EasyChair Preprint

№ 6722

Teaching English and Science to the Deaf Students

Afnan Zafar, Hira Gull, Uzma Farooq,
Mohd Shafry Mohd Rahim and Adnan Abid

September 29, 2021

Teaching English and Science to the Deaf Students

Afnan Zafar
Department of Computer Science
University of Management and Technology, Lahore, Pakistan
F2019279015@umt.edu.pk

Hira Gull
Department of Computer Science
University of Management and Technology, Lahore, Pakistan
F2019279010@umt.edu.pk

Uzma Farooq
Department of Software Engineering
University of Management and Technology, Lahore, Pakistan
School of Computing
Universiti Teknologi Malaysia, Malaysia
Uzma.farooq@umt.edu.pk

Mohd Shafry Mohd Rahim
Department of Software Engineering
University of Management and Technology, Lahore, Pakistan
School of Computing
Universiti Teknologi Malaysia, Malaysia
shafry@utm.my

Adnan Abid
Department of Computer Science
University of Management and Technology, Lahore, Pakistan
Adnan.abid@umt.edu.pk

Abstract— Deaf students need special class room settings where a teacher is supported by an interpreter who performs the gestures for the students. This paper presents the role of technologies and techniques in the teaching English and Science to the deaf students. Furthermore, it highlights the usage and importance of avatar technology in improving the teaching process of deaf students. Different researchers have presented many techniques for teaching English and Science to deaf students. For example, AR Book, E-Gloves, animated software, and interactive software, ICT based technology. The Avatar approach also plays an important role. An Avatar approach provides a platform where teachers teach easily English words, phrases and sentences more accurately, more efficiently and in a low cost. The Basic purpose of avatar approach is to minimize the workload of teachers as an important instructing help.

Keywords— Teaching, Deaf students, technologies, Pakistan sign language, Science, English, Avatar.

I. INTRODUCTION

Now a day, to improve the quality of education of deaf students our researchers and teachers play a vital role in the field of deaf education. It is the big challenge for teachers to improve the education of deaf students. So let them be able to understand like normal students. Deaf students have lack of basic skills due to vast difficulties in gaining and developing learning skills in spoken language.

Sign language is very difficult to understand for the beginner's students. Developing countries have some limited institutions for deaf students. There are many educational applications that enable deaf students to lean a broad verity of knowledge. Many techniques are used for teaching deaf students. Glove based technique is very helpful in learning the process of deaf students. By using sensory gloves, a deaf student easily communicates and learn more comfortably. Drawback of this system is that it can only acquire the hand movement or hand shape. It cannot be able to acquire other body movements i.e. face, arms and elbows. For deaf students this area of education is not enough and no so much accessible. An understanding interface should be made that enable deaf students to understand what they actually want to say, because deaf students are not able to express their thoughts by spoken words. In this way teacher can easily understand them like other normal students in the class. The purpose of this environment is usage of the English language that is written in sign language through avatar. This is the easy and efficient way of communication of deaf students. This research explores the needs of e-learning environment structure, also the needs of avatar for such kind of environment via literature review. This paper explains the methodology of usage of avatar available for deaf students. The aim of this research is to able deaf students to learn English by using avatar. According to Pivetta et al. (2014) avatar makes life of deaf students more comfortable and make educational environment more efficient. It is a good resource of communication for deaf community. The main purpose of this paper is to develop a conceptual Framework of Virtual Learning Environment (VLE) for deaf people. By using the avatar, environment become more attractive, furthermore, being a more relevant resource for deaf people.

This paper is organized in such a way that next part consists of literature review in which different researchers present their ideas and learning strategies how to teach deaf students more efficiently. The third part consists of a research methodology in which most important section is the research question and others are search string, choice of resources, inclusion and exclusion and evaluation of quality, limitations of applications and the next section is the research result and last one is a conclusion.

II. REVIEW OF THE LITERTURE

In this portion, we described the comprehensive review of the past work taken for deaf students and also describe the

difficulties that deaf student face. The main problem arises when deaf students communicate and learn on the university level and cannot understand the subject like other students. Overcoming this problem sign language plays a vital role and the best solution. Different applications were introduced for helping deaf students. These applications help in learning a different type of sign languages. These applications play a big role in learning the process of deaf students. With the passage of time different applications were introduced.

There are many teaching strategies used for deaf students. Researchers have introduced many strategies for deaf people. Oralism was the best strategy used for deaf people. After 'Oralism' (A system of teaching deaf people to communicate by the use of lip-reading and speech rather than sign language), 'Bilingualism' is the commonly established teaching method in the field of deaf education. 'Total Communication' is a teaching methodology which makes use of the residual hearing and visual skills of deaf children with sign language for teaching deaf students. `English language teaching-learning problems in the classrooms of deaf students can be solved by combining technology and special teaching methods like bilingualism and total communication [7].

Deaf people can share their thoughts and ideas by using sign language. Study through computer software to learn any sign language. Main focus on American sign language, Japanese sign language and Japanese to American conversion, they have used different motion pictures to show each sign [1].

Deaf children who grow up in deaf families have a gap of communication. They learn sign language for communication. They only have understanding about their mother tongue and learn sign language like their mother tongue and just communicate with those people who could understand sign language otherwise they could not communicate. A user has provided both the dictionary i.e. JSL dictionary and ASL dictionary when he types a word as an input. A deaf user need to look through related language, she/he need to learn. On the other chance that a deaf user needs to learn ASL, she/he can learn English at the same time also. It is developed a structure of dictionary that has detail of the word and also example [2].

Researchers have design of a system that helps the deaf children to learn about vowels. It makes the learning of deaf children (4 to 8 years) more easy [16].

Developing a mobile app to enhance learning and communication is of great importance in the field of deaf education specially learning English. By using mobile app, a teacher can easily teach a deaf student.

Almost all deaf people are facing incredible difficulties speaking with individuals in the public arena notwithstanding the way that they are important for the society and are taken part at the typical educational system where instructing and learning happen utilizing communicated in language

The application of a computer-based teaching strategies with students of hearing loss in English classes is highly effective. There are many visual stimuli and manual commands which increase the user-friendliness of these strategies for students with hearing loss, during the teaching-learning process [22].

A system is suggested that can move and resume animation. It helps the deaf students to learn better and communicate better [3]. The aim of researchers is to make a system that interprets a sign language in to English words so that deaf students easily understand this [4].

A sensory glove technique is suggested which enables deaf students to communicate like normal students. The purpose of this system is to acquire hand movement data [5]. Researchers have explained the sign quiz, that is a practical online finger-spelled sign language app that is designed for Indian communication through signing acknowledgment procedure. It helps to learn about the signs without any type of outside help [8].

Sign language video is more compatible than text so the AR Book approach is more interactive for deaf students [10]. At first in 1994, it was notice that the science subject was ignored at elementary level for deaf students. In some school science and mathematics was teach. It was declared that the deaf student also learns science as other students. By using Procedure, oriented Method teacher creates such environments, which boost the learning and practice in science subject [23]. Web-based science education presented that includes graphical representation of data that is improve version. The deaf can easily communicate with the data [24]. The deaf student should not treat as the hearing students. There must be other methods for teaching the deaf students. The learning of the deaf student is same as the oral language given in written form [25]. Augmented reality guide for science is developed. The focus is on the topic microorganism. It consists of 3D modeling of objects consists of marker and symbols of sign language [26]. The animated interactive software developed for the teaching 2 subject's math and science [27]. Science space is a new technique that is used in teaching and learning the science which increase the deaf interest as well as increased confidence and self-worth [28]. In addition, an interactive game is design in order for learning of deaf students. Hard of hearing students cannot hear any kinds of voices that why a game was design which prefers the things fill in the blanks and jumping that helps in learning for the deaf [29]. Teaching the science subject method improves when we understand the language derivation and by using fingerspelling. Providing additional material in written form, that deaf student can write and understand [30]. Deaf people can learn science very well. The supporting instruments in determining that can be utilized among others direction and development, material and sensation learning, hear-able learning and facilities, and assistive advances, which rely upon the understudy, vision level [31]. Students that are suffering from autism spectrum disorder can learn science by using the model, e textbook or communicating Programs [32].

III. RESEARCH METHODOLOGY

In this article we explain the methodology that we follow to answer the research questions by the process of classifying, assessing and interpreting the results. By this method we are able to find an accurate answer to research question. For collecting accurate result from basic study we take result in two ways automatic search and manual search. Our main aim is to find the gap between the old research and new research. A new idea is to explain the methodology approved for enlargement of learning applications for deaf students.

Selection of Articles:

Research has 2 types manual and automatic search. A manual search has more value and more accurate according to our own project and research question. We perform manual search to verify our search string. A google scholar gives 450000 results for these search string of our research. ACM gives 402781results 5720 result from the springer. IEEE Xplore gives 1320 results.

Analysis of studies:

In this section we will analyze the quality of papers that full fill the requirement of our research questions. According to content of papers we will score them. [2] has a more reliable and useful content about sign language we score it 1 out of 1. [1] has the medium quality in content so score it 0.5 out of 1. [4] is also a high rank journal paper and a lot of knowledge about sign language. We score it 1.

Basic Idea

Our main focus is on avatar approach. In this approach we use Hamnosys as a dataset. Hamnosys is Humberg Sign language notation that was developed in 1985 by the University of Humberg in Germany. Linguistics and investigator mostly used Hamnosys due to its linearity.
Hamnosys is used worldwide as it is not different from country to country; it consists of arrangement of iconic Symbols that are easy to understand. Hamnosys Notation provides single hand symbol as well as two-hand symbol. Single hand symbol consists of non-manual features like hand shape, hand orientation, hand location and performing the action in sequence. However, the two handed Symbol start from the symmetry operator which specify the explanation of dominant and non-dominant hand. The Gesture in Hamnosys, represents in manual and non-manual features are shown in Figure 1.

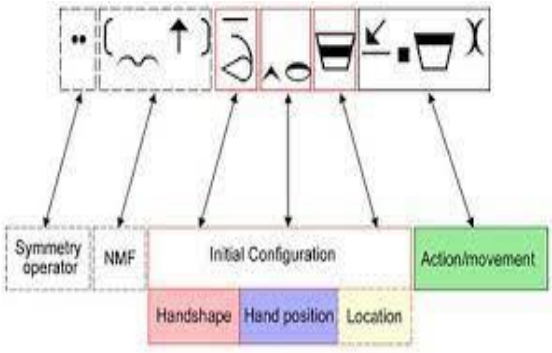

Figure 1. HamNoSys representation.

Hamnosys has four basic mechanisms. Hamnosys contains 350 iconic character to write Sign writing notation. Hamnosys use avatar based approach. The solid boxes consist mechanisms which are obligatory for representation of signs in Hamnosys. The element in dotted boxes are non-compulsory that are non-manual and symmetry operator characteristics. The orientation is considered important in Hamnosys. The non-manual feature consists of facial expression, Shoulder movements, eye movements, mouthing etc. Hamnosys write from left side to right. There is extraordinary font used in Hamnosys. It allows 3D avatar animations.

In sign writing notation, Stokoe is considered as derivation but does not allows non-manual feature. To resolve an issue Sign writing is introduced that have symbolic representation allow manual and non-manual Components. It is easy to understand but having difficulties in 3D animation. For that reason, Hamnosys was introduced which are evaluated from left to right. Hamnosys used avatar approach, which can easily build symbol from the texts that deaf people can understand. The avatar receives Sigml that consists of Unicode's and show Signs.

a) . Research Questions

Research question is an important part of Research methodology. In this research 3 questions are described and answered with a deep study and research. These questions are the main concern of our paper. Research questions and their motivations have been presented in Table 1.

Table 1. Questions with their inspirations

	Questions	Inspirations
RESEARCH QUESTION 1	Which type of Strategies teachers use for teaching English to deaf learners?	Identify the strategies that are helpful for teaching English to deaf learners.
RESEARCH QUESTION 2	Which type of Strategies teachers use for teaching Science to deaf learners?	Identify the strategies that are helpful for teaching Science to deaf learners.
RESEARCH QUESTION 3	How avatar approach is best for teachers to teach English and Science to deaf students?	The aim of this question to investigate the deaf knowledge about the avatar approach by comparing it with other learning strategies.

IV. RESULTS

In this section we will explain the answers of our research questions.

R. Question 1: Which type of Strategies teachers use for teaching English to deaf learners?

Many strategies and application are used for teaching English to deaf learners. Basic means of getting information is vision for deaf students, description videos, pictures and other visual-aids are used as an educational tool for deaf education.

Oralism technique:

In this technique deaf students are educated through lip reading and lip movement.

Bilingualism Approach:

In this approach deaf students are educated through both the sign language and spoken\written language.

Interpreters:

They provide the accurate access of communication between deaf students and teachers. They provide teachers instructions to the students, so the students can easily understand the teacher like other normal students.

Sign quiz web application:

It is an application that deaf students used to learn signs that can be helpful in education. It is cost effective and easy to use by deaf leaners. A deaf student provides a sign to application and after processing and recognizing the sign, it gives back a feedback.

Sign language videos are also helpful for educating deaf students.

An Android based Approach: It enables deaf students to learn English alphabets, most frequent words from SL to English, letters in SL (sign language) etc.

Animated software can also help teachers to teach students in a better way so that they can learn like normal students.

R. Question 2:

Which type of Strategies teachers use for teaching Science to deaf learners?

Teaching Science to deaf students is a challenging task. Many researchers introduced many strategies and technologies for teaching science to deaf students. Some of them are as follows:

ICT based Learning:

The deaf student faces many difficulties in order to learn science subject. The ICT based learning helps them to learn things in good manners.

Science e-text:

This approach increase students' knowledge their experience.

Interactive Book Reading with Expository Science Text: Interactive teachings strategy and explaining their structure, semantics and language strategies.

Verbal Communication and physical benefit:

The verbal and physical communication helps in better understandings of preparation and activities.

Peer-Mediated Intervention (PMI):

The students with Autism spectrum disorder needs to improve their societal skills and speculative learning. The PMI effectiveness to improve these two skills in the deaf.

R. Question 3:

How avatar approach is best for teachers to teach English and Science to deaf students?

An Avatar plays an essential role in the lives of deaf students. Avatar is a 3D virtual object that works according to hamnosys given to it and performs signs for deaf students. Avatar approach is best than videos, gifs and other approaches because it takes less storage. By using avatar deaf students can more efficiently learn Science and English literacy and more English words, sentences and phrases more easily than other approaches. It makes the lives of deaf students more comfortable. Some techniques and approaches are expensive and out of reach to the deaf students so avatar approach is cost effective.

V. LIMITATIONS OF TECHNOLOGIES

Many strategies and application are used for deaf learners. Basic means of getting information is vision for deaf students, description videos, pictures and other visual aids are used as an educational tool for deaf education. There are some limitations in strategies due to which some strategies have no scope. Gloves based Sign language recognition strategy is one of them.Some limitation are as follows:

- Sensors noise, device cost
- The Size of user hand, Finger-joints angles.
- System accuracy

- Gesture type

Interpreters also face some challenges.

- Lack of experience.
- Cannot explain everything to teacher that a student said
- Have not sufficient receptive skills

AR Book challenges: -

- Internet connectivity is a big challenge.
- Accessibility is a big challenge.
- Cost is also a big challenge.

Face to face interview approach Challenges: -

- The lack of teacher inspiration and mentorship.
- Lack of tools used in learning science.

Computer-based intervention approach challenges: -

- Not accurate in the sense of learning.

VI. CONCLUSION

It is a demanding task to teach deaf students, as they require specialized class room setup. Many people use different approaches and techniques for teaching English and Science to deaf students. The Augmented reality book, Electronic Gloves, Animated software and some android apps are used to teach deaf students, and with AR, different types of work have been published in deaf education, inclusive education and disability in 2008 to onward. In the field of Electronic Gloves 2008 to 2016 is a golden time. As a result, it has been found that both English and Science can be taught more effectively to the deaf students by using technological support. Where most attractive and useful approach is avatar based approach.

In future, there is a need to develop comprehensive applications and games to support the teaching and learning of the deaf students.

REFERENCES

[1] E. Suzuki and K. Kakihana, "On the Web Communication Assist Aide based on".

[2] E. Suzuki, M. Horikoshi and K. Kakihana, "Bilingual sign language dictionary for learning a second sign language without learning the target spoken language," in Proceedings of the Workshop on Multilingual Linguistic Ressources, 2004.

[3] M. Huenerfauth, "A linguistically motivated model for speed and pausing in animations of american sign language," ACM Transactions on Accessible Computing (TACCESS), vol. 2, no. 2, p. 9, 2009.

[4] Sampada S. Wazalwar & Urmila Shrawankar (2017) Interpretation of signlanguage into English using NLP techniques, Journal of Information and Optimization Sciences,38:6, 895-910,

[5] Ahmed, Mohamed Aktham, et al. "A review on systems-based sensory gloves for sign language recognition state of the art between 2007 and 2017." *Sensors* 18.7 (2018): 2208.

[6] Hutchison, Iain. "Oralism: A sign of the times? The contest for deaf communication in education provision in late nineteenth-century Scotland." *European Review of History—Revue européenne d'Histoire* 14.4 (2007): 481-501.

[7] Nisha, Ms, and J. Chriso Ricky Gill. "English Language Teaching Approaches to Deaf and Hard-of-Hearing Students in India."

[8] Joy, Jestin, Kannan Balakrishnan, and M. Sreeraj. "SignQuiz: a quiz based tool for learning fingerspelled signs in indian sign language using ASLR." *IEEE Access* 7 (2019): 28363-28371.

[9] Bala, Bulus P., and Laminu Aminu Song. "Android App for Improvising Sign Language Communication in English and Hausa." (2020).

[10] Zainuddin, Norziha Megat Mohd, Halimah Badioze Zaman, and Azlina Ahmad. "Developing augmented reality book for deaf in science: the determining factors." *2010 International Symposium on Information Technology*. Vol. 1. IEEE, 2010.

[11] Bouzid, Yosra, Mohamed Ali Khenissi, and Mohamed Jemni. "Designing a game generator as an educational technology for the deaf learners." *2015 5th International Conference on Information & Communication Technology and Accessibility (ICTA)*. IEEE, 2015.

[12] dos Passos Canteri, Rafael, et al. "An Evaluation Method of Educational Computer Games for Deaf Children Based on Design Guidelines." *International Conference on Universal Access in Human-Computer Interaction*. Springer, Cham, 2015.

[13] Egusa, Ryohei, et al. "Preparatory development of a collaborative/interactive learning game using bodily movements for deaf children." *Proceedings of the The 15th International Conference on Interaction Design and Children*. 2016.

[14] Eichenbaum, A., Bavelier, D. and Green, C. (2014) "Videogames - Play that can do Serious Good", American Journal of Play, Vol 7, No. 1, pp. 50-72.

[15] Bouzid, Yosra, et al. "Using educational games for sign language learning-a signwriting learning game: Case study." *Journal of Educational Technology & Society* 19.1 (2016): 129-141.

[16] Sotelo, Julián, et al. "Design of an interactive system for teaching deaf children vowels." *Proceedings of the XVII International Conference on Human Computer Interaction*. 2016.

[17] Zainuddin, Norziha Megat Mohd, H. B. Zaman, and Azlina Ahmad. "Learning science using AR-Book by blended learning strategies: a case study on preferred visual needs of deaf students." *Journal of Educational Technology Development and Exchange* 9.2 (2009): 5-20.

[18] Abana, Ertie, et al. "Electronic glove: A teaching AID for the hearing impaired." *International Journal of Electrical and Computer Engineering* 8.4 (2018): 2290.

[19] Cawthon, Stephanie W. "Teaching strategies in inclusive classrooms with deaf students." *Journal of Deaf Studies and D*eaf Education 6.3 (2001): 212-225.
[20] Huenerfauth, Matt. "A linguistically motivated model for speed and pausing in animations of american sign language." ACM Transactions on Accessible Computing (TACCESS) 2.2 (2009): 1-31.
[21] Ferreira, Marta Angélica Montiel, et al. "Requirements for a Framework of a Virtual Learning Environment for Deaf People Mediated by Avatar." International Conference on Human-Computer Interaction. Springer, Cham, 2019.
[22] Zamfirov, Milen, and Svetoslava Saeva. "Computer Enhanced English Language Tool for Students with Hearing Loss–A Bulgarian study." Journal of Educational Technology & Society 16.3 (2013): 259-273.
[23] McIntosh, R. A., Sulzen, L., Reeder, K., & Kidd, D. H. (1994). Making science accessible to deaf students: The need for science.
[24] Lang, H. G., & Steely, D. (2003). Web-based science instruction for deaf students: What research says to the teacher. Instructional Science, 31(4), 277-298.
[25] Coil, Susan. "Teaching science to deaf students: resources for teachers in kindergarten to fifth grade." (2005).
[26] N. M. M. Zainuddin, H. B. Zaman and A. Ahmad, "Developing Augmented Reality book for deaf in science: The determining factors," 2010 International Symposium on Information Technology, 2010, pp. 1-4, doi: 10.1109/ITSIM.2010.5561325.
[27] Adamo-Villani, N., & Wilbur, R. (2010). Software for math and science education for the deaf. Disability and Rehabilitation: Assistive Technology, 5(2), 115-124.
[28] da Fonseca Flores, A. C., & Rumjanek, V. M. (2015). Teaching science to elementary school deaf children in Brazil. Creative Education, 6(20), 2127.
[29] Egusa, Ryohei, et al. "Preparatory development of a collaborative/interactive learning game using bodily movements for deaf children." Proceedings of the The 15th International Conference on Interaction Design and Children. 2016.
[30] Andrews, J. F. (2017). Teaching Science to Deaf Students: Language and Literacy Considerations.
[31] Kawai, N. (2019, June). Science learning for students with visually impaired: A literature review. In Journal of Physics: Conference Series (Vol. 1227, No. 1, p. 012035). IOP Publishing.
[32] Ediyanto, Wulandary, V., & Fatmawati, D. (2020, April). Science learning for student with autism spectrum disorder: A literature review. In AIP Conference Proceedings (Vol. 2215, No. 1, p. 040004). AIP Publishing LLC.
[33] Ediyanto, E., Atika, I. N., Kawai, N., & Prabowo, E. (2017). Inclusive Education In Indonesia From The Perspective Of Widyaiswara In Centre For Development And Empowerment Of Teachers And Education Personnel Of Kindergartens And Special Education. INDONESIAN JOURNAL OF DISABILITY STUDIES (IJDS), 4(2), 104-116.
[34] V. F. Knight, C. L. Wood, F. Spooner, D. M. Browder and C. P. O'Brien, Focus on Autism and Other Developmental Disabilities 30, 86-99 (2015).
[35] A. Breit-Smith, J. D. Busch, M. S. Dinnesen and Y. Guo, Teaching Exceptional Children 49, 185-193 (2017).
[36] Azeta, A. A., Inam, I. A., & Daramola, O. (2018). A Voice-Based E-Examination Framework for Visually Impaired Students in Open and Distance Learning. Turkish Online Journal of Distance Education, 19(2), 34-46.
[37] S. H. Hedges, S. L. Odom, K. Hume and A. Sam, Autism 22, 70-79 (2018).