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RESEARCH ARTICLE

TECHNOLOGY OF COMMUNICATION AND TRANSLATION SOLUTIONS IN EDUCATION OF DEAF STUDENTS

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Abstract

Researches on using technology of communication and translation solutions in education of deaf students are still developing alongside the shifting implementation of practice. This study seeks to explore the importance, benefits and usefulness of using assistive technologies in supporting and improving the communication and academic progress of deaf students. It, also, aims to identifying the most popular assistive technologies that can be used to assist deaf students to learn the educational content. Qualitative research method has been adopted in this study and to obtain deeper and subjective responses from the participants, an in-depth interview has been conducted to 10 teachers selected randomly from Gallaudet University. The results revealed that technology of communication and translation solutions in the form of mobile phone applications, iCloud services, and sign languages are likely to provide necessary support to deaf students in learning, academic progress and sharing their knowledge with others in classrooms. It also helps them to translate the educational content to understand it in an efficient manner. The study concluded that the use of assistive technologies play an important role in improving the communication and translation abilities of deaf students.

Introduction:-

Individuals with hearing impairments, particularly with complete hearing loss, are often prevented to take participation in society; therefore they have to face numerous challenges in society. Similarly, students with hearing loss become unable to participate in cooperative, synchronous and live learning activities, mainly due to increased dependence on voice communication involved in these activities (World Health Organization, 2015).

While deaf students are being provided with an eventual pathway of speech to text systems to ensure better communication, it does not allow them to take participation in routine classroom activities. These are also problems with the use of content text. Not same communication skills are being possessed by all deaf people: some deaf students communicate using writing and lip reading or oral language, other make use of SL. However, some of the deaf bilingual students use both type of communication (Pivetta et al., 2014) to bring considerable improvement in their hearing ability.

Classroom support services are frequently being required by deaf students in general educational settings. Despite new ideas to support deaf students have evolved in recent years, however, it has been suggested through a variety of

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evident that significant hearing loss among students lags them behind across different placement settings and in various academic domains and researches (Karchmer & Mitchell, 2003; Kidd et al., 1993; Stinson & Kluwin, 2003; Traxler, 2000).

It has been argued by different research investigators that failure to minimize the difference between deaf students and academic achievement of hearing students has urged educationists to adopt and implement new solutions to ensure academic compatibility of deaf students. The differences between two students' group has not been completely elucidated in how they learn and what they know, and therefore educational institutions have become unable to make necessary adjustment to their instructional methods to match the needs of deaf students (Knoors, 2005; Marschark et al., 2004; Marschark et al., 2006)**.** This challenge has urged research to explore the cognitive underpinnings of learning related methods adopted and used to support deaf students.

Meanwhile, a focused has been laid by other lines of researcher on specific interventions that have been developed to facilitate learning and communication of deaf students in the classroom. Perhaps the most common among these are recent efforts undertaken by educational institutions to provide multiple or alternative forms of communication to deaf students via technologies such as on-demand lecture notes, C-Print and Communication Access Real Time Translation and many more such technologies (Stinson et al., 1988; Stinson et al., 2009; Stuckless, 1983).

Aims of the study:-

The present study aims to explore the importance, benefits and usefulness of using assistive technologies in supporting and improving the communication and academic progress of deaf students. It, also, aims to identifying the most popular assistive technologies that can be used to assist deaf students to learn the educational content.

Theoretical Framework and Literature

Sign Language

It has been demonstrated by Ladd (2003) that sign language is an advanced technology based assistive tool that helps deaf students to achieve their academic goals. Sign language is basically the language in which body movements and manual communication is used to deliver meaning rather than using patterns of sound through integration of facial expressions, body actions and hand movements to convey meaning.

An assurance has been provided by El-Soud et al. (2010) that Sign Languages are being used by approximately 70 million deaf people as their native language to interact and communication with the nearby environments. Sign languages have been proposed as a strategic solution by which messages can be conveyed by a person with the help of facial expressions and bodily movements. In recent years, a great focus has been witnessed on how electronic tools and computers can be used to develop sign languages to interact with deaf students in various communities (Han et al., 2007).

A sign language can be used to translation through the use of flex sensors or cameras. It has the ability to reduce the communication gap between deaf students and their hearing counterparts because it allows interaction without any typing or writing content. These tools of translation actually have an ability to bring considerable improvement in the speed and quality of the educational process (Brown & Mirri, 2013). In sign language translation, three processes are involved such as (1) interpretation of all facial expression, movements and gestures; (2) representation (reflected by animations or avatars) and (3) translation (from speech/txt to sign language)

iCloud Services

In order to ease the procedure of deaf communication, different products have been provided by Microsoft such as TDD/TTY service. Moreover, a video call center has been designed by Samsung for deaf students and the application can be accessed by deaf students by installing it on their mobile phones.

There is also an availability of large number of iCloud services to bring considerable improvement in the communication process (Sood **&** Mishra, 2016). It has been assured by Nagori and Malode (2016) that a critical role is being played by virtual environments and virtualization to bring considerable improvement in the process of learning and teaching deaf students at different levels of education.

Wearable Sensor Gloves

The sensor-based assistance can be taken into consideration to solve the social issues faced by deaf students. For example, the wearables sensor gloves have been proposed by Sharma et al to detect the hand gestures of sign language (Sharma et al., 2013). In this system, flex sensors were utilized to sense the environment and to record the sign language. The glove is being activated through hand gesture of a person; those gestures were converted by glove into electrical signals. The signals are then matched with the data in database and they are then displayed on LCD by converting them into corresponding speech.

The sensor-based cost-effective communication device has also been recommended for deaf mute students to communicate with teachers and other students (Rojanasaroch & Laohapensaeng, 2015). This mainly comprises of a processing unit, LCD to display output or input and 32-bit microcontroller. The pictures related hand sign language is being displayed on LCD to assist students in communication process. The relevant pictures are being selected by user to describe the content/material of subject in the classroom.

Flex sensors have been used by Vijayalakshmi and Aarthi (2016) on the glove for recognition of gesture. The system was created to identify the words of American Sign Language (ASL). The text output acquired from sensor-based system is transformed into speech through the use of popular technique of speech synthesis of hidden Markov model (HMM). The system is attached to HMM-based-text-to-speech synthesizer (HTS) so that text obtained from hand gestures of deaf students can be converted into speech.

In HTS system, the training phase is involved for the extraction of excitation and spectral parameters from the collected data speech and its content dependent HMMs can be used to model it. The synthesis stage of HTS system was taken into consideration for the development of HMM sequence. Similarly, five flex sensors have been used by Arif et al. (2016) on a glove to convert ASL gestures for deaf students into audio and visual output on LCD which eventually helps them to learn the academic concepts more effectively and efficiently.

Gesture Based Game and Voice for the Mute

Different kinds of vision-based interventions of technology can be used to identify the sign languages of deaf students. For instance, a gesture-based game has been developed by Soltani et al. (2012) for deaf mutes through the use of Microsoft Kinect. It helps to identify the gesture command and transform it into text so that interactive environment can be enjoyed by deaf students in classrooms.

Voice for the mute (VOM) system was designed to acquire input in the form of fingerspelling and transform it into corresponding speech (Tripathy et al., 2015). The pictures of fingerspelling signs are obtained through camera. After performing image and noise removal processing, the trained dataset is used to match the fingerspelling signs. Appropriate text is linked to processed signs and this text is then converted into required speech.

The communication platform has been proposed by Nagori and Malode (2016) by obtaining images from the video and transforming these images into corresponding speech. The system has been presented by Sood and Mishra (2016) in which the images of sign language are taken and speech is then displayed as output. In vision-based approaches, the features for processing the speech are also taken into consideration in various applications based on object recognition in classroom (Yousaf et al., 2018).

Smartphone-Based Technology Approach

An important role has been played by smartphone technology in helping deaf students to overcome their communication barriers and providing an assurance for social interaction with other students in classroom. Smartphone technology is more effective and portable in comparison to vision or sensor-based technology. The features in the form of high-resolution cameras, high processors and advanced sensors are being incorporated in the new smartphones (Ghanem et al., 2017).

Moreover, a real-time emergency assistant “iHelp” has been developed for mute deaf students where any kind of emergency situation can be reported by them (Chen et al., 2016). The current location of the deaf student can be obtained through GPS system that is already built in into the smartphone. The data about the emergency situation is received through SMS by management and it is them given to the nearest appropriate rescue units, and rescue services can be obtained by deaf students while being in school.

An Android application has been proposed by MonoVoix (Kamat et al., 2016) and it also plays the role of a sign language interpreter. The signs from the android application are being captured from camera in the mobile phone and it is then converted into appropriate speech text. One of the examples of Android application is Ear Hear (Subhaashini et al., 2015), which has specifically been designed for deaf students. It makes use of the sign language to help deaf students to interact with other students in classroom or school.

For a hearing person to communicate with Deaf-mute, the speech signal is input by the text to speech technology and corresponding video of sign language is played against that input, as a result of which it becomes easier for deaf student to interact with other people. Furthermore, a sound detector has been proposed by Bragg et al. (2016) in which red alert sounds are being detected and deaf-mute student get alert by showing a popup notification and vibration of the mobile phone, which will enable deaf students to access the appropriate and relevant educational content.

Research Methodology:-

This study adopted qualitative research method to obtain deeper and subjective responses, and an in-depth interview has been used to collect data from the participants. The interview has been conducted to a total of 10 teachers selected randomly from Gallaudet University. This university has specifically been selected because it mainly focused on teaching deaf students who need assistive technologies to acquire education.

The interview mainly consisted of 5 questions, however the researcher developed relevant questions to identify and explore different possible solutions to help deaf students to achieve their academic goals. Each interview lasted for about 30 minutes in which the researcher has collected detailed subjective responses from the participants. The interviews have been conducted with the participants in a natural research setting without intervention of the researcher, and the data has been presented through data visualization technique.

The interview session required respondents to provide their demographic information and provide detailed and subjective responses to the interview questions developed by the researcher. The obtained data from participants has been kept confidential and it has solely been used for the purpose of carrying out the research analysis.

Results:-

The current section of the paper has been focused on the results of analyzing the data obtained from the participants. It has enabled the researcher to obtain a deep and thorough insight into the responses obtained by participants about different solutions to improve their communication and leaning at in educational institutions.

Importance of assistive technologies for learning of deaf students

The first question that has been asked to the participants is related to the importance of using the assistive technologies to support communication and learning of deaf students. Figure (1) displays the percentages of participants' responses regarding the importance of assistive technologies for deaf students.

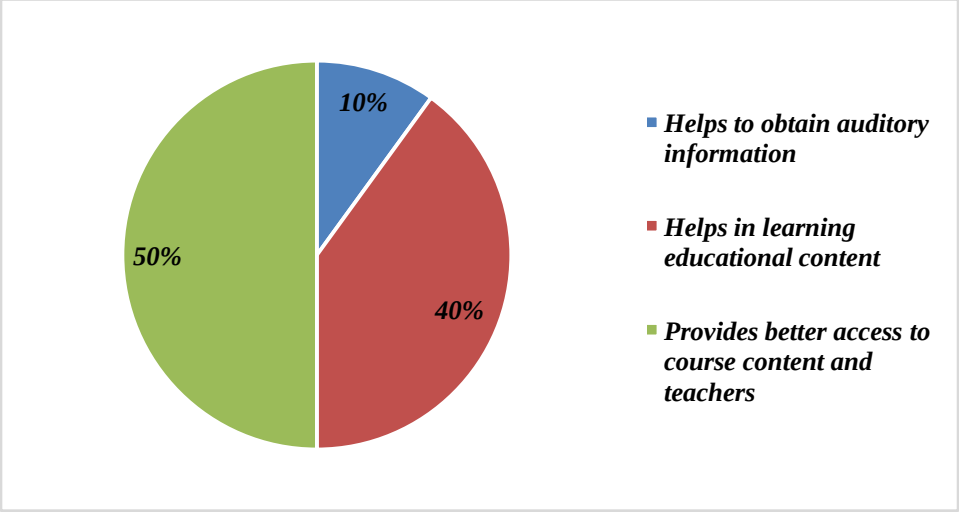

Figure 1:- Importance of assistive technologies for deaf students.

Based on the data obtained from the participants, it has been found that 10% of the participants said that assistive technologies provide necessary assistance to the deaf students to obtain auditory information in different possible ways. Similarly, 40% of the participants stated that assistive technology solutions are considered to be highly important because they had a significant impact on the ways by which deaf student learn educational content. However, 50% of the participants stated that assistive technologies help deaf students to communicate and interact with the teachers and other students to access course content and teachers.

Popular assistive technologies for deaf students to learn educational content

The second question that has been raised in the interview session is about the most popular assistive technologies that can be used to assist deaf students to learn educational content. Figure (2) displays the percentages of participants' responses regarding the assistive technologies that are required to help deaf students in classrooms.

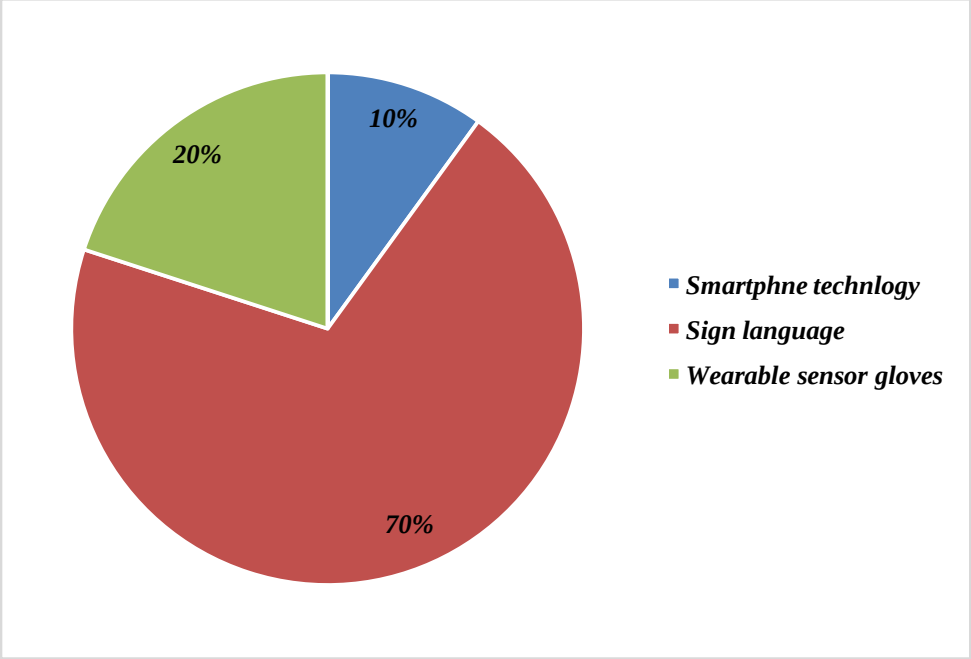

Figure 2:- Tools/ assistive technologies that are required to help deaf students in classrooms.

Although a large number of advanced assistive technologies can be used by educational institutions to support deaf students, but 70% of the participants said that sign language is most frequently used tool to help deaf students in accessing and learning the educational content.

However, 10% of the participants clearly stated that use of smartphone technology proves to be a better option for the deaf students. They consider that using mobiles and smartphones are compatible with hearing aids. It clearly suggests that they make use of a small wire coil, also known as Telecoil or hearing loop. It develops a magnetic field in which sound is picked by up by the tool and it is then moved onto the hearing aids on the setting of a hearing loop. It eventually helps deaf students to hear the clear voice of teachers and classmates in the classroom. On the other hand, 20% of the participants said that wearable sensor gloves are most effective in helping deaf students to access leaning material in classroom.

Effectiveness of communication and translation solutions

The next question that has been raised is related to the effectiveness of communication and translation solutions on the academic progress of deaf students. The viewpoints of the participants regarding this question are displayed in the figure (3).

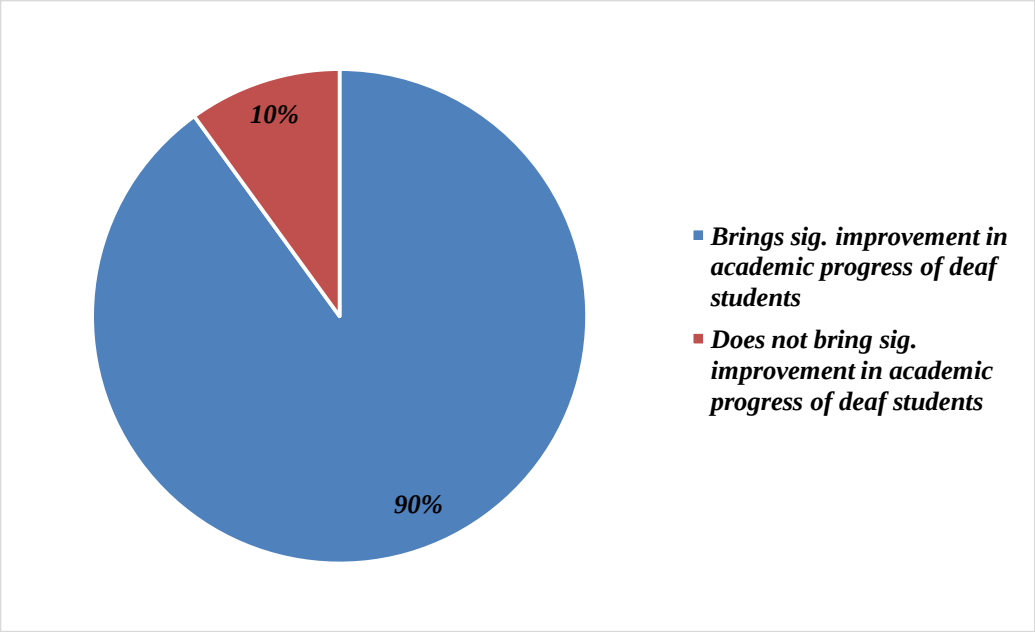

Figure 3:- Effectiveness of communication and translation solutions on the academic progress of deaf students

Based on the results obtained from the participants, it has been found that 90% of the teachers believed that incorporating and using communication and translation solution have helped deaf students to bring significant improvement in their academic progress, while 10% of the teachers believed that incorporation and use of these technologies does not have any significant impact on the learning and academic progress of deaf students.

Extent to which assistive technologies help deaf students

In order to explore the extent to which assistive technologies help deaf students to bring considerable improvement in their academic progress, the researcher has raised a question "Do you think that use of assistive technologies help deaf students to have same academic performance as non-deaf students". The participants' responses regarding this question are displayed in the figure (4).

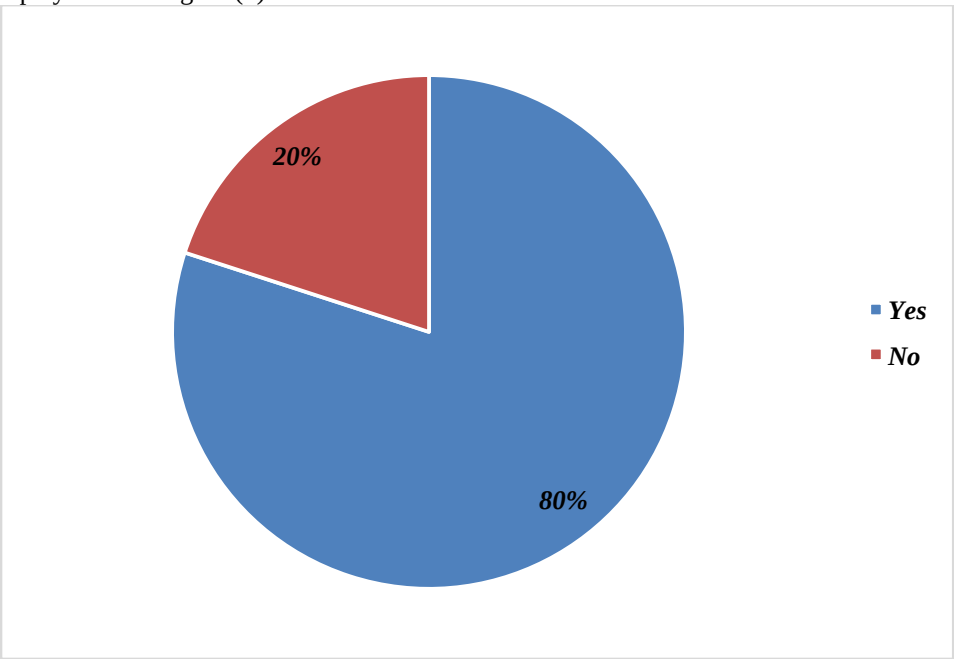

Figure 4:- Do the use of assistive technologies help deaf students to have same academic performance as non-deaf students.

The results obtained from the participants showed that 80% of the teachers said that assistive technologies such as the use of iCloud services and mobile devices helped deaf students to have same academic scores as non-deaf students. However, rest of 20% teachers believed that there is just a minor difference in the academic progress of deaf students before and after the use of such assistive technologies.

Benefits of assistive technologies in educating deaf students in compare to their costs

Through research interview, the researcher explored the benefits of incurring huge costs of assistive technologies to provide education to deaf students? The participants have expressed their subjective responses regarding this question. Figure (5) shows the results of these responses which were centered within three answers.

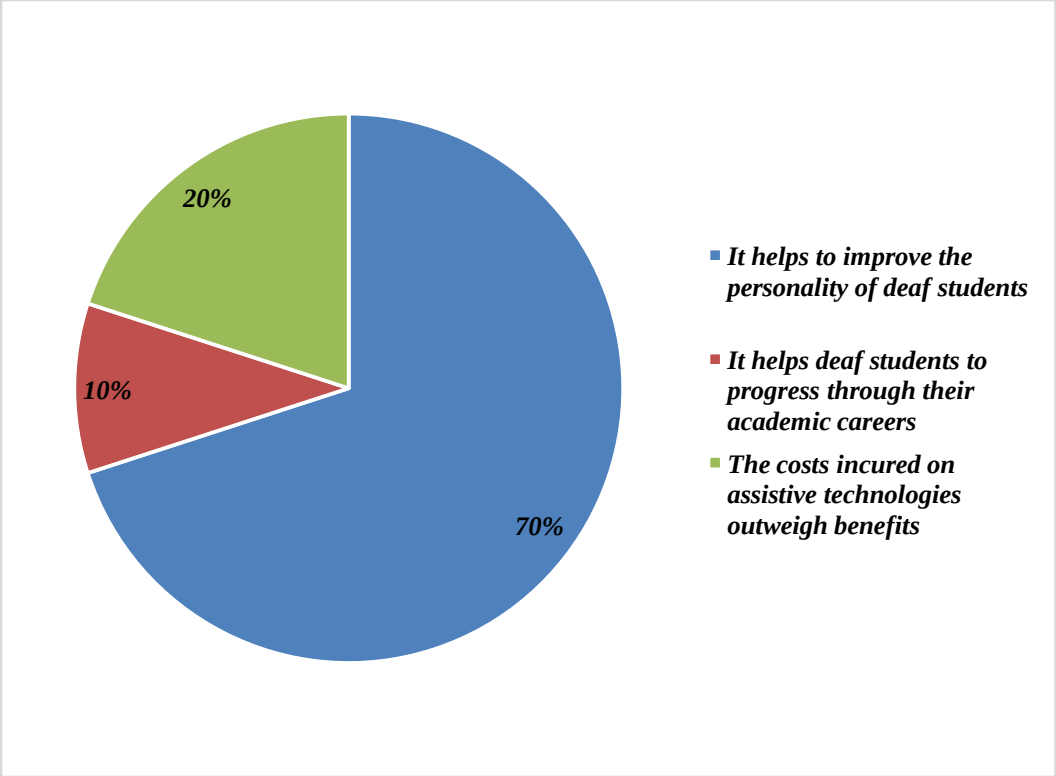

Figure 5:- Benefits of incurring huge costs of assistive technologies to educate deaf students.

Based on the obtained from the participants, it has been found that 70% of the teachers believed that incurring higher costs on assistive technologies helps to improve the personality of deaf students. It brings confidence in their personalities that they are beneficial to society. Similarly, 10% of the participants believed that huge costs on assistive technologies help deaf students to progress through their careers. According to these participants, the primary and secondary education provided to students through the use of assistive technologies has helped them to get hired on higher managerial positions based on the disability quotas set by organizations for disabled candidates.

However, about 20% of the participants recorded their response by stating that costs incurred on assistive technologies outweigh benefits. Based on the response obtained from these participants, it has been found that a vast majority of deaf students who have acquired education through assistive technologies does not become successful in progressing through their academic careers. Their disability often prevents them to secure a better job position in a reputable organization in their respective countries.

Discussion:-

Based on the entire results, it has been found that the use of assistive technologies in educating deaf students can improve their communication and translation abilities. The frequent use of sign language and other related technologies such as iCloud services and mobile technologies by teachers in classrooms proves the importance of such assistive technologies to facilitate deaf students to learn educational content and bring considerable improvement in their academic progress. A large number of participants claimed that costs of acquiring,

implementing and using assistive technologies is considerably high, but it makes significant contributions in supporting deaf students to show academic excellence similar to their non-deaf counterparts. It provides necessary support to deaf students to improve their personality, academic progress and make significant advancement in their careers.

Conclusion:-

It is important to conclude that assistive technologies and translation solutions play an important role in improving the ability of deaf students to acquire the educational content appropriately and improve their communication and translation abilities. These technologies ensure that deaf students take active participation in communicating with other students and teachers in classrooms. It also enables them to pave their way to achieve academic and professional excellence in near future. Therefore, the associations that provide educational services to deaf students are recommended to use assistive technologies and translation solutions that proved their importance and usefulness in educating deaf students.

Limitations and Future Research

The paper has proposed effective and appropriate solutions to meet the needs of deaf people in educational setting, however there are certain limitations that can be addressed by future researchers to further expand the scope and generalizability of research results. These limitations provide necessary guidance and direction to future researchers to address different factors that are not being discussed in this paper.

One of the major limitations of this paper is that it did not include a large sample size. Taking large sample size in future researches would help to get a more detailed and subjective responses into the subject matter. By increasing the sample size, the researcher will get an opportunity to explore the viewpoints, and perceptions of other teachers who are being engaged in teaching deaf students in an educational setting.

Another limitation of the current research study is that the researcher has used qualitative research design to obtain data from the participants. The data is solely based on the life experiences, perceptions and viewpoints of participants; therefore it does not ensure the reliability and validity of the research results. In future, the researchers can make use of the quantitative research design to use statistical tools and procedures to validate research results. It is likely to increase reliability and validity of research results.

This paper has limited scope as it tends to collect data from the teachers in Gallaudet University, but it did not collect any data from teachers of other deaf related educational institutions. In future, the researchers can conduct interviews from different educational institutions and compare the results based on the data obtained from teachers belonging to different educational institutions for deaf students.

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