THE USE OF ASSISTIVE TECHNOLOGY APPLICATIONS IN IMPROVING THE LEARNING OUTCOMES OF STUDENTS WITH HEARING DISABILITIES

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Abstract

This research aims to analyse the use of assistive technology that should be used by students with hearing disabilities for courses. This research was carried out by collecting quantitative data on learning outcomes. The subjects in the first experimental class were 5 students with hearing disabilities, and in the second experimental class 5 students with hearing disabilities. The research results show that the use of assistive speech-to-text instant transcription technology using a Bluetooth microphone connected to an LED screen has a more significant effect on the learning outcomes of students with hearing disabilities, compared to using a personal smartphone. The use of assistive speech-to-text instant transcription technology is beneficial for students with hearing disabilities in understanding lecture material, self-confidence, and practice of using it in higher education.

Keywords: Assistive technology, Higher education, Learning outcomes, Speech-to-text, Students with hearing disabilities.

1. Introduction

Assistive technology (AT) is designed to improve the functional abilities of people with disabilities, assist with mobility and accommodation, as well as environmental adaptation. The number of students with hearing disabilities at Universitas Negeri Surabaya has increased since the university opened a special affirmation registration route for people with disabilities. The large number of students with hearing disabilities is directly proportional to the evaluation of the use of assistive speech-to-text technology for them.

Four analytical themes emerged from the use of assistive technology (AT) by students with disabilities in higher education: AT as a facilitator of academic engagement; obstacles to effective AT use can impede academic participation; the psychologically transformative potential of AT; and AT as a facilitator of participation and Numerous people are investigating the usage of assistive technology, according to research in the field of inclusive education [1, 2]. Students with hearing disabilities have difficulty understanding speech in a quiet atmosphere, but this becomes worse when there is background noise, such as in class during lectures. lots of visual information that pays attention to the accommodation needs of students with hearing disabilities, helping students understand the material being studied [3]. Since hearing loss is now acknowledged as a public health issue and a worldwide health risk, higher education needs to be prepared to accept and provide accessibility for students with hearing impairments. In higher education, Bloom's Taxonomy must be used to assess student learning outcomes. Learning based on the cognitive, affective, and psychomotor domains of the taxonomy is advised for the development of scientific literacy and creative thinking skills [4-6]. The implementation of assistive technology effectively enhanced the inclusion and accessibility of students with disabilities, despite the presence of obstacles such as inadequate teacher training, insufficient information, and limited accessibility [7].

The purpose of this research is to analyse the comparison of the use of assistive technology speech-to-text for instant transcription displayed via a personal smartphone compared to displayed via an LED screen. The novelties of this research is (i) the use of assistive speech-to-text instant transcription technology in higher education, (ii) assistive speech-to-text instant transcription technology with LED screens to accommodate learning in classes that have students with more than one hearing disability, and (iii) improving the learning experience of students with hearing disabilities achieving better learning outcomes in higher education.

2. Literature Review

Assistive speech-to-text technology has various specifications, its use can be divided into instant transcription, running text, and voice or video transcription from recorded files. The interactions of individuals with hearing loss and disabilities are not merely additive but multiplicative, influencing communication, cognition, social development, and behaviour [8]. It is evident from the categories of hearing impairments that disabilities can arise during either the pre-linguistic or post-linguistic phases. Hearing loss that occurs before speech and language abilities mature is called deafness. In contrast, post-lingual deafness is a loss of hearing that occurs after language and speech development on its own. Because of this, growing and developing students with impairments encounter obstacles on many levels -

physical, mental, intellectual, social, and emotional. Early cognitive development is dependent upon sensory input [9, 10]. This research explores the idea that deaf people are visual learners [11]. Speech-to-text is not limited to a certain level of hearing loss. The classification of levels of hearing loss that humans can experience is explained in Table 1 [12].

Consequently, the tools used to facilitate interaction including those for students with hearing disabilities determine how effective communication is. Students with hearing impairments have a great deal of aptitude and visual creative thinking, their social, scholastic, cognitive development will suffer if they don't acquire the language necessary, and visual materials were found to be more effective than using only [13, 14]. Analysis of learning outcomes with indicators [15] in the cognitive domain, namely (i) understanding of the material, (ii) affective domain, namely changes in behavior which are analysed from attitudes of self-confidence and feelings of not being discriminated against, and (iii) psychomotor which is analysed from the practice of using assistive technology speech-to-text.

Table 1. The classification of hearing impairment dB (Decibel).

No.	Sound	Performance [16]
1	0-25.50 dB	No or very slight hearing problems.
2	25.51-40.5 dB	No issues at 1 meter in silence with a regular voice. A hearing aid can be required.
3	40.51-60.5 dB	Able to hear, repeat, and raise one's voice one meter away. It is advised to use hearing aids.
4	60.51-80.5 dB	Capable of perceiving certain words when yelled into a better ear. Required are hearing aids.
5	$\geq$ 80.51 dB	Unable to comprehend or even hear a yelled voice. Hearing aids might be helpful, but more rehabilitation is required.

3. Method

This research uses quantitative method where the first experimental class and the second experimental class. Enable students with disabilities to convey their learning experiences and be involved in the course [17]. A pre-test was used to calculate the first experimental class's and the second experimental class's beginning learning results, and a post-test was utilised to determine the final learning results. The first experimental class had 5 students with hearing disabilities who were given assistive speech-to-text technology treatment via personal smartphones. Meanwhile, the second experimental class also had 5 students with hearing disabilities who were given instant speech-to-text transcription treatment via smartphone mirroring to an LED screen with the addition of a Bluetooth microphone as a sound conductor. The indicator for assessing the learning outcomes of students with hearing disabilities is 80% of the learning outcomes of hearing or typical students.

4. Result and Discussions

The main objective of this research is to understand the importance, practice, and availability of assistive technology in higher education as well as its role in the development and teaching process for hearing disabilities students according to the

perceptions of hearing disabilities students themselves. Students with hearing impairments use speech-to-text on their own smartphones as assistive technology. Because it relies on the sensitivity of personal devices, classroom management is needed, such as students seating positions at the front of the class, so that the smartphones used can capture the lecturer's voice well and minimize noise interference from other students, and the results of voice transcription into writing can only be seen by one person.

The assistive technology that students with hearing impairments use LED screen-based speech-to-text technology helps students with hearing impairments without limiting their sitting positions or creating the appearance of prejudice, the interpretation of sound to writing can be seen from all over the room because the size of the text is larger than a smartphone, and the lecturer makes less effort to make sound because he uses a Bluetooth microphone. The explanation above will be outlined in the flow chart as in Fig. 1.
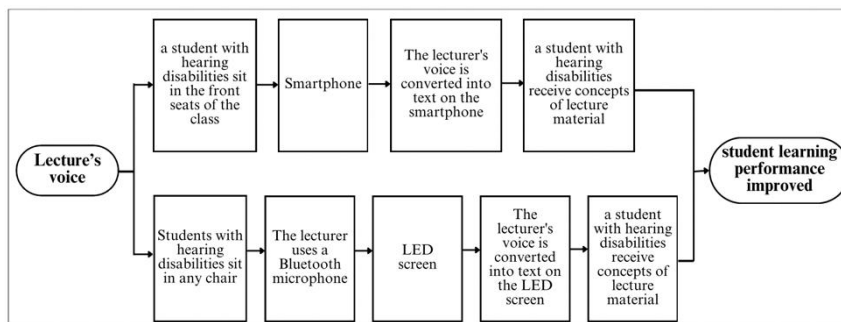

Fig. 1. Flow chart of assistive technology speech-to-text instant transcription.

The research tool includes questions designed to support students answers to the research scale. In higher education across the globe, the participation of all students in learning in general and instruction in particular has become a problem [18]. The students response was positive. Students with hearing disabilities who saw visuals + text were significantly higher than students who saw visuals or text only [19]. Some stated that they were able to understand classroom lectures through the use of assistive technology, others stated that students had knowledge of several technological tools that would facilitate their learning.

Nowadays most students are educated in an inclusive environment and use hearing technology, this access further enables age-appropriate language development which is the basis for improving cognitive outcomes [20, 21]. Our 10 students with hearing disabilities who are actively attending lectures at Surabaya State University can see how the effectiveness of assistive technology is linked to improving their learning outcomes. The results obtained cannot be separated from the device used as a speech-to-text integration medium, semester level of students with hearing disabilities, type of speech-to-text application, degree of hearing loss, number of students with hearing disabilities in class. These variables are in Table 2.

The results of the research show that the perspective of students with hearing disabilities students who use assistive technology in courses is important, and the scale of practice of students with hearing disabilities who use speech-to-text assistive technology with instant transcription via LED screens on increasing

achievement is on average more effective than use via smartphones. Compared to hearing people, people with hearing disabilities have certain advantages in terms of visual-spatial abilities [22]. Vocabulary written in notebooks accumulates more significantly and confidence in taking classes inclusively without feeling discriminated against. Technology availability has the lowest average value. The fact that the students who participated in this research agreed on the significance of using technology in the lecture process supports the idea that students with hearing disabilities have the abilities and motivation to use assistive technology in their learning process, despite the ease of use and limitations of technological tools available independently.

Table 2. The distribution of variables.

No.	Variable	Information
1	Type of device AT integration	Smartphone, microphone Bluetooth, LED screen
2	Student semester level	2, 4, 6
3	Type of AT application	Instant transcription
4	Degree of hearing loss	Severe, profound
5	Students with hearing disabilities in first experimental class	5 person
6	Students with hearing disabilities in second experimental class	5 person

The questionnaire consists of 50 statements which are divided into 3 domains, namely the cognitive, which consists of 20 items containing questions about understanding the material. Second, affective in learning consisting of 20 items that test changes in behavior which are analysed in terms of self-confidence and feelings of not being discriminated against. Lastly, the psychomotor which consists of 10 items which measures the practice of using assistive speech-to-text technology. Validity testing is carried out to determine whether the instrument is valid or not. The questionnaire consists of 50 questions. If the table r value is smaller than the calculated r value, it means the instrument is valid. The results of the validity test for calculating the questionnaire instrument obtained that the r-table (0.234) was smaller than the r-value (0.834). This means that the questionnaire is valid to be applied to the subject. Standardized written assessments are better used to assess understanding of course [23].

The analysis's F test findings show a significance value of 0.000, which is less than 0.05. This yields a sig value indicating the significance of the second experimental class value. 0.000<0.005. These findings support the acceptance of the alternative hypothesis (Ha). Thus, a comparison between the learning outcomes of the students with hearing difficulties in the first experimental class and the second experimental class reveals a noteworthy difference in the former's learning outcomes. Students with hearing disabilities who are facilitated with visual media learn more actively, and communication strategies naturally [24, 25]. The positive impact of using assistive speech-to-text technology for students with hearing disabilities can be seen through increasing understanding of the material, self-confidence and practice of using assistive technology in lectures. The significant impact of using assistive technology for instant speech-to-text transcription via LED screens shows its potential as a model for exploring the use of assistive technology. Faculty should work with the University's Disability

Services office or resource center to find out support options for students with disabilities [26]. Finally, this study adds new information in virtual laboratory as reported elsewhere [27, 28].

5. Conclusions

Students with hearing disabilities can benefit from the use of assistive speech-to-text technology in higher education by being able to actively engage with the course material and comprehend complex subject. To further investigate the value of assistive speech-to-text technology in facilitating learning materials in higher education in the fields of science, linguistics, vocational training, and other areas, further research is still required. As well as for accessibility to fulfil the right to learning and adaptation so that it is effective in integrating course concepts into a form of information that can be processed by students with hearing disabilities.

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