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Learning through Assistive Devices: A Case of Students with Hearing Impairment

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Abstract

Present era has introduced persons with disabilities with a range of assistive devices that have rapidly increased their educational, vocational, and frivolous activities. Current descriptive study attempted to explore the effects of assistive devices on the learning of hearing impaired students. A sample of 200 hearing impaired students was selected to identify the assistive devices that are more in use by hearing impaired students. All of the assistive devices commonly used for hearing impairment were included in the study to explore the effects of each on the learning of students with hearing impairment. The mean difference in the learning of students suggested that assistive technologies are overall assistance for the students with hearing impairment and there is no substitute to these devices that could assist them in such a quite differentiated manner. The role of high tech assistive devicesas well as low tech devices has been highlighted prominently. The parents of hearing impaired students were also the part of study and found satisfied with the use of assistive devices for their children. It is divulged that there is a need to reduce the cost of assistive devices to be used by the students with hearing impairment.

***Key words*:** Hearing impaired children, assistive technology, assistive learning, and assistive devices.

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Introduction

The products or equipments used to develop and enhance the functional competencies of disabled people are known as Assistive Technology. Assistive technology (AT) provides aid of adaptive technology to individuals with disabilities (UNESCO, 2006).The latent array of assistive technologies is unbelievably great including high and low tech assistive devices and equipments. High tech assistive devices functioned electronically while low tech assistive devices are manually operated (Dede, 1998, p.75). In different types of assistive technology, low tech is realized to be an effective tool for the persons with disabilities. Low tech is cheap to buy and operate. It supports persons with disabilities to the extent that reduce the cost of hospitalization (Posse & Mann, 2005).

From last many years, the persons with disabilities are using assistive technology and its use is rapidly increasing in educational, vocational and frivolous activities. Professionals are introducing special need people with a range of assistive devices and services after proper screening of individual needs and technology specifications for persons with disabilities (Cook & Hussey,1995, p.24). Before choosing assistive devices many considerations are taken into account like what will be the effects of technology in body and what will be the effects of body on technologies (Hersh & Johnson, 2003).

Assistive technologies help individuals to spend their lives independently (Hameed & Bano, 2009). "Technology has opened many educational doors to children, particularly to children with disabilities. Alternative solutions based on technology are accommodating physical, sensory, and cognitive impairments in many ways" (Dede, 1998, p.73). Selected and useful solutions have been adapted to the individual's needs of disabilities. User centered approaches has been taking flexibility to help out the persons with disabilities (Penaud, Mokhtari & Abdulrazak, 2004).

Assistive devices are more useful and with the help of these devices "desired sound is sent to the listener's ears directly with improved signals to background noise ratio and reduce effects of poor room acoustics and diffused sounds" (Yi-Lin, 2005).The cost of assistive technology decreases as much as it profits to students with hearing loss (Wald, 2009).

In Pakistan, it is difficult for many families to purchase assistive devices for their hearing impaired children. They just can rely on dreams to help out their children. Assistive technology is helping special education teachers in Pakistan endowing their students with disabilities to assistive listening. Research has been

carried out regarding the assistive technology's use, impact, and effects on the learning of special needs students. The purpose of this research is to highlight the competence of assistive equipments to assisting children with disabilities. This study explored the use of assistive technologies for hearing impaired children.

Review of Literature

Decisions about the rehabilitation of individuals with disabilities give a stance to adopt assistive technology for individuals with disabilities. Hearing impaired children are more inclined to use assistive technology than the children with other disabilities. Medical measures of curing hearing impairment also rely on assistive technologies. Considerations in the use of assistive technologies revolve around the need, use, age, cost, level and disability of an individual. Assistive devices are the helpers and necessary for each individual with disability according to his/her use and settings. Assistive technology can be a lifelong partner and supporter for the person who use it, to make the things possible at any level of intellectuality (Bouck, Shurr, Tom, Jasper, Bassette, Miller & Flanagan, 2012).Lee & Templeton (2008) stated that "Empirical studies consistently show that the use of assistive technology promotes self-confidence, freedom, independence, and meaningful participation in home, school and community".

Assistive technologies are of different types like low tech. and high tech devices. Low and high tech assistive devices have been used by persons with disabilities for years. Low tech and high tech interventions are used for the persons to overcome their educational and social barriers (Gitlow, Dininno, Choate, Luce &Flecky,2011).Low tech devices are those assistive equipments that are available at the low cost and can be easily purchasable by the persons with disabilities (Cook & Hussay, 1995).These devices deal with the mild and moderate level of disabilities in order to help the individuals to use their residual abilities effectively. High tech. devices are sophisticated, complex, expensive and more functionalized in comparison to former, used to assist students with impairments. Their performance is more efficient, reliable, convenient and relatively inexpensive (Seok & DaCosta, 2013).

Assistive technology (AT) is helping persons regardless of their disability to accept their life challenges and overall working to enhance their independence in every aspect of leading a functional life (Bouck, et.al 2012).Considerations in the implementation of AT include: Cost, availability, funding, training and other related issues. It is argued that AT selection must be economically effective i.e., according to the needs of student and his/her environment to improve learning outcomes (Seok &

DaCosta, 2013). AT must be in access of all persons with disabilities so that all persons must be treated with the same rights. There should not be any gender and age biasness in providing assistive technology to special need persons (Borg, Larsson & Ostergren, 2011).It has been viewed that the cost of AT devices for the persons with disabilities restricts their desires to lead an independent life either in school or at home (Harris, 2010).

Cook & Hussay (1995) stated that "A girl, who was deaf and blind, is reported to have been asked whether she would prefer to have her vision or her hearing if she could have one or the other. She responded that she would prefer to have her hearing since she felt that people who are blind are cut off from things, whereas those who are deaf are cut off from people" (P. 662). Most of the people try to escape from the labeling. They usually feel ashamed to use hearing aid as a sign of disability and stigma. There is a need to make them realize the importance and use of assistive technology, that how the technology is serving in bringing the improvements in the lives of persons with hearing impairment.

It is expected that people who have more sensory problems are on the edge to use more high level devices (Yeager & Reed, 2008). "People with hearing loss can benefit from devices such as hearing aids, assistive devices and cochlear implants, and from captioning, sign language training, educational and social support" (WHO, 2013). It is observed in a study that among all disabilities hearing impairment is more likely to use assistive technology (Yeager & Reed, 2008).Children with hearing impairment have the familiarity with the problems that they may face in the sounds. Somehow assistive technology tries to recover those gaps of detection and occurrence of sounds (Lozano, Hernaez, Navas, Gonzalez & Idigoras, 2007).

Assistive technology/devices for students/persons with hearing impairments can be categorized into three broad terms: Hearing Assistive technology, Alerting devices, and Communication supportive technology.

Hearing Assistive Technology

Hearing assistive technology is to help individuals with hearing needs in listening, comprehending or recognizing sounds, and enhancing the frequencies of sound to make them much clearer (Bankaitis, 2007). Hearing aids, Cochlear implants, F.M systems, Infrared system, and loop system are the hearing assistive tools.

Alerting Devices

Alerting devices are to assist the persons with hard of hearing and deaf from long ago. These devices use the sound and visual amplification or vibration techniques for alerting the individuals with hearing impairment. Vibrotactiles and signaling devices are some of the alerting tools (Hersh & Johnson, 2003).

Communication Supportive Technology

Communication is the prevalent confront for individuals with hearing impairment either it is verbal or written. It helps individuals to share their thoughts to the external world. Communication assistive technology can be categorized into three further systems as: Telecommunication (Cell phones, amplified and captioned telephones, pagers, TTY/TTDs), closed captioning, and person to person and group communication activities (Web cameras, computer assisting note taking devices, real time captioning and voice to text devices) (Hersh & Johnson, 2003).

Assistive technology is a compensatory tool for the students with disabilities to push up their selves in learning and to deal with daily life problems (Maor, Currie, & Drewry, 2011). Dalton (2011) believes that "Assistive technology can be a powerful tool for educational equity, but only if technology-relevant content and skills are well-learned, well-practiced, and appropriately applied to meet the needs of both the individual and the educational environment". Assistive technology helps a child to progress up to the optimal performance level by participating in day to day educational activities (Murchland & Parkyn, 2011).

It is very important to include parents to get their views that how effectively the assistive equipments helping their children to learn and is proving to be cost effective (Merbler, Hadadian & Ulman, 1999). Parents and schools must be aware that assistive technology improves the students learning possibilities. They must seek knowledge of assistive technology use so that they can enhance their skills to engage in students learning activities, which are happening effectively by using assistive technology (Weikle & Hadadian, 2003).

Different studies in recent years showed that assistive technologies are helpful for individuals with special needs in many ways. These are helping persons with special needs in different ways to function normally, recognize speech and sounds (Poss & Mann, 2005), and managing their time (Green, Houghes & Ryan, 2011). Assistive technology users do not concentrate over their devices after 2 to 4 years of use. These devices become their part and parcel for routine life functioning.

"Lack of consideration of user opinion in selection, easy device procurement, poor device performance, and change in user needs or priorities" minimizes the use of assistive technology devices for successive years of lifetime (Philips & Zaoh (2010).

It is a common understanding that first the disability was hard to manage and secondly the availability of helping devices was out of question in the past times. Now the easy availability of latest assistive technologies has changed the notion. Assistive technology is helping persons with disabilities to achieve their targets either minimally or maximally. It was a need of the hour to conduct such a study in the context of Pakistan that how much the students with hearing impairment are benefiting from the use of assistive technologies. Although in this scenario it seems tough for many students to acquire technology just because of the cost of it.

Objectives of the Study

This study intended to:

1. Identify various assistive devices being used by students with hearing impairment.
2. Explore the perceptions of parents of children with hearing impairment about benefits of the assistive devices.
3. Investigate effectiveness of assistive technologies on the learning of students with hearing impairment.

Method and Procedure

Assistive technology solutions are prevailing with a great relativity to relieve the persons with hearing loss. Keeping in view this scenario, current research was an effort to find out the effectiveness of assistive technologies for learning of students with hearing impairment. The study was descriptive in its nature. This study aimed to explore the learning experiences of hearing impaired children using assistive technologies.

The sample comprised of 100 students of Grade 4 from seven schools of hearing impaired children. The sample was selected purposively by proper screening of students using high tech and low tech assistive technologies. Sample was selected with the equal participation of high and low tech. assistive technology which was being used. The selected sample included 60 volunteer parents of children with hearing impairment to find out their perceptions regarding the assistive technology used by their children. These parents of the sample students were taken on the volunteer basis.

The data were collected from the respondents using three main tools: An Urdu Language test, a checklist on assistive technology and a questionnaire to collect the responses of parents. An Urdu language test was developed to assess the academic performance of children with hearing impairment using assistive technology. A checklist was developed to collect the information about each child that what kind and form of assistive technology is being used by the child. A questionnaire based on Likert type scale was also developed to take the perceptions of parents of children with hearing impairment to get access to their views and opinions about the use of assistive technology. This instrument aimed to discern the parent's thoughts about the benefits of assistive technology; like independency, communication, cost and considerations for the use assistive technologies.

The tools of research were validated by experts of the field and pilot tested before the administration for data collection. For pilot testing 60 students were drawn from the population. Test was found reliable as coefficient of reliability, α =0.838 for writing portion of the test & for reading was α = 0.755. The questionnaire was also found reliable as coefficient of reliability was α= 0.899.

Data Collection and Analysis

The data were analyzed in the light of objectives of the study and parametric statistical procedures were used. One independent sample t-test was used to analyze the effects of assistive technologies on the learning of students with hearing impairment. Pearson's product moment correlation was used to find relationship between parent's perception and learning of their children. One way ANOVA was used to differentiate the most useable and effective device among all the assistive devices.

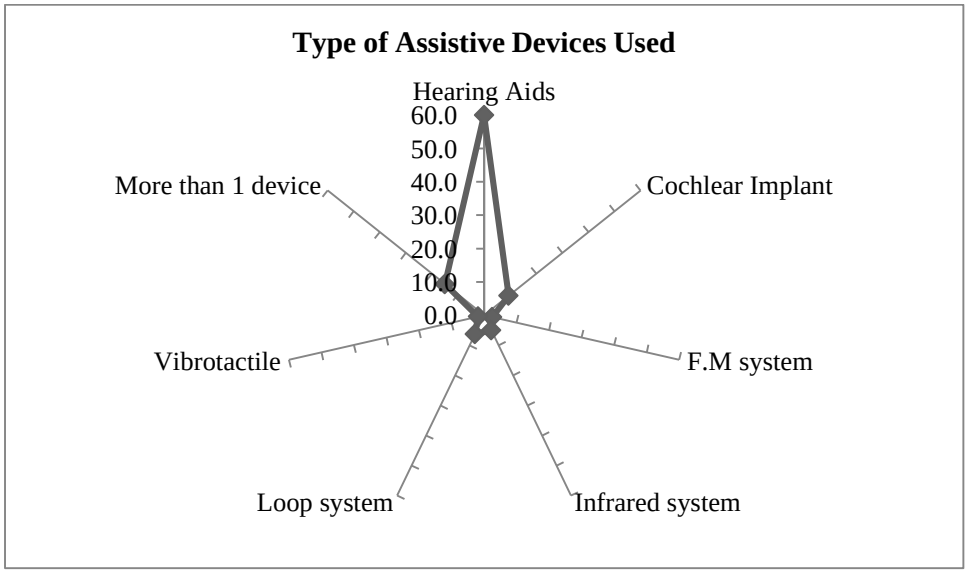

Figure 1: Types of assistive devices used by the hearing impaired students

Figure I indicates that the sample students with hearing impairment were mostly using hearing aid (60%), about 10% were with cochlear implant, and all other types of assistive devices were in the use of a few students (*i.e*<10% of sample). The students using more than one device at a time were 15%. It can be concluded from the above graph that the most commonly used assistive device is "hearing aid". Low tech. devices like Closed captioning, Amplifiers, Signaling devices, Real time captioning, Alerting devices, TDD/TTY and high tech. devices like Computer aided note taking, and Screen flash for computers are not used by any of the sample students.

Table 1

Comparison of students' test scores using different types of assistive technologies

Scores	Sum of Squares	df	Mean Scores	F
Between groups	48187.761	7	8031.293	3.671
Within groups	334694.614	153	2189.546	
Total	382882.375	160		

* p< 0.05

Table 1 shows that there exists a statistically significant difference in performance on the learning of students with hearing impairment, as measured by the Urdu language test of students using different types of low tech and high tech devices (F=3.671, P=.001) at p < .05 level of significance. The sample students were using

seven more popular devices: Hearing aids, cochlear implants, vibrotactiles, F.M systems, Infrared and loop systems as well as some are using of more than one device. It can be concluded that the students with hearing impairment are getting benefit from the use of assistive aids and are performing differently depending upon the nature of their devices. Their further comparisons can be studied by applying LSD Post Hoc tests.

Table 2

Comparison of students' score of different assistive technology users

Device type (I)	Device Type (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Hearing Aids	Cochlear Implant	-16.523	12.887	.202	-41.98	8.94
	F.M system	52.510*	23.688	.028	5.71	99.31
	Infrared system	45.135*	17.081	.009	11.39	78.88
	Loop system	47.510*	15.424	.002	17.04	77.98
	Vibrotactile	39.344	27.215	.150	-14.42	93.11
	More than 1 device	.635	10.593	.952	-20.29	21.56
Cochlear Implant	F.M system	69.033*	26.121	.009	17.43	120.64
	Infrared system	61.658*	20.322	.003	21.51	101.81
	Loop system	64.033*	18.950	.001	26.60	101.47
	Vibrotactile	55.867	29.357	.059	-2.13	113.86
	More than 1 device	17.158	15.278	.263	-13.02	47.34
F.M system	Infrared system	-7.375	28.425	.796	-63.53	48.78
	Loop system	-5.000	27.461	.856	-59.25	49.25
	Vibrotactile	-13.167	35.452	.711	-83.21	56.87
	More than 1 device	-51.875*	25.069	.040	-101.40	-2.35
Infrared system	Loop system	2.375	22.018	.914	-41.12	45.87
	Vibrotactile	-5.792	31.425	.854	-67.87	56.29
	More than 1 device	-44.500*	18.950	.020	-81.94	-7.06
Loop system	Vibrotactile	-8.167	30.556	.790	-68.53	52.20
	More than 1 device	-46.875*	17.471	.008	-81.39	-12.36
Vibrotactile	More than 1 device	-38.708	28.425	.175	-94.86	17.45

(*. The mean difference is significant at the 0.05 level., Dependent Variable: Scores on Urdu Test)

Table 2 shows the mean differences in the comparisons of students' scores on Urdu test using different assistive devices. Students using hearing aids show statistically significant difference with students using F.M system (M=52.510, P=.028), Infrared system (M=45.135, P=.009) and Loop system (M=47.510, P=.002) at P<.05 level of significance. This comparison also reveals that the performance of students using F.M system, Infrared system, and Loop system is better than the students using hearing aids.

The comparison of Cochlear implant with F. M system (M= 69.033, P=.009), Infrared system (M=61.658, P=.003) and Loop system (M=64.033, P=.001) shows a statistically significant difference. Further it can be concluded that the students using these devices are better performer than the students using Cochlear implant.

The students using F.M system, Infrared, Loop system and Vibrotactile are not having statistical significant difference in their performance on comparison to each other. However the students using more than one device perform significantly better than the students using F. M system (M=-51.875, P=.040)

The comparison of performance of students using more than one device with the students using Infrared system (M=-44.500, P= .020), and Loop system (M=-46.875, P=.008) devices show a statistical significance difference. In other words it can be concluded that the students using more than one device perform better in comparison to the other groups shown in the Table 2. Other comparisons show that there is no statistical significant difference among their performance at P<.05 level of significance.

Table 3

Performance comparison of students using High-tech and Low- tech devices

Variable	Nature of Technology	N	Mean	Std. Deviation	t
Total score on test	Low-tech	80	119.55	28.914	-17.38*
	High-tech	80	198.83	28.785	

* p< 0.05

There is a statistically significant difference in the scores of students using low tech and high tech (t=-17.38, p= .000) devices at p<.05 level of significance. The difference in the mean values shows that students with High-tech devices (M = 198.82, S.D = 28.78) perform better than the students using Low-tech (M = 119.55, SD = 28.91) devices on a same test. It can be concluded that the nature of technology used by the students with hearing impairment contributes towards their betterment in academic achievement.

Table 4

Parents' opinion about the effectiveness of Assistive Technologies (N=60, Max.=5, Min=1)

Statements	Mean	Std. Deviation
Enhances communication between hearing impaired children and family	4.28	1.027
Increases the goal attainment of my child	4.28	0.958
Changes in the quality of life of my child	4.22	0.865
Increases learning opportunities of the child	4.20	0.898
Increases the child participation in community	4.05	0.982
Helps in adaptation to the learning needs of the child	4.05	0.811
Awareness of the need of assistive technologies is more today than past	4.00	1.302
Lessens dependency of child on others	3.97	1.073
Assistive technologies in according to school environment	3.88	0.885
Affordability of needed Assistive Technologies	1.88	1.027

(Strongly disagree=1, Disagree=2, Undecided=3, Agree=4, Strongly agree=5)

Table 4 indicates that the parents of students with hearing impairment are convinced with the need, usefulness and benefits of the assistive technologies in accordance to the performance of their children in academic and social settings. They believe that the assistive technologies make the children independent for smooth day to day functioning. As the affordability of the assistive technologies is concerned they seem unsatisfied. It can be concluded that the parents of the children with hearing impairment are familiar and informed about the use and significance of assistive technologies for their children as compared to the previous years but the compatibility and affordability are still the issues to be addressed.

Table 5

Relationship of students' test scores and parents' opinion about the use of assistive technologies (N=60)

Variable		Parents' Perceptions
Students achievement scores	Pearson Correlation	0.435^{**}
	Sig. (2-tailed)	0.001

There is a significant positive correlation between the perceptions of parents about assistive technology and learning achievements of their children with hearing impairment using assistive technology (r = .435, N = 60, P=.000). The parents perceived that the use of assistive technology has positive effects on the performance of their children. It can be concluded that the parents' perception about the use of assistive technologies by their children positively affects the performance of their children. It may lead to the fact that assistive technologies are good tools for students with hearing impairment, as it increases the overall learning opportunities and independence of children to make them good learners (Table 5).

Findings

1. Students were asked about the low-tech assistive technologies (Hearing aid, Closed captioning, Amplifiers, Signaling devices, Vibrotactiles, Real time captioning, Alerting devices, Infrared system, TDD/TTY) and high-tech devices (Loop system, FM system, Cochlear Implant, Computer aided note taking, Screen flash for computers) that they were using. Most of the students (60%) use Hearing aid and a few use Cochlear implant (10%), less than 10% were using Vibrotactiles, Loop system, FM system, Infrared system and 15% were using more than one device. None of the sample students was using; Closed captioning, Amplifiers, Signaling devices, Real time captioning, Alerting devices, TDD/TTY and high tech. devices like Computer aided note taking, and Screen flash for computers.
2. There exists a significant difference in the achievement score of students on Urdu language test of students with different types of assistive devices ($F=3.671$, $P=.001$) at $p<.05$ level of significance.
3. Students with F.M system ($M=52.510$, $P=.028$), Infrared system ($M=45.135$, $P=.009$) and Loop system ($M=47.510$, $P=.002$) show better performance than the students using Hearing aid.
4. Students using F. M system ($M= 69.033$, $P=.009$), Infrared system ($M=61.658$, $P=.003$) and Loop system ($M=64.033$, $P=.001$) are better performer than the hearing impaired students with Cochlear implant.
5. Those students who are using more than one device also show better results on the test than those of with only Infrared system ($M=-44.500$, $P= .020$), and Loop system ($M=-46.875$, $P=.008$) devices.
6. The students using High-tech devices ($M = 198.82$, $S.D = 28.78$) are significantly better ($t=-17.38$, $p= .000$) than the students with Low-tech hearing devices ($M = 119.55$, $SD = 28.91$).
7. There is a significant positive relationship ($r = .435$, $P= .001$) of parents' perceptions about the use of assistive technologies and the academic performance of students with hearing impairment. Parents' of the students with hearing impairment believe that the use of assistive technologies enhances the communication ($M=4.28$), goal attainment of ($M=4.28$), quality of life ($M=4.22$) and also increases the learning opportunities ($M=4.20$) for the students with special hearing needs. The suitability of assistive devices according to the school needs ($M=3.88$) and their affordability is still a problem faced by the parents.

Conclusions

Following conclusions are made on the basis of the findings of the study.

Assistive devices are distinguished tools used by students with hearing impairment. This study aimed to analyze the effectiveness of assistive technologies on the learning of students with hearing impairment. It is concluded that students are more independent learners and good achievers, no matter what kind and form of assistive devices being used by them. Among different forms of high and low tech. assistive technologies, hearing aids, cochlear implants, vibrotactiles, loop, infrared and F.M systems are most commonly used by children with hearing impairment. Hearing aids are most preferred and affordable devices to children with hearing impairment in Pakistani context. This study also conceded that there is a clear difference in the learning achievements of students with hearing impairment who are using high tech assistive technologies in comparison to low tech assistive technologies. Parents' perceptions about assistive technologies have also shown that their children's learning, communication and independency are increased with the use of assistive technology. Assistive technology has brought families on the edge of survival for their child with such type of disability. The issue that hinders the use of assistive technologies for most of the children with hearing impairment is affordability of equipments. But mostly the families are striving to meet their children needs at any cost. This study divulges the benefits of assistive technologies on the lives of children with hearing impairment who were in more critical situation to develop their lives nevertheless assistive technology has changed their lives.

Recommendations

All over the world the use of assistive devices has been prevailing and assisting people with and without disabilities. The overall results of the conducted analysis reveals that assistive technologies are the best choice for the individuals with disabilities. In Pakistan, these devices are helping almost 70% of the children with disabilities. Hearing impaired students are more sensitive and critical to use assistive technologies so there is a need of proper screening and assessment procedures to introduce the individuals with assisted equipments.

The practitioners and professionals must use proper screening methods and procedures to suggest the use of assistive technologies to individuals with hearing impairment. Schools would yield their students good performances if they will hire practitioners and professionals for regular screening of their students needs. Best

working of assistive equipments depends on regular examination so school must held monthly visits for practitioners in order to support their students as it should be.

Teachers in the classrooms must be trained enough to check students assistive equipments in case of any problem during class. Friendly relationship towards students would develop a kind situation for both. Teachers can plan students IEPs according to the needs, abilities and assistive technology's requirements although it matters a lot in developing the considerations to get more benefits from technology being used.

Parents' views also demonstrated that assistive devices have assisted their children to enhance their existing and suppressed abilities. Parents must go for a thorough assessment of their children before indulge them to use any assistive equipment. Besides the best partner of the individuals, technology is also harmful for them. So there is a need to do thorough assessment before choosing any device to get benefits or relieve pains.

The cost of assistive technology is a great issue for most of the families throughout the world. As cochlear implantation, auditory brain stem implants and bone hearing aids are relatively expensive equipments and parents whose children face more chronic disabilities of ear are more depressed to give a hopeful life to their children with severe to profound hearing impairment.

It has been indicated in the study that assistive technologies are assisting students learning and independency which was once restricted by their disabilities. A campaign must be commenced to create the awareness about the use of assistive technology for all disabilities along with hearing impairment.

Assistive technology has eliminated the differences in the access of education for the persons with disabilities. Federal laws of special education must be implemented regarding the compulsion of assistive technologies for removing or reducing the effects of disabilities.

It is playing a significant role in the field of special education to help the disabled to qualify in mainstream or inclusive setting. There is a need to train mainstream and inclusive set up teaching staff regarding the use of assistive technology to teach children with disabilities. A large number of devices for every kind of disability and severity level exist in market; from a writing pen to adapted clothing devices and home assistive system, all are helping individuals with disabilities.

There is a need to upraise the wakefulness of assistive technologies by running an awareness campaigns. The government, non-governmental organizations and school authorities should come forward and make arrangements for the subsidized assistive devices for the non affording children with hearing impairments. Parent-Teacher Associations (PTAs) can take this lead to get social and financial help from the community for the provision of suitable devices according to the communication and academic needs of the students with hearing impairments to make them effective and efficient learners. The use of High tech. devices should also be brought into use for the better performance of students with hearing impairments in Pakistan.

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