Usability Evaluation of AI-Powered Audio-To-Text Systems for Deaf Learners

Angelo Luisaga Nicolas., Judge Matthew F. De Leon., Rajie M. Declaro., Dr.Erlito M. Albina

School of Computer Sciences Arellano University - Jose Abad Santos Pasay, Philippines

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ABSTRACT

Artificial intelligence and audio-to-text tools offer ways to improve accessibility in education, especially for Deaf learners, who face challenges accessing verbally transmitted information. However, usability and accessibility in relation to such tools still need to be considered to ensure they are applicable in educational settings. Therefore, this study assessed the AI-powered audio-to-text system for usability, accessibility, and satisfaction. A quantitative approach was adopted using a Figma-based mobile prototype with simulated features, including live captioning, caption customization, classroom communication, and others. The sample size included 58 respondents who evaluated the prototype after doing their assigned tasks. The researcher used a researcher-made questionnaire with 20 statements on a four-point Likert Scale. The findings revealed that usability and accessibility had a weighted mean of 3.29, both interpreted as strongly agree. Satisfaction got the highest score of 3.30, also interpreted as strongly agree, and the overall weighted mean was 3.29. These findings indicate that the respondents have a favorable view regarding the proposed prototype in terms of usability, accessibility, and satisfaction. Because the study evaluated a Figma-based prototype with simulated interaction features, the findings reflect only respondents' perceptions of the proposed interface.

Keywords: Artificial Intelligence, Audio-to-Text Systems, Deaf Learners, Usability Evaluation, Accessibility, User Satisfaction.

INTRODUCTION

The rapid development of artificial intelligence technology has dramatically changed modern education. With the rise of digital classrooms and virtual learning environments, AI has become an integral part of the modern teaching process, facilitating the learning experience and improving accessibility and inclusion for diverse learners. This technology offers many possibilities to help learners with disabilities participate actively in academic life and overcome barriers to learning and development.

At the same time, audio-to-text technology is considered one of the most widespread applications of AI. It is designed to transform speech in a lecture, video, discussion, or other academic activity into written language and enable deaf learners to follow the process. Today, schools and universities use it to make learning environments inclusive and ensure deaf students can participate actively in academic life, both offline and online.

Nevertheless, while audio-to-text technology has high transcription accuracy due to rapid advances in natural language processing, usability issues remain. These systems still face difficulties with interface design, navigation, and adaptability across different learning environments. At the same time, a lack of usability evaluation can prevent deaf students from accessing useful and important information.

This study evaluates the usability of AI-powered audio-to-text technology for deaf learners in terms of usability, accessibility, and user satisfaction. It can help us understand this technology's features and its practical advantages and disadvantages.

This study aims to evaluate the proposed AI-powered audio-to-text system for Deaf learners in terms of usability, accessibility, and satisfaction.

1. What is the perceived usability of the proposed AI-powered audio-to-text system among the respondents?

2. What is the perceived accessibility of the proposed AI-powered audio-to-text system among the respondents?

3. What is the level of satisfaction of the respondents toward the proposed AI-powered audio-to-text system?

LITERATURE REVIEW

Artificial Intelligence has been proposed as one way to make learning more accessible to students with disabilities. It can provide adaptive tools, from personalized instruction to automated speech processing, that increase independence and participation [1], [3], [9]. This perspective frames speech-to-written text systems as accessibility tools that must be intentionally developed to meet students' needs, rather than relying on technology alone.

Several articles in educational AI research have shown the importance of personalization and the impact of digital design on engagement and inclusion. Saleem et al. [6] and Singh [8] explore AI-based personalized learning systems that can increase student engagement, while Kooli and Chakraoui [10] review assistive interfaces such as voice assistants and NLP tools that help users become more independent and access content [9]. Overall, these studies show that educational AI is most useful when paired with learning-oriented features. This connection, in turn, means that evaluating an audio-to-text interface should take both factors into account.

Accessibility and usability are connected concepts in these works. Choi and Seo [2] discuss the relationship between Universal Design for Learning and design accessibility and usability, and Paice et al. [16] emphasize customization and user-centered design in the context of assistive technologies. At the same time, Fuentes-Cortázar and Rojano-Cáceres [17] note the limitations in the existing evaluation methods for Deaf users. In general, this indicates that usability testing must be included along with the accessibility evaluation.

The most critical issue faced by deaf and hard-of-hearing students is communication, and interface design can help address it. Kim et al. [4] evaluate the communication-assistive mobile applications and highlight the importance of matching interfaces to the preferences of users, and Jolly et al. [5] demonstrate that even real-time captioning in higher education may lack adequate access opportunities. Learning tools such as Pocket Sign by Suriani et al. [25] show that assistive applications can support language learning when designed for the users' needs. Hence, accessibility in this case involves both the availability of tools and how they present information.

Speech-to-text technologies directly address communication barriers by converting spoken information into text. However, their effectiveness depends on text quality and task fit. Nacheva [11] evaluates the use of conversational AI and speech-to-text technologies for students with hearing disabilities and recommends carefully evaluating quality. Similarly, Almgren Bäck et al. [12] show that speech-to-text can help students express their ideas and overcome writing barriers. Hadi and Zulkarnain [15] demonstrate how a real-time converter can facilitate classroom participation. Thus, speech-to-text technologies can support both receptive and productive learning, provided the transcript is high-quality and usable in the learning context.

The technical components, automatic speech recognition (ASR) and natural language processing (NLP), drive performance differences that matter to users. Höhne et al. [13] compare ASR systems and note variability in terms of transcription accuracy and processing speed. Tulsyan et al. [14] describe improvements in intent recognition and response generation in NLP pipelines. Because latency, vocabulary coverage, and error types affect readability and timing, these technical differences translate directly into practical impacts for users who rely on transcripts during instruction and discussion.

AI was also utilized for communication supports beyond speech-to-text. Yu et al. [19] evaluate an AI-based communication system involving both Deaf and hearing participants and conclude that participants prefer systems that provide broader communication support, and Azizah et al. [21] consider sign-language recognition technology a complementary tool. Kamikubo et al. [20] recommend involving Deaf community members during

development to highlight needs designers may have missed. These works indicate that multiple communication modes and community involvement can provide more options and make the design more relevant for Deaf users.

Finally, consider ethical and access-related concerns alongside technical and design ones. Loughrey et al. [22] list equity, bias, and privacy as the key problems for AI technologies developed for Deaf, hard-of-hearing, and disabled communities, and Doğan et al. [7] discuss the advantages and disadvantages of AI adoption in higher education. These reviews remind researchers that responsible technology implementation requires considering fairness and data practices, and that access cannot come at the expense of privacy and equity.

Some practical platform examples show how applying accessibility principles alongside AI can lead to noticeable improvements. Stelea et al. [23] describe the accessibility-first e-learning platform featuring personalized instruction and multi-format content, with the early results indicating increased engagement; Kooli and Chakraoui [10] present assistive interfaces that help users become more independent and access content [9]. This shows that integrating accessibility principles into platform design can improve learning outcomes through AI-based features.

Finally, measuring usability in a way that reflects Deaf users' experience requires the right methodology. Fuentes-Cortázar and Rojano-Cáceres [17] discuss current limitations in user experience assessment for Deaf users, and Liu and Yang [24] explain usability in user experience assessment. Deshmukh and Chalmeta [18] provide an example of usability assessment for a speech-based interface. Usability assessment requires considering not only technology features but also users' needs. This study used a researcher-made questionnaire to assess usability, accessibility, and satisfaction.

User-centered and participatory design practices improve the design and the evaluation. Paice et al. [16] and Kamikubo et al. [20] both argue for user involvement in the development process to better align features with needs; such practice reduces the risk of failure in technically effective systems due to interface mismatches. Incorporating user feedback into prototype testing supports a usability-focused approach, helping identify interface problems that technical tests may not reveal.

[18] Furthermore, evidence shows that assistive tools can support learning beyond the communication process. For instance, Suriani et al. [25] describe vocabulary learning through a sign-language application, and Choi and Seo [6] highlight the importance of considering the needs of various users. Consequently, these factors suggest that such tools can support language learning and interaction.

Research Gap

Studies have examined artificial intelligence, speech-to-text systems, assistive technology, and communication aids for deaf learners; however, deaf learners have not sufficiently evaluated the usability of AI-based audio-to-text systems.

METHODOLOGY

A. Research Design

This research study uses quantitative research methodology to evaluate the usability of the proposed AI-powered audio-to-text system for Deaf learners. The study will use a mobile prototype that simulates the system's main functions, including live captions, caption customization, classroom communication, and other accessibility features. The researcher-made questionnaire will gather quantitative data to measure participants' perceived usability, accessibility, and satisfaction with the prototype.



B. Respondents

The respondents in this research will be Deaf learners who fit into the category of the target users of the proposed system. These respondents will test the prototype by performing assigned tasks related to classroom communication. They will give relevant information on the usability and accessibility of the proposed system for its target users.

C. Sampling Design

For this study, purposive sampling will be used to select respondents who meet the set criteria for the system's target users. Purposive sampling will identify participants with attributes relevant to assessing the proposed artificial intelligence audio-to-text system for Deaf learners. Selecting the right participants will help obtain relevant feedback on the prototype.

D. Research Instrument

The main research method used in this study is a **r**esearcher-made questionnaire. The questionnaire includes 20 statements, and participants will respond on a four-point Likert scale from 'strongly disagree' to 'strongly agree.' It will be administered after participants complete the task using the prototype.

E. Data Gathering

The participants will first use the prototype and perform the designated tasks. After using the prototype, participants will respond to the researcher-made questionnaire via Google Forms. The gathered results will be analyzed to measure the usability, accessibility, and satisfaction with the proposed system.

F. Statistical Treatment of Data

The researcher will analyze the collected data using the researcher-made questionnaire to gauge the usability, accessibility, and satisfaction with the proposed prototype system. The researcher-made questionnaire consists of twenty statements rated on a four-point scale ranging from “strongly disagree” to “strongly agree”.

Frequency will be used to count how many participants choose each option. This shows how responses are distributed across the statements.

Percentage will be utilized to determine the distribution of responses for each questionnaire item answered by the respondents.

$$P = (f/N) \times 100$$

Where:

P = Percentage

f = frequency of responses

n = total number of responses

The weighted mean will be used to calculate total agreement for each statement and category in the questionnaire.

$$WM = \sum fx / N$$

Where:

WM = Weighted Mean

f = Frequency

x = Weight of the response

n = Total number of respondents

Table 1. Likert Scale

Weighted Mean	**Interpretation**
3.26–4.00	Strongly Agree
2.51–3.25	Agree
1.76–2.50	Disagree
1.00–1.75	Strongly Disagree

RESULT AND DISCUSSION

Respondent Demographic

Figure 4.1 presents the demographics of the 58 respondents who participated in the evaluation of the proposed AI-powered audio-to-text prototype. The respondents included Deaf learners, professors, IT experts, developers, and an AI enthusiast.

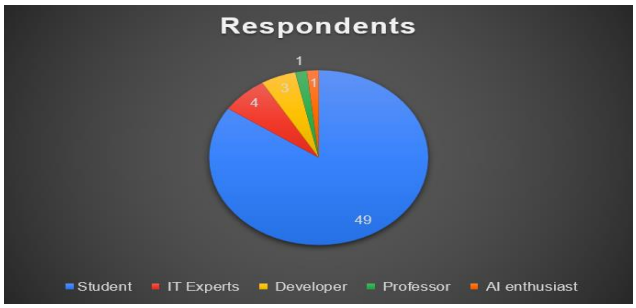


Figure 4.1

Quantitative Findings: Likert-Scale Results

Figure 4.2 presents descriptive results for the three indicators used in the evaluation process: Usability, Accessibility, and Satisfaction. These results come from the researcher-developed questionnaire, which comprises 20 items based on a four-point Likert scale.

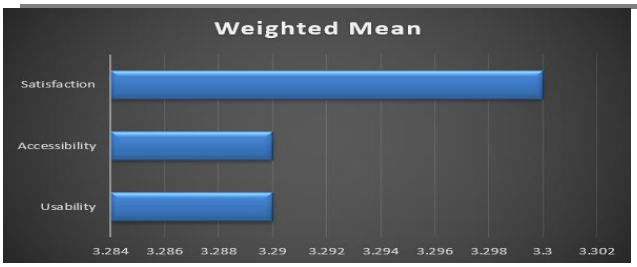


Figure 4.2

The **Usability** criteria achieved a weighted mean of 3.29, indicating a strong agreement. This result suggests that respondents found the prototype easy to use and understand. This outcome aligns with Paice et al. [16], who emphasized the importance of addressing the needs of persons with disabilities in designing assistive and inclusive technologies. In the present study, the usability criteria were used to assess the prototype's ability to provide an understandable and user-friendly interface for respondents.

The **Accessibility** criteria attained a weighted mean of 3.29, interpreted as "Strongly Agree." This result reflects respondents' views on their ability to access the information provided in the prototype. The result implies that respondents viewed the proposed prototype as able to provide spoken information in text form, allowing them to access and understand it. This outcome aligns with the work of Fuentes-Cortázar and Rojano-Cáceres [17], who emphasized the importance of considering communication and accessibility requirements for Deaf users. A similar idea was raised by Nacheva [11], who discussed conversational AI technology for students with hearing disabilities.

Satisfaction got the highest weighted mean value of 3.30 and was marked as Strong Agreement. This means that users felt satisfied with how the text was represented, including its usability and performance.

SUMMARY OF FINDINGS

This chapter presents the study's findings, conclusions, and recommendations. The findings are based on the evaluation of the proposed AI-powered audio-to-text prototype using a researcher-made questionnaire.

Summary of Findings

The researchers evaluated the proposed AI-based audio-to-text system prototype for usability, accessibility, and satisfaction among 58 respondents. Usability and accessibility both had a weighted mean of 3.29, indicating Strong Agreement. Satisfaction had the highest weighted mean of 3.30 and was interpreted as Strongly Agree. Thus, the overall measure for the prototype was 3.29.

CONCLUSION

Based on the collected responses, respondents viewed the designed prototype for an AI audio-to-text system favorably. The data showed that the prototype was clear, easy to use, and effective at representing spoken language through text.

However, because the study used a Figma-based prototype with hypothetical interaction, the results reflect respondents' perceptions of the interface rather than the accuracy and efficiency of an actual AI-powered speech-to-text tool.

RECOMMENDATIONS

1. **Develop and test the AI System**

Developers in the future should develop and conduct tests on an AI-powered audio-to-text converter to test the effectiveness of the software.

2. **Include Deaf Learners in Development**

Developers should include Deaf learners in the software development process.

3. **Conduct Further Usability Evaluation**

Future researchers should conduct further usability evaluations of the system with qualified Deaf learners.

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