindi city. This school was chosen by the author because it is one of the local state-run institutions that best exemplifies the overall level of student competition and learning settings. As a result, it gives the author a simple and undeveloped example to work with.

Research Instrument

The investigation was conducted utilizing a researcher-developed questionnaire as an instrument for the systematic collection of essential information from study participants.

The research employed a researcher-designed questionnaire as the primary instrument for methodically acquiring requisite information from the surveyed participants. The research methodology included questionnaires where the following variables were tested; Self efficacy, Discovery and Information Use.

The instrument used to measure student's intrinsic motivation and self-efficacy was tailored from various studies (Fettahlioglu & Ekici, 2011; Soetan et al., 2020). The instrument consists of the following constructs:

1. **Information Use.**

It relates to intrinsic motivation to experience simulation and engagement (Fettahlioglu & Ekici, 2011). This construct evaluates the use of information that relates to motivation to learn new and different things and then use and implement them. The next six items on the questionnaire were related to this, and the mean and standard deviation was calculated to evaluate the responses and identify the student's intrinsic motivation to experience simulation and engagement.

2. **Discovery.**

It relates to internalization of intrinsic motivation. Discovery focuses on the student's eagerness to do the best, out of pure curiosity and without the expectation of reward (Nartgün & Cakir, 2014) - incentives do not drive it. The last seven items were related to this construct.

3. **Self-Efficacy.**

Self-efficacy refers to an individual's belief in their capacity to succeed in specific situations or accomplish a task (Soetan et al., 2020). It is a belief in one's own abilities and strengths and is a subjectively-held belief that is influenced by past experiences, current situation, and social support. Self-efficacy can be an important factor in predicting success in academic, professional, and personal endeavors, and plays a role in how people respond to stress and adversity.

Selection of AT

A speech-to-text application called "Ava" was selected due to its cost efficiency and availability beyond multiple platforms on. Furthermore, close captioning software was used to automatically update captions in the video. After evaluation of costs and usability, these two soft wares were selected as the Assistive technology to be used as a tool of intervention in this study.

Intervention

The writer employs a pretest-posttest methodology. The dependent variables are assessed twice in this design—once before the intervention and once at the conclusion of the research. The average scores of the pretest and posttest are a direct measure of changes, and researchers may remark on the efficacy of the study design based on these average scores, which enable the measurement and comparison of the variables involved.

Implementation Phase

The implementation phase of the research aimed at enhancing self-hygiene education for students with hearing disabilities was a multifaceted process. In this phase, the planned interventions were put into action to evaluate the effectiveness of utilizing closed-caption videos and speech-to-text applications as educational tools for communication with these students.

The first aspect of the implementation involved the selection and creation of lecture content tailored to the unique needs of students with hearing disabilities. Special attention was given to ensuring that the content was informative, engaging, and conducive to comprehension through visual aids. The integration of closed-caption videos provided an additional layer of accessibility, offering textual support synchronized with the spoken words to facilitate understanding.

The implementation also featured the incorporation of speech-to-text applications as a means of communication with the students. This approach aimed to bridge communication gaps by providing a written form of dialogue, enhancing interaction between educators and students with hearing disabilities. The selection of appropriate speech-to-text applications and their seamless integration into the educational setting required thorough planning and technical considerations.

Throughout the implementation phase, close monitoring and adjustments were made to address any unforeseen challenges or barriers that emerged during the use of these assistive technologies. Educators received training to effectively utilize the tools, ensuring a smooth integration into the learning environment. The students' feedback and engagement were closely observed to gauge the impact of the interventions on their learning experiences.

The implementation phase of this research incorporated a robust pretest and posttest model to systematically assess the impact of the interventions on students with hearing disabilities. Prior to the implementation of the self-hygiene lecture, students underwent a pretest assessment. This initial evaluation aimed at establishing baseline measurements for key variables, including discovery, self-efficacy, and information use.

The pretest phase involved the careful administration of assessments designed to gauge students' proficiency in discovering information, their level of self-efficacy, and their utilization of information resources. These variables were chosen as essential indicators to measure the effectiveness of the interventions on enhancing both learning outcomes and the overall educational experience for students with hearing disabilities.

Following the implementation of the self-hygiene lecture with the integrated use of closed-caption videos and speech-to-text applications, a posttest assessment was conducted. This phase aimed to measure any changes or improvements in the variables of interest—discovery, self-efficacy, and information use—based on the interventions introduced during the educational sessions.

The pretest and posttest model provided a comprehensive framework for measuring any changes in student outcomes resulting from the utilization of assistive technologies during the self-hygiene education program. This structured approach to assessment allowed for a thorough examination of the intervention's impact on the targeted variables, enabling a thorough understanding of how these technologies contributed to the students' learning experiences.

III. FINDINGS

This section discusses the results of the intervention and whether it has had any impact on efficacy, information use and discovery of students with hearing disabilities. The data collected from the questionnaires was gauged on a 7-point Likert scale, which was later compiled to show the following results:

Table 1.
Paired Sample Statistics

Variable	Pre-test/Post-Test	Mean	N	Standard Deviation	Error
Self-efficacy	Pre-Test	3.40	7	1.28	0.48
	Post-Test	5.11	7	1.28	0.48
Information Use	Pre-Test	4.52	7	0.56	0.21
	Post-Test	5.21	7	1.03	0.39
Discovery	Pre-Test	3.00	7	0.82	0.31
	Post-Test	3.45	7	0.95	0.35

The data above indicates that the mean Self efficacy score increased from 3.40 in the pretest to 5.11 in the post-test. This suggests an improvement in Efficacy after the use of Assistive technology. This means that students' innate belief in their ability to perform a task was positively impacted after the intervention suggesting Assistive technology can be of help to students with special needs and can help them manage stress while feeling confident in their ability to perform a task.

Moreover, as mentioned in the table, the mean information use score increased from 4.52 in the pre-test to 5.21 in the post-test. Similar to efficacy, this indicates an improvement in information use. This suggests that students with special needs were innately motivated to learn new and different things while experiencing simulation and engagement.

Table 2
Paired Sample T test

Variables	Mean	Std. Deviation	t	Sig (2 tailed)
Self-efficacy	-1.714	1.4871	-3.050	.023
Information Use	-.690	.813	-2.246	.066
Discovery	-.452	.731	-1.637	.153

The research outcomes reveal substantial insights into the impact of Assistive technology integration on various dimensions of student outcomes. The mean differences between pre and post self-efficacy scores indicated a noteworthy increase, as evidenced by a negative value (-1.7143), signifying that the mean of post-efficacy was 1.7143 points higher than the mean of pre-efficacy. This result was corroborated by the paired samples t-test, demonstrating a statistically significant difference between pre and post self-efficacy scores ($t = -3.050$, $df = 6$, $p = 0.023$). The negative t-score aligns with the negative mean difference, further affirming a substantial improvement in self-efficacy following the intervention.

Additionally, the examination of information use exhibited a marginally significant increase post-intervention. Although not achieving full statistical significance, the observed positive trend suggests a potential positive impact on students' utilization of information resources. Conversely, the results concerning the discovery dimension indicated no statistically significant change between pre and post intervention. The t-score of 0.000, with 6 degrees of freedom, accompanied by a p-value greater than the conventional significance level, denotes that the observed differences in discovery scores are not statistically significant.

In summary, the findings underscore a statistically significant enhancement in self-efficacy following the assistive technology intervention. While the increase in information use was marginally significant, the non-significant change in the discovery dimension prompts further exploration into the factors influencing this specific outcome. These results collectively contribute valuable insights into the effectiveness of assistive technology in fostering positive changes in specific dimensions of student outcomes.

IV. CONCLUSION

In conclusion, the findings of this research suggest that the intervention involving the integration of assistive technology in a classroom setting for children with hearing impairment yielded notable outcomes. Notably, there was a statistically significant increase in self-efficacy post-intervention compared to the pre-intervention phase. This positive shift indicates that the incorporation of assistive technology had a meaningful impact on the students' confidence in their ability to navigate and engage with educational materials.

While the results indicated a marginally significant increase in information use, demonstrating a positive trend in the students' utilization of information resources, it is essential to note that there was no statistically significant change in discovery. This nuance suggests that while the intervention positively influenced certain aspects of information use, further exploration may be required to understand the factors influencing the discovery process.

These findings collectively underscore the potential of assistive technology to bring about positive changes in the educational experiences of children with hearing disabilities. The statistically significant increase in self-efficacy implies that the integration of assistive technology not only enhances the students' access to information but also positively influences their perception of their own capabilities. As we navigate the complexities of inclusive education, these insights contribute to the growing body of knowledge supporting the meaningful integration of assistive technologies to create more inclusive and empowering learning environments for students with hearing impairments.

Limitations

Several limitations affect the scope and generalizability of this study. Firstly, the study acknowledges the pervasive lack of awareness in Pakistan regarding assistive technologies, particularly in the context of special education. This limitation may impact the widespread adoption and effective implementation of assistive technologies in educational settings.

Furthermore, the constrained spending on special education initiatives in the country poses a significant challenge, limiting the resources available for comprehensive and sustainable integration of assistive technologies. Additionally, the study recognizes the widespread illiteracy within the common public regarding how to access and utilize available resources, hindering the potential benefits of assistive technologies. Lastly, the overarching issue of unaffordability due to prevailing poverty levels in certain segments of the population may impede the accessibility and utilization of assistive technologies, particularly among those who stand to benefit the most. These limitations highlight the complex socio-economic and awareness-related challenges that may impact the effectiveness of integrating assistive technologies in the educational landscape for individuals with special needs in Pakistan.

Recommendations

The research findings hold significant implications for the future enhancement of educational experiences for Pakistani children with hearing impairments through the integration of assistive technology. To further advance the positive impact observed in self-efficacy, it is recommended that future studies in the Pakistani context delve into the intricacies of the discovery process. Understanding the specific challenges and facilitating factors in this aspect will contribute to a more nuanced approach in the implementation of assistive technology. Additionally, a key

recommendation emphasizes continuous professional development for Pakistani educators, ensuring they possess the necessary skills and knowledge to effectively integrate and support the use of assistive technology in classrooms. Collaborative efforts among educators, parents, policymakers, and stakeholders should be fostered, particularly in the context of resource allocation and policy development, to create an inclusive educational landscape. The user-centric design and accessibility of assistive technologies must be prioritized, considering the diverse needs of Pakistani children with hearing disabilities. Finally, longitudinal studies can provide a more comprehensive understanding of the sustained impact of assistive technology integration in the Pakistani educational context, guiding future interventions and policies for the benefit of this student population.

conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

APPENDIX

Questionnaire:

Coded Response Scale

Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5	6	7

Self-Efficacy

Q1. I can use hearing assistive technology when I cannot perform the activity on my own

1	2	3	4	5	6	7

Q2. I can use the hearing assistive technology every time if required by the situation

1	2	3	4	5	6	7

Q3. I believe that the use of hearing assistive technology will develop my listening skills.

1	2	3	4	5	6	7

Q4. I am willing to use hearing assistive technology for learning.

1	2	3	4	5	6	7

Q5. With the use of hearing assistive technology, I can do things independently.

1	2	3	4	5	6	7

Q6. By using hearing assistive technology, the rate at which I perform activities will be faster.

1	2	3	4	5	6	7

Q7. By using hearing assistive technology, the rate at which I perform activities will be much easier

1	2	3	4	5	6	7

Q8. When I have an academic problem, I will seek a relevant solution using hearing assistive technology.

1	2	3	4	5	6	7

Q9. I believe that I can learn easily using hearing assistive technology.

1	2	3	4	5	6	7

Q 10. I can figure out anything when using hearing assistive technology

1	2	3	4	5	6	7

Information Use

Q1. I get happy to have learned much when I look back.

1	2	3	4	5	6	7

Q2. I enjoy helping others with what I have learned

1	2	3	4	5	6	7

Q3. Learning new things excite me

1	2	3	4	5	6	7

Q4. I always like studying new and different topics

1	2	3	4	5	6	7

Q5. I seek opportunities to use what I have learned outside the school

1	2	3	4	5	6	7

Q6. There have been many times that I do not understand how time passes while learning something

1	2	3	4	5	6	7

Discovery

Q1. I pay attention to the course as soon as it starts

1	2	3	4	5	6	7

Q2. I sometimes get so engaged with the lesson that I get surprised about why the break-time bell rings so early

1	2	3	4	5	6	7

Q3. The things that are taught at school do not draw my interest

1	2	3	4	5	6	7

Q4. I study much to learn something even when there is no score given in return

1	2	3	4	5	6	7

Q5. I often feel like solving an enjoyable crossword during the exams

1	2	3	4	5	6	7

Q6. I search other books immediately if I do not find enough information in textbooks

1	2	3	4	5	6	7

REFERENCES

[1] Aerschot, L., & Parviainen, J. (2020). Robots responding to care needs? A multitasking care robot pursued for 25 years, available products offer simple entertainment and instrumental assistance. *Ethics and Information Technology*, 22(3), 247-256.

[2] Áfio, A. C. E., Carvalho, A. T. de, Carvalho, L. V. de, Silva, A. S. R. da, & Pagliuca, L. M. F. (2016). Avaliação da acessibilidade de tecnologia assistiva para surdos. *Revista Brasileira de Enfermagem*, 69(5), 833–839. https://doi.org/10.1590/0034-7167.2016690503

[3] Alahmadi, M. (2007). The Problems of integrated physically handicapped students in Almadina Almonawarh School, *The Arabia Journals for Special Education*, 10, 13-92.

[4] American Psychology Association. (2017*). Stress in America: coping with change. Apa.org*. http://www.apa.org/news/press/releases/stress/2016/coping-with-change.pdf

[5] Badawi, A. A., Al-Kabbany, A., & Shaban, H. (2018). Multimodal Human Activity Recognition From Wearable Inertial Sensors Using Machine Learning. 2018 *IEEE-EMBS Conference on Biomedical Engineering and Sciences (IECBES*). https://doi.org/10.1109/IECBES.2018.8626737

[6] Baer, M., Tilliette, M-A., Jeleff, A., Ozguler, A., & Loeb, T. (2014). Assisting older people: from robots to drones. *Gerontechnology*, 13(1). https://doi.org/10.4017/gt.2014.13.1.012.00

[7] Bryant, B., & Seay, P. (1998). The Technology-Related Assistance to Individuals with Disabilities Act: *Relevance to Individuals with Learning Disabilities and Their Advocates. Journal of Learning Disabilities*, 31(1), 4-15

[8] Bryant, B., (1998). The Technology-Related Assistance to individual with Disabilities Act: Relevance to individual with learning disabilities and their advocates. *Journal of learning disabilities*, 31(1), 4-15

[9] Burgstahler, S. (2003).The role of technology in preparing youth with disabilities for postsecondary education and employment. *Journal of Special Education Technology*, 18, 7-19 journal of learning disabilities 31(1), 4-15

[10] Busse, T. S., Kernebeck, S., Nef, L., Rebacz, P., Kickbusch, I., & Ehlers, J. P. (2021). Views on using social robots in professional caregiving: content analysis of a scenario method workshop. *Journal of medical Internet research*, 23(11), e20046.

[11] Chen, L., Nugent, C. D., & Wang, H. (2012). A Knowledge-Driven Approach to Activity Recognition in Smart Homes. *IEEE Transactions on Knowledge and Data Engineering*, 24(6), 961–974. https://doi.org/10.1109/tkde.2011.51

[12] Chen, X., Gong, L., Wei, L., Yeh, S.-C., Da Xu, L., Zheng, L., & Zou, Z. (2021). A Wearable Hand Rehabilitation System With Soft Gloves. *IEEE Transactions on Industrial Informatics*, 17(2), 943–952. https://doi.org/10.1109/tii.2020.3010369

[13] Connors, C., and Stalker, K. (2007). Childrem's experiences of disability: pointers to a social model of childhood disability. *Disability and Society*, 22(1),19-33

[14] Costello, E. J., Mustillo, S., Erkanli, A., Keeler, G., & Angold, A. (2003). Prevalence and Development of Psychiatric Disorders in Childhood and Adolescence. *Archives of General Psychiatry*, 60(8), 837. https://doi.org/10.1001/archpsyc.60.8.837

[15] Diehl, J. J., Schmitt, L. M., Villano, M., & Crowell, C. R. (2012). The clinical use of robots for individuals with Autism Spectrum Disorders: A critical review. *Research in Autism Spectrum Disorders*, 6(1), 249–262. https://doi.org/10.1016/j.rasd.2011.05.006

[16] Fitter, N. T., Mohan, M., Kuchenbecker, K. J., & Johnson, M. J. (2020). Exercising with Baxter: preliminary support for assistive social-physical human-robot interaction. *Journal of NeuroEngineering and Rehabilitation*, 17(1). https://doi.org/10.1186/s12984-020-0642-5

[17] Jain, S., Thiagarajan, B., Shi, Z., Clabaugh, C., & Matarić, M. J. (2020). Modeling engagement in long-term, in-home socially assistive robot interventions for children with autism spectrum disorders. Science Robotics, 5(39). https://doi.org/10.1126/scirobotics.aaz3791

[18] Kesarwani, A., Maheshwari, S., Sharma, S., and Rai, B. K. (2022). Hand talk: Intelligent gesture based communication recognition & object identification for deaf and dumb. *AIP Conference Proceedings* 2424, 080007 https://doi.org/10.1063/5.0076796

[19] Kitt, E. R., Crossman, M. K., Matijczak, A., Burns, G. B., & Kazdin, A. E. (2021). Evaluating the Role of a Socially Assistive Robot in Children's Mental Health Care. *Journal of child and family studies*, 30(7), 1722-1735.

[20] Łukasik, S., Tobis, S., Kropińska, S., & Suwalska, A. (2020). Role of Assistive Robots in the Care of Older People: Survey Study Among Medical and Nursing Students. *Journal of Medical Internet Research*, 22(8), e18003. https://doi.org/10.2196/18003

[21] Natale, S., & Cooke, H. (2021). Browsing with Alexa: Interrogating the impact of voice assistants as web interfaces. Media, *Culture & Society*, 43(6), 1000-1016.

[22] Parette, H.P. and Stoner, J.B., 2008. Benefits of assistive technology user groups for early childhood education professionals. *Early Childhood Education Journal*, 35(4), pp.313-319.

[23] Robinson, H., MacDonald, B., Kerse, N., & Broadbent, E. (2013). The Psychosocial Effects of a Companion Robot: A Randomized Controlled Trial. *Journal of the American Medical Directors Associatio*n, 14(9), 661–667. https://doi.org/10.1016/j.jamda.2013.02.007

[24] Shonkoff, J. P., Garner, A. S., Siegel, B. S., Dobbins, M. I., Earls, M. F., Garner, A. S., McGuinn, L., Pascoe, J., & Wood, D. L. (2012). *The Lifelong Effects of Early Childhood Adversity and Toxic Stress.* PEDIATRICS, 129(1), e232–e246. https://doi.org/10.1542/peds.2011-2663

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