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Role of Assistive Technology in the Rehabilitation of Children with Hearing Impairment

Muhammad Javed Aftab[1], Muhammad Ashfaq[2], Robina Naqvi[3] & Kiran Shehzadi[4]

Abstract

Assistive technology plays a vital role in the lives of disable children. Main objective of this paper is to identify the role of assistive technology in the rehabilitation of children with hearing impairment. A self-developed questionnaire was used as a research tool and for the purpose of data collection. Due to the COVID-19 situation the data were collected with the help of google form and through social media platform. Descriptive and inferential statistics was used to analyze the data. It is observed that cochlear implant, FM system, ASR (Automatic Speech Recognition) software, loop induction system, captioning, Telecommunication devices (TDD), TV streamer, remote microphones, notification systems devices, infrared systems and amplified telephones were the frequent assistive technologies used by the children with hearing impairment which are equally helpful for children in acquiring education as well as in daily life activities. It is recommended that the better and more positive results, professional need to be aware with the new technologies and get trained with the positive attitude towards the rehabilitations of children with hearing impairment.

Keywords: Assistive Technology, Hearings-impaired, Rehabilitation

[1] Lecturer, UE, Lahore, drmjavedaftab@ue.edu.pk
[2] Assistant Professor, UE, Lahore, drashfaqch@gmail.com
[3] Assistant Professor, UE, Lahore
[4] Department of Special Education, Government of Punjab

Introduction

Rehabilitation is “a set of measures that assist individuals who experience, or are likely to experience, disability to achieve and maintain optimal functioning in interaction with their environments” (NBHW, 2006). According to Ozoji (1993) defined rehabilitation as "the process of restoring the crippled to the maximum physical, mental, social, occupational, and economic usefulness that they are capable of achieving." Education of persons with special needs would deteriorate if rehabilitation is not provided. The rehabilitation procedure differs for each individual based on the disability and the individual's demands. Because no two abnormalities are similar, rehabilitation methods should be tailored to each individual's specific needs. Accordance to Ihenacho (2010), persons with special needs can be served by a wide range of organizations and individuals. All organizations should be allowed to take part in a specified rehabilitation program for persons with special needs, according to the report.

i. A person's innate healing powers and the brain's relearning processes are directed through rehabilitation in order to reduce their suffering in the quickest and most effective manner possible.
ii. As part of rehabilitation, patients must also learn new ways to compensate for permanently changed skills.
iii. There has been a rapid advancement in treatment methods and technology as we learn more about the injured body component and it’s functioning. The goal of rehabilitation is to help patients in regaining the highest level of self-sufficiency feasible.

Management and care are gradually replacing traditional services. Rehabilitative care, according to Shivers and Fait (1985), encompasses aspects such as medical, mental, social, vocational and economic components. When it comes to mental fitness activities, such as eye-hand coordination tasks, the author explains that special education is used to educate the affected person. Social aspects can be addressed through planning programs that prepare the individual to interact well with others. In the vocational aspect, training in a competitive skill is referred to as vocational training. The economic component has to do with the requirements for individual employment, whether it's self-employment or government-employment. There is a possibility that persons with special needs may find job as a result of all of this. So, those who previously had no or limited access are now given the opportunity to take advantage of the opportunities that are accessible. Crotty (1989) comments on four aspects of the medical component:

i. *Medical Based Rehabilitation***:** It is critical to intervene early. Ideally, rehabilitation should begin in the intensive care unit. At this stage, rehabilitation is primarily preventative. Right from the start, pressure score prevention and

orientation are critical. Rehabilitation exercises begun in the intensive care unit (ICU) can frequently minimize problems and, in certain cases, the length of stay.

ii. *Day-treatment-day rehabilitation***:** Day therapy provides rigorous rehabilitation in an organized setting during the day and permits the patient to return home to his or her family at night. A range of rehabilitation providers are frequently included on the treatment team.

iii. *Outpatient facilities rehabilitation***:** Persons recovering from acute or subacute rehabilitation may continue to receive outpatient treatment in specialist fields, such as speech pathology. A home health agency provides this sort of therapy to patients in their own homes.

iv. *Transitional living programs*: Transitional living programs provide accommodation for people with special needs in order to help them become as self-sufficient as feasible. Depending on the individual's level of need, programs may have several levels. This type of program also requires skills therapists, who assist individuals with physical disabilities in learning new skills and adopting compensatory techniques so that they may live independently in every situation, regardless of the environment.

For example, Punwar (1994) states that rehabilitation programs may have the goals such as restoration or enhancement of functional skills, maintenance of clients' capabilities at an acceptable level, and prevention of future impairments. If the client's abilities improve, they can return to their jobs or educational programs after modifying their surroundings and adjusting to temporary or permanent limitations. The rights of many persons with special needs may be denied if rehabilitation is not offered.

A better standard of life can be achieved through the increase of economic status and employment opportunities. Learning to adapt helps a person become socially mature and ready for life's realities. It reduces the impact of handicaps so that the individual may operate effectively at his or her level. In addition to resolving other issues, the rehabilitation process necessitates a great deal of courage. Whether it is a genuine accident or a problem, the procedure may focus on its objective that may aid the person body in returning to normal functioning in the end result, such as: provision of sufficient treatment and education for person specific requirements based on their unique demands. It promotes self-awareness in order to improve human interactions (Andrews & Herrelson, 1991).

The study was to ascertain the Role of Assistive Technology in the Rehabilitation with hearing Impaired for a future researcher in the life field. The study also explores the effects of assistive technology in rehabilitation with hearing impaired. In the study, the following goals were set; 1) to identify the role of Assistive Technology in the process of Rehabilitation with hearing Impaired in daily life activities as well as in education and 2) to compare the difference of the different stakeholders regarding the role of assistive

technology in the rehabilitation of children with hearing impairment. Following questions were needed to address in this research study; 1) how assistive technology can be beneficial in daily life activities of children with hearing impairment? and 2) what are the assistive technologies used in educational setting to educate the students with hearing impairment?

Literature Review

Hearing Impairment

WHO defines hearing impairment as being unable to hear at a normal level (WHO, 2015)? When a person's hearing threshold is reached, he or she cannot hear anything. To be normal, thresholds of -10 to +20 decibels are used. Thresholds of -10 to +20 decibels hearing level (dB HL) are considered typical. Hearing impairment is defined as thresholds more than 25 dB in both ears, which can be treated (WHO, 2016). The level of hearing impairment is Mild (26-40 dB better ear), Moderate (41-69 dB better ear), Severe (61-80 dB better ear) and Profound (81 dB or greater, better ear).

Various medical problems can cause it to occur in one or both ears, and it can occur in either ear. From an anatomical and physiological point of view, it can be caused by either an external or middle ear malfunction, cochlea deterioration, or neurological diseases affecting the auditory nerve, nucleus, or brain (neurologic hearing loss). When the auditory cortex is under stimulated, it atrophies, as previously stated. As a result, untreated sensory hearing deficits (those caused by the organ of hearing) tend to deteriorate the auditory cortex sooner or later (i.e., lead to neurosensory hearing loss). This is especially important since hearing aids become less effective when a hearing loss becomes neurosensory. They may enhance sensory function, but they will not significantly alleviate neuronal atrophy. People who are hard of hearing (HOH) have moderate to severe hearing loss.

Assistive Technology (AT)

Schneidert Hurst Miller Ustun (2003) suggests that assistive technology may play a vital role in helping individuals with disabilities engage in regular life and be accepted by society. There are two sides to this technology: one side is freedom, and the other side is inability (Scherer, 2002). Because assistive technologies are seen as tools or ways to achieve desired tasks, users are more likely to accept them into their life. When technology is used as a visible indicator of a handicap, it may be stigmatized. There might be a lack of meaningful activities as well as social and physical isolation if you don't use technology (Polgar, 2010).

Hearing Technologies

When it comes to hearing aids and cochlear implants, as well as classroom sound field amplification, many persons with hearing loss rely on non-head- or body-worn hearing devices (Dillon, 2001). Disabled students with hearing loss may benefit from specialized hearing aids that can help them overcome hurdles in the classroom, such as noise, a quick pace of talk, a rapid change of subjects, and a high number of individuals involved in conversation (Luckner & Muir, 2001; Stinson & Antia, 1999). When it comes to sustaining successful inclusion, DHH students and teachers agree that hearing technology is essential. However, owing to the stigma associated with assistive technologies (Eriks-Brophy, 2006; Luckner & Muir, 2001), an insufficient amount of time is spent on equipment.

Additionally, teachers wearing microphones and hearing peers wearing microphones may be used to give hearing technology to DHH children in inclusive classrooms. Teachers and students must utilize the equipment on a daily basis. Their views regarding hearing technology may influence their use and, as a result, their level of involvement in school. This article discusses DHH children's views regarding the various hearing devices available, as well as factors that can influence these children's attitudes and usage of these technologies. A thorough knowledge of the characteristics influencing HA use can help to enhance rehabilitative treatments offered by health experts and itinerant educators both at school and at home (Eriks-Brophy et al., 2006).

Assistive Technologies (ATs) for deaf and hearing impairment

Assistive Technology (AT) for HIC is divided into three primary types of equipment for the deaf and the hearing impaired e.g. listening aids, security alarms, and communication devices. Deaf people who have fully lost their hearing ability should not use hearing technology since it incorporates devices designed to increase the quantity of sound that can be heard. People with hearing impairments can benefit from hearing aids and other technologies for example, cochlear implants, personal sound amplification equipment, and assistive listening devices (Hersh & Johnson 2003).

A few such examples are assistive listening devices and personal sound amplification items (PSAPs). Audio amplifiers and noise-cancelling headphones are devices that raise the loudness of sound while decreasing background noise. Acoustic nerve stimulation (ARNS) is the conversion of sound input into electrical impulses given to the brain via the auditory nerve, which is surgically implanted. Cochlear implants are advised for deaf youngsters in order to assist them develop fundamental speaking and listening abilities. Children who are deaf will benefit from improved social relationships, academic achievement, and quality of life. Cochlear implants are intended more for "oral culture" individuals than for deaf people, according to the Deaf community. The Deaf community has a different take on the matter. As alerting systems do not need residual

hearing capacity, they may be used by the deaf as well. Some of these devices notify consumers by using light and vibrations or a mix of the two (NC-DHHS, 2016).

Communication support technology often known as augmentative and alternative communication (AAC), covers a variety of technologies aimed at enhancing the handicapped person's communication abilities. They are often divided into two categories: 1) telecommunications services and 2) face-to-face contacts

- In the majority of cases, telecommunication services rely on traditional technology like as keyboards, touch screens, video conferencing, phone call captioning and text messaging, among others (e.g., WhatsApp, FB Messenger, Snapchat etc.). Using speech recognition software, spoken words are converted into sign language or text.
- Personal communication devices such as picture boards, keyboards, touch screens; displays, voice generators, and software are examples of AAC for personal communication. They're intended towards deaf people who are born deaf, deaf people who are at risk of losing their ability to speak, and deaf-blind persons, among other groups (NAD, 2016).

It is possible for individuals or large groups to make use of assistive listening equipment (ALD). When there's a lot of background noise, they're very helpful since they amplify the sound (NAD, 2016). Tele-coils (also called as t-coils) are small wireless receivers that receive ALD signals and transform them back into sounds using various types of energy (see below). Receiver t-coils are often used in hearing aids and cochlear implants, and were initially designed for use as headsets. According to NSW Government (2016) following points are important in this regard.

- Devices that enhance sound levels while minimizing background noise are called PSAPs (Personal Sound Amplifier Products). For example, they provide a wide selection of items such as stethoscopes, TV/telephone amplifiers, etc. For hearing aid wearers, they generally use earbuds, headphones, or neck loops that let them listen through their hearing aids while wearing them. They may also be equipped with directional microphones that may be aimed towards specific sources of sound (NAD, 2016).
- Since they do not require any residual hearing ability, alerting or alarm systems may be utilized by deaf people as well (Hersh, & Michael, 2003). When an event is about to take place, they use light, vibrations, or a combination of both to alert consumers.
- It is a set of technologies intended at improving the disabled person's communication abilities, usually referred to as AAC (Augmentative and Alternative Communication). It is common for them to be split into two groups. The first is telecommunications services, and the second is in-person contacts (NSW Government, 2016).

Emerging technology

To make cochlear implants even more effective, new and better versions are being created (Gaylor et al. 2013). Hearing aids that bypass the inner ear and acoustic nerve, such as the auditory brainstem implant (ABI), are also on the rise in the field (Pulcherio et al. 2014). For newborns born with substantial hearing loss who are unable to get cochlear implants for a variety of medical reasons, this device is designed for them. It is possible that children's conditions will improve even when normal hearing is not restored. This will aid in preventing communication problems created by their challenges. New technologies for deaf and hearing-impaired consumers are:

- As a result of a number of pre-existing programs (e.g., Hand Talk, Mimix3, ASL Translator and Pro-Deaf Translator), A sign language interpreter appears on the screen of Google Glasses.
- If you want captioning in real time, there are several methods available, including a smartphone app developed by Georgia Tech. You simply talk into your phone while speaking with someone and your voice is transcribed and shown within the glass.
- Software designed for laptops and tablets
- A number of smartphone applications (Andersson, et. al, 2006).

Data collection and analysis

Data was collected with the help of the online resources using google forms and other social media services like WhatsApp, Facebook etc. due to COVID-19 situation; it was not possible to interact with the respondents in person. Descriptive and inferential statistics was used a statistical treatment to making the inferences from the collected data. Frequencies and percentages are used to show the demographic items and questions, and an independent sample t-test and One-Way ANOVA were used to illustrate the differences in opinions among respondents based on different demographic characteristics.

Table 1

Sample Description based on demographics

Sr#	*Description*	*Frequency (f)*	*Percentage (%)*
Gender			
1	Male	32	32
2	Female	68	68
	Total	100	100
Designation			
1	SSET	31	31
2	JSET	39	39
3	Educator	8	8

4	Psychologist	3	3
5	Speech Therapist	6	6
6	Other	13	13
	Total	100	100
Area			
1	Rural	28	28
2	Urban	72	72
	Total	100	100
Experience			
1	1 to 5 years	68	68
2	6 to 10 years	13	13
3	11 to 15 years	11	11
4	Greater	8	8
	Total	100	100
Divisions of Punjab`			
1	Lahore	11	11
2	Multan	37	37
3	Rawalpindi	2	2
4	Sargodha	5	5
5	Bahawalpur	7	7
6	Dera Ghazi Khan	28	28
7	Faisalabad	3	3
8	Gujranwala	3	3
9	Sahiwal	4	4
	Total	100	100

Table 2

Role of Technologies in Life Activities

Sr.#	*Statements of Questions*	*Agree f (%)*	*Undecided f (%)*	*Disagree f (%)*	*M*	*S.D.*
Section-1: Role of AT in daily life activities of HI Children						
1	Amplified telephones are used to assist individuals who have difficulty hearing when conversing on the phone.	89(89)	6(6)	5(5)	1.11	.39
2	Loop systems, which can be found in places of worship, auditoriums, and theatres, can assist those who have hearing difficulties.	81(81)	10(10)	9(9)	1.21	.59

3	HIC may utilize cochlear implants to send sound straight from a microphone in public.	89(89)	8(8)	3(3)	1.09	.48
4	Infrared systems are utilized in circumstances requiring secrecy and confidentiality, such as courtrooms and banks.	95(95)	4(4)	1(1)	1.11	.40
5	Notification systems are gadgets that replace household alarms such as alarm clocks, doorbells, and smoke detectors.	82(82)	16(16)	2(2)	1.29	.68
6	The pillow shaker vibrates your pillow and can be employed by individuals who will miss even the most audible alarm or just to avoid waking others in the room.	85(85)	13(13)	2(2)	1.30	.70
7	A personal sound amplifier is a gadget that assists you in hearing when you are conversing with another person.	81(81)	14(14)	5(5)	1.28	.67
8	Remote microphones are tiny devices that may be utilized in difficult listening settings, such as conversing in a noisy restaurant or in a car.	96(96)	2(2)	2(2)	1.03	.29
9	A TV streamer is beneficial for individuals who, owing to physical restrictions, are unable to use a hearing aid while watching television.	80(80)	16(16)	4(4)	1.40	.81
10	Assistive listening devices and systems bridging the gap between deaf students and the community	94(94)	3(3)	3(3)	1.02	.43
11	Interaction between people and hearing-impaired students become easy with the use of AT	91(91)	7(7)	2(2)	1.20	.62
12	AT provide confidence to students with hearing-impaired	93(93)	4(4)	3(3)	1.10	.38

13	People can live healthy, productive, and independent lives with the help of assistive technology.	76(76)	21(21)	3(3)	1.52	.91
14	Assistive technology decreases the need for formal health and support services, long-term care, and caregiver duties.	92(92)	6(6)	2(2)	1.20	.88
Section-2: Role of AT in Education of HI Children						
15	AT helps the HIC to participate in educational activities	90(90)	7(7)	3(3)	1.18	.61
16	AT helps the students with HI to overcome communication barriers encountered in school	88(88)	6(6)	6(6)	1.20	.63
17	FM Systems are most often used in schools and use FM radio signals	90(90)	7(7)	3(3)	1.22	.64
18	AT gives access to HI students for those opportunities which their normal peers can avail.	86(86)	9(9)	5(5)	1.23	.61
19	The use of ASR (Automatic Speech Recognition) software in the classroom aids in the distinguishing of different voices.	89(89)	4(4)	7(7)	1.12	.41
20	Cochlear Implant can help deaf students to acquire knowledge in normal way	82(82)	10(10)	8(8)	1.29	.58
21	Personal FM system is best way to get educate for students with HI which are far from school	88(88)	7(7)	5(5)	1.11	.49
22	Loop induction system helps the students with HI in classroom setting to listen the teacher voice and get knowledge	89(89)	5(5)	6(6)	1.21	.49
23	Captioning can also be very effective for lesson involving audio or video.	92(92)	5(5)	3(3)	1.09	.38

24	Telecommunication devices (TDD) for deaf can help the students within classroom for education	89(89)	6(6)	5(5)	1.08	.53

Table 3

Comparison of opinions of the respondents on the basis of gender

Gender	*N*	*M*	*S.D.*	*df*	*t*	*Sig.*
Male	32	41.2	5.4	98	-1.19	.352
Female	68	42.8	5.9			

**P > .05 Level of Significance*

Table 3 shows the statistics for female (*N* = 32, *M* = 42.8, *S.D.*=5.9), male (*N*=68, *M* = 41.2, *S.D.*= 5.4) and (*t* (98) = -1.19, *P* >.05) which leads to the conclusion that there is no significant difference in the opinion of the male and the female respondents regarding the role of the assistive technology in the rehabilitation of the children with hearing impairment.

Table 4

Comparison of opinions of the respondents on the basis of their living area

Area	*N*	*M*	*S.D.*	*df*	*t*	*Sig.*
Rural	28	39.14	4.2	98	-1.43	.003
Urban	72	41.23	5.9			

**P < .05 Level of Significance*

Table 4 shows the statistics for rural (*N* = 28, *M* = 39.14, *S.D.*= 4.2), urban (*N= 72, M* = 41.23, *S.D.*= 5.9) and (*t* (98) = -1.143 *P* < .05) which leads to the conclusion that there is significant difference in the opinion of the rural and urban respondents regarding the role of the assistive technology in the rehabilitation of the children with hearing impairment.

Table 5

Comparison of opinions of the respondents on the basis of designations

Designation	*Sum of Squares*	*Df*	*Mean Square*	*F*	*Sig.*
Between Groups	103.9	17	5.81	2.78	.002
Within Groups	168.8	82	2.08		
Total	272.7	99			

**P < .05 Level of Significance*

Table 5 presents the statistics (*F* (99) = 2.78, *P*<.05)) which leads to the conclusion that there is significant difference in the opinion of the respondents on the basis of their designation regarding the role of the assistive technology in the rehabilitation of the children with hearing impairment.

Table 6

Comparison of opinions of the respondents on the basis of their length of experience

Experience	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Between Groups	6.16	17	.34	.66	.84
Within Groups	41.95	82	.52		
Total	48.11	99			

**P > .05 Level of Significance*

Table 6 presents the statistics (F (99) = .66, P>.05)) which leads to the conclusion that there is no significant difference in the opinion of the respondents on the basis of their length of experience regarding the role of the assistive technology in the rehabilitation of the children with hearing impairment.

Table 7

Comparison of opinions of the respondents on the basis of their relevant division

Division	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Between Groups	88.69	17	4.93	.67	.83
Within Groups	600.27	82	7.41		
Total	688.96	99			

**P > .05 Level of Significance*

Table 7 presents the statistics (F (99) = .67, P>.05)) which leads to the conclusion that there is no significant difference in the opinion of the respondents on the basis of their division to whom they have belonged regarding the role of the assistive technology in the rehabilitation of the children with hearing impairment.

Findings and Conclusions

The aim of this article was to explore the role of assistive technology in the rehabilitation of children with hearing impaired. Assistive technology helps the children with hearing impairment in utilizing the different communication devices, supportive in secrecy and confidentiality, courtroom and banks, notification system, and in the loop system. Assistive technology has a significant role in the bridging up the gap between the children with hearing impairment and the society. Assistive technology also has a substantial role and contribution in the uplift of the personality of students in terms of confidence, social development, emotional development and in the enhancement of the miscellaneous skills and abilities of children with hearing impairment. Moreover, it is believed that the assistive technology helps the hearing-impaired children in their educational, overcome the communication barriers, helping in the provision of equal

opportunity as the normal peers and in the personal life activities. It is concluded that there is no significant difference in the opinion of the respondents on the basis of gender, length of experience in the relevant field service and division and have significant difference on the basis of the respondents living area and designations.

Discussion and Recommendations

This study was directed to investigate the role of assistive technology in the rehabilitation of children with hearing impaired. The researchers under the guidance of experts in the field of special education made a fruitful discussion at the role of assistive technology in the lives of children with hearing impairment and also discuss its role for acquiring the education. The research showed that AT play an important role in the daily life activities of children with hearing impairment as well as in the educational setup to acquire education. Participants agreed that assistive technology increases the ability and working of the student with a hearing impairment. Cochlear implant, FM system, ASR (Automatic Speech Recognition) software, Loop induction system, Captioning, Telecommunication devices (TDD), TV streamer, Remote microphones, Notification systems devices, Infrared systems and Amplified telephones are the main assistive technologies which are equally helpful for children in acquiring education as well as in daily life activities. These findings are supported by the research conducted by Dhanjal & Singh (2019) and Baglama, Haksiz, & Uzunboylu, (2018). The recommendations made for future researchers are given below;

1. Public institutions need to arrange the seminars for the awareness of the latest technology entered in the market for the purpose of rehabilitation for the children with hearing impairment.
2. Expert human resources may be developed for the effective use of the assistive technology for the rehabilitation of children with hearing impairment.
3. The role of Assistive Technology can be enhance in the rehabilitation of the children with hearing impairment by increasing the participation of professional and paraprofessionals.

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