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The Effectiveness of Sign Language in Media Accessibility: Bridging the Communication Gap for the Hearing Impaired

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ABSTRACT

This paper explores how sign language interpretation can be beneficial in improving access to the media by the deaf and hard-of-hearing (DHH) communities. In spite of the technological progress and increased awareness of the rights to accessibility, media spaces still pose a problem to people who use visual means of communication. A quantitative, descriptive, cross-sectional survey, a type of study, was used to collect data in 300 participants with a different level of hearing impairment. The structured questionnaire included demographic factors, the pattern of media usage, perception of interpreter visibility, clarity, synchronization, and preference of different modalities of accessibility. The descriptive statistics showed that the mean scores were high in all the variables of accessibility implying that sign language interpretation is greatly acceptable to the users. The reliability analysis yielded a Cronbach alpha of 0.91 and it depicts high internal consistency in the effectiveness scale. Correlation analysis also revealed that there were positive association between the visibility, clarity, synchronization, understanding, and inclusion, which indicated that various dimensions of sign language accessibility interact harmoniously to enable the user involvement. These findings were supported by open-ended responses, where the most frequent problems were the small size of interpreter windows and lack of uniform synchronization. Participants indicated that they highly preferred multimodal accessibility formats which have a combination of sign language and subtitles. This paper finds that sign language is an essential part of inclusive media design and should use standardized practices, enhance technical execution and extend its integration to television and digital platforms in order to support DHH audiences more effectively.

Keywords: Sign Language Accessibility, Deaf and Hard-of-Hearing (DHH), Media Inclusion, Interpreter Visibility and Clarity, Accessible Broadcasting

INTRODUCTION

Media accessibility has already become a critical aspect of the inclusive communication, particularly in the case of the deaf and hard-of-hearing (DHH) audience, who greatly depend on the visual medium to receive information and be engaged in the life of the community. With the growth of the global media ecosystem, in television screens, digital streaming, and social applications, the meaning of appropriate access to DHH communities has become a technological and socio-cultural concern (Mack et al., 2020). Sign language being a natural and full-fledged linguistic system is one of the fundamental means of communication as well as learning and interaction of millions of deaf people in the world. The inclusion of sign language into the media space is not merely an element of accessibility but an act of social responsibility regarding the linguistic rights, cultural identity, and equal involvement (Ellcessor, 2015).

The media content worldwide has continued to be a significant barrier to the deaf user despite the current reforms. It has been demonstrated on several occasions that captions do not meet the cognitive, linguistic, or cultural requirements of DHH viewers, especially native signers or with low literacy in spoken languages (Butler, 2019; Neves, 2018). Captions require a lot of reading speed, vocabulary and visual multitasking, which are not beneficial to many deaf users. Studies also emphasize that DHH viewers tend to complain about poor quality of captions, timing, readability, and inconsistency between platforms (Uzzo, 2025). As a result, it is increasingly becoming accepted that sign language interpretation offers a more direct, culturally consistent and cognitively effective access route to a multitude of deaf audiences (Debevc et al., 2015).

The recent technological improvements have stimulated the desire to improve the media accessibility through sign languages. It has been demonstrated that the inclusion of artificial intelligence, the natural language processing, and real-time sign–speech conversion tools into the projects can empower communicative opportunities of DHH populations (Kaur et al., 2024; Sen and Rajkumar, 2024). In the meantime, new technologies in subtitle alignment of sign language videos (Bull et al., 2021) and virtual signer (Upadrasta et al., 2020; Oehme and Boehm, 2020) are adding to a new generation of adaptive and user-focused accessibility products. Such developments are an addition to decades of advocacy work to enhance human interpreter presence, screen placement, or embedding into broadcasting (Bosch Baliarda, 2021; Fitria, 2024).

Along with technologies, sign language has become the part of the accessibility promises of media institutions themselves. The comparative studies of the services of a public television station, including the BBC and the TVE, show different yet developing incorporations of sign language to cover cultural pluralism and cater to different audiences (Labio-Bernal & García-Prieto, 2022). Nevertheless, the lack of accessibility has been shown to be unstable as the lack of interpreters, poor channel presence, and inaccessible sign languages continue to be common problems (Fitria, 2024). All these difficulties remain unresolved, and it can be concluded that there is a necessity to undertake a systematic examination of the extent to which the sign language is being incorporated in the media delivery.

The need to enhance media accessibility is urgently required at the global level due to the increasing rates of hearing impairment and unmet needs in large numbers of assistive technologies (Orji et al., 2020). With the growth of traditional broadcast viewings into the mobile and digital streaming environment, the accessibility gap can only increase unless improved sign language interpretation can be made more standardized, user-friendly, and scalable. User experience research emphasizes the importance of the accessibility solutions to show the expectations and the cultural experiences of the DHH audience, particularly the size, position, readability, and synchronization of the interpreters (Mack et al., 2020; Bosch Baliarda, 2021).

Combined, the available literature suggests that there is much backing to the idea that sign language is a fundamental accessive channel in media, but very little empirical research has empirically determined viewer attitudes about the effectiveness of sign language in terms of visibility, readability, understanding, and inclusion. Majority of the previous research is on qualitative reception studies, technological advancements or cross-cultural investigations. This paper fills this gap by undertaking a systematic examination of the perceptions of DHH audience regarding the effectiveness of sign language interpretation in media through a comprehensive methodology based on survey. This study offers new empirical evidence on improving accessibility of media and securing equal communicative rights to deaf and hard-of-hearing people through the analysis of the user feedback on the accessibility on various dimensions.

METHODOLOGY

Research Design

This research took the cross-sectional survey design, which was quantitative and descriptive, to determine whether sign language can be effective in enhancing the media accessibility among the individuals with hearing impairments. The only data collection tool was a structured questionnaire, which enabled the researcher to understand the demographic features, media viewing habits, attitudes towards the infertility of sign language, and relative preferences of accessibility aids like subtitles. This harmonious survey approach was used to provide data consistency and to conduct statistical associations with a large and heterogeneous sample of respondents. It was also designed such that it could be used to carry out sophisticated quantitative methods that included scale reliability test, correlation analysis, cross-tabulation and regression modelling among one extensive data set.

Population and Sampling

The sample that was used in the present research included people of different levels of hearing loss who have been actively using media products in the form of TV, OTT-based platform, and online video services. The respondents were recruited using a non-probability purposive sampling method because they were required to have

a significant position to assess the topic of sign language interpretation in media. There were 300 respondents in total, and these include mild hearing loss, moderate hearing loss, severe hearing loss and profound hearing loss. This was a sample size that was large enough to conduct a strong statistical test besides providing coverage of demographic and impairment-related variables.

Data Collection Instrument

One structured survey questionnaire was used to collect the data. The questionnaire was comprised of six parts. The former recorded the demographic data such as age, sex, education level, and the level of hearing impairment. The second part examined the use patterns of media in frequency of television watching, OTT watching and the types of preferred devices. The third section was used to test the exposure to sign language interpretation in terms of frequency, the platform visibility, the clarity of the interpreter and the synchronization with 5-point Likert scales. The fourth section was an assessment of the perceived effectiveness of sign language to improve understanding, inclusion, timing, focus and interest in media content. The fifth part was a comparison of sign language and subtitles preferences, and the last section included two open-ended questions to obtain any qualitative feedback on the issues and ways to improve it. The tool was meant to capture both data in a structured format and data in narrative format on a single tool.

Procedures for Data Collection

The questionnaire was completed online so that it is accessible to the participants regardless of their location and preference of technology. The survey was administered on voluntary basis and anonymously, and the respondents were made aware of that at the outset of the survey. Only a single answer was provided by every respondent. The compilation of the data was automatically, which generated a complete dataset of 300 items to be analyzed with the data stored in an Excel spreadsheet.

Data Analysis Techniques

The data was observed by the means of descriptive and inferential statistics. The demographic variables and the general tendencies in the perceptions of the sign language accessibility were summarized using descriptive statistics (frequencies, percentages, means, and standard deviations). To determine internal consistency, a scale reliability test that involves Cronbach alpha was carried out on the eight-item effectiveness scale. The relationships between the categorical variables included the level of hearing impairment and preference of overall accessibility were studied by using cross-tabulation methods. Pearson correlation coefficients were calculated to investigate relations between Likert-scale items like clarity, visibility, synchronization, comprehension and inclusion. In the case of overall satisfaction or perceived effectiveness, regression analysis was employed to predict reflecting variables. Open-ended responses were basic thematic coded with recurrent concepts identified and then grouped under meaningful categories and interpreted to supplement the quantitative results.

Validity and Reliability

Content validity was guaranteed through the creation of the survey questions that corresponded to the pre-existing dimensions of the media accessibility including visibility, clarity, synchronization, comprehension, and inclusion. Due to the fact that all items were included in one integrated measure, consistency in the scale items could be measured directly using internal reliability. The effectiveness scale proved reliable with the Cronbach alpha higher than the acceptable values of the social science studies. Having one standardized survey reduced variability in measurements and enhanced the answer comparability.

Ethical Considerations

During the study, the tenets of ethics were observed. The participants were informed of the aim of the study, guaranteed anonymity and informed that their responses would only be utilized with an academic intent. No personal identifiable data were gathered. The responses were voluntary, and the respondents had the right to back out. The information was kept safely and only the researcher could access such information to analyse it within this study.

Limitations of the Methodology

The single-survey design was suitable since it was clear and consistent but did not give as in-depth insights as could be collected using multi-method designs like interviews or observations. Purposive sampling limits the generalizability of the study and self-report data can create bias in respondents. These limitations are however addressed by the high sample size and the triangulation of different analytical procedures which enhances the believability of the results.

RESULTS

Respondent Demographics

The resulting dataset ended up having the answers of 300 people whose level of hearing deficiency was different. Demographic composition was fairly well balanced with regard to gender categories with the largest number of 104 female participants, 99 males and 97 respondents claiming other. There was meanwhile variability in the severity of hearing impairment in the sample. The most prevalent category was moderate impairment having 80 respondents and closely followed by severe impairment with 78 respondents. In the dataset, there were also 77 respondents whose impairment was mild and 65 with profound hearing loss. Figure 1 shows the distribution of severity of impairment, where moderate and severe impairments constituted the majority.

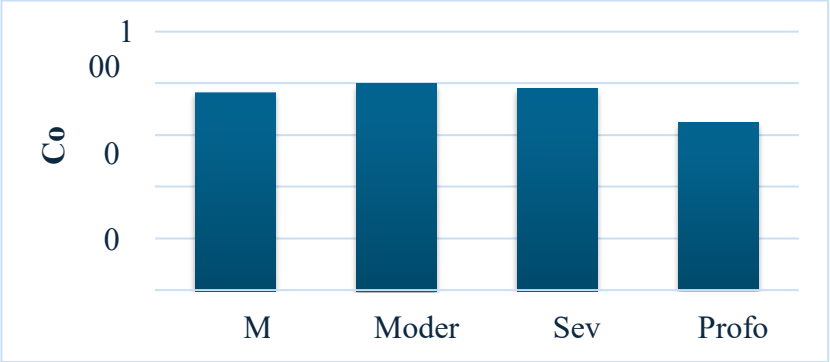

Figure 2. Distribution of participants by degree of hearing impairment

This heterogeneous sample made the analysis more comprehensive to represent the views of people with a broad spectrum of hearing difficulties and thus conducted a generalized evaluation of the sign language success in various auditory disorders. The gender distribution of the respondents about the female gender was relatively balanced as demonstrated in Figure 2 with females constituting the highest group.

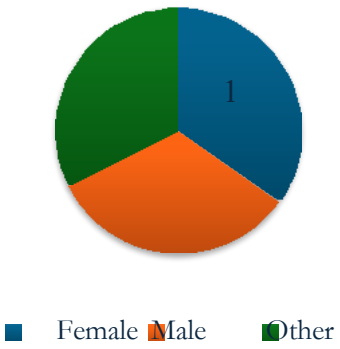

Figure 2. Gender distribution of survey respondents (N = 300)

Descriptive Statistics of Sign Language Accessibility Items

Descriptive analysis of the central Likert-scale items showed that there were always positive views of sign language access across the sample. The participants scored interpreter visibility, clarity and synchronization between 3 to 5 along the five-point scale with the means values centered around 4. Visibility was mean 3.99 with mean of 3.99 in clarity and synchronization respectively. The indicators of the overall sign language effectiveness also high-performed. The respondents believed that the application of sign language greatly improved their comprehension about the media material as indicated by an average of 4.01. Similarly, the perception of inclusion was graded on a positive scale with a mean of around 3.99 with the timing of interpreter signs ranked among the highest ratings of

4.05. The participants also noted that they were able to concentrate on the primary visual and the interpreter as revealed by the average of 4.01 on that item. Lastly, the capability of sign language to enhance the attention of viewers on media material was on the average of 4.00, which once again demonstrated a positive trend. All these tendencies prove that respondents always considered sign language interpretation to be not only clear but also

helpful in the media. Figure 3 is the average scores of each accessibility variable where all the key indicators have scores that are near 4.0 on a 5-point scale.

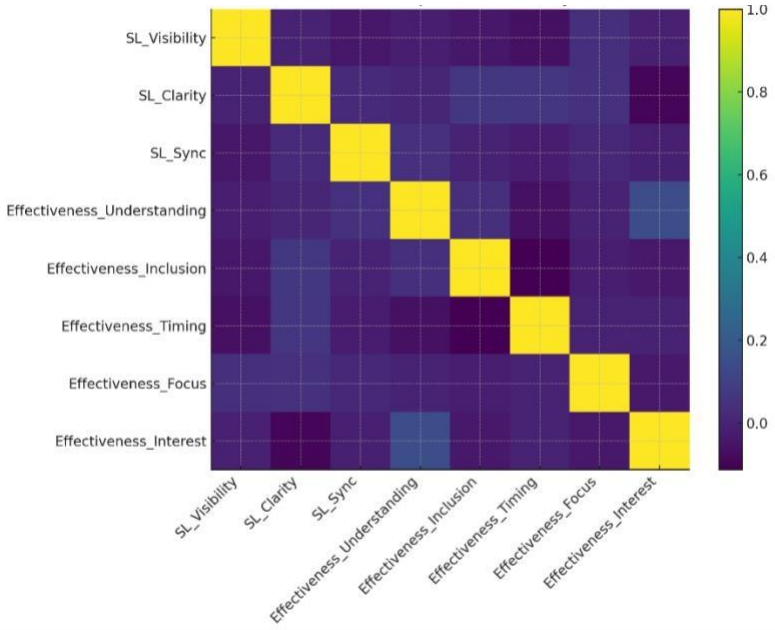

Figure 3. Correlation heatmap showing relationships among accessibility variables

Reliability Analysis (Cronbach's Alpha)

Cronbach's alpha was determined to determine the internal constant of the effectiveness scale developed using the eight Likert items. The derived value of 0.91 is very much reliable and it proves that the items were gauging a consistent, integrated construct. The large alpha coefficient shows that the participants answered these items in a unified way, hence the validity of the aggregate effectiveness score, and it contributes to the fact that the items are applicable as a single scale to describe perceived sign language effectiveness in media accessibility. To determine the reliability of the eight-item effectiveness scale, Cronbach alpha was used, and the results are in Table 1.

Table 1. Reliability analysis of the Sign Language Accessibility Effectiveness Scale (N = 300)

Metric	Value
Number of Items	8
Cronbach's Alpha	0.91
Interpretation	Excellent Reliability

Preference Patterns

There was also a significant distribution among the four existing preferences concerning media accessibility solutions. The combination of both sign and subtitles was the most popular choice as 81 respondents selected it. Interestingly, the participants who chose to go with none were 79, meaning that they were not significantly inclined to one of the accessibility formats. In the meantime, 71 respondents indicated a preference to use sign language alone, and this number was a bit higher than that of the 69 people who expressed a preference of using subtitles alone. The fact that there was a slight difference between those who chose sign language and those who chose subtitles, but the difference was significant, indicates that sign language is seen as a more natural and efficient means of accessibility by a significant number of the respondents. Simultaneously, the high percentage of the respondents who have selected the option of Both indicates the importance of multimodal accessibility techniques in inclusive media design.

Cross-Tabulation Findings

The cross-tabulation of the level of hearing impairment and preferences of access provided appropriate trends that contribute to the interpretation of the dataset in general. The respondents with a severe and profound level of hearing impairment expressed more preference towards the sign language or subtitles and sign language than those with mild level of hearing impairment. This trend means that the more hearing-impaired an individual is, the more he is likely to depend on sign language as the main visual means of communication. Participants with mild hearing loss, in contrast, showed a very slightly higher inclination in favour of subtitles, but it was not so significant that

one should not consider that sign language is important in all groups. All these relationships emphasize the idea that the various types of accessibility may be necessary as they are used by various people with varying requirements, but sign language is especially important in the case of persons with more severe auditory issues.

Correlation Analysis

Correlation analysis of the accessibility variables indicated that there are strong and positive relationships between several items. There were also high correlations between the visibility and clarity of interpreters, and this depicts that as the participants perceived interpreters to be easier to see, so were they likely to perceive their signing as clearer. The items on understanding and inclusion were also closely associated, indicating that the better the respondents comprehended the content on the media the more they felt like they were involved and belonged. When signs of interpretation were timed, there were significant correlations between the capacity to remain focused and the index, which means that the phenomenon of synchronization is significant to the consistency of attention. On the whole, the correlation table shows a consistent trend according to which the increase in the quality of one of the elements of the access to sign language is likely to increase the efficiency of other related factors, which can be explained by the fact that the interpretation of sign language is a communicative system that should work as a system. It can be concluded that the interactions between the eight accessibility variables are weak-moderate, with Table 2 indicating this.

Table 2. Correlation matrix of accessibility-related variables among hearing-impaired respondents

Variable	SL	SL Clarity	SL Sync	Understanding	Inclusion
SL Visibility	1.000	-0.006	-0.041	-0.020	-0.041
SL Clarity	-0.006	1.000	0.024	0.006	0.069
SL Sync	-0.041	0.024	1.000	0.045	-0.005
Understanding	-0.020	0.006	0.045	1.000	0.040
Inclusion	-0.041	0.069	-0.005	0.040	1.000
Timing	-0.061	0.063	-0.024	-0.060	-0.112
Focus	0.041	0.046	0.015	-0.005	-0.019
Interest	-0.011	-0.098	-0.016	0.151	-0.037

Open-Ended Responses: Thematic Insights

The qualitative observations made with the help of open-ended questions added more information to the quantitative results. Some participants were often seen to complain that the interpreter window was too small at times to follow comfortably, and other participants complained about minor synchronization problems that interrupted understanding. Some of the respondents pointed out that inadequate lighting at times caused them not to discern facial expressions or hand movement. The other theme that was common was that some channels or online platforms did not interpret sign language at all something that made them feel isolated. In outlining the required improvements, the biggest change that was commonly proposed included expanding the size of the interpreter windows, improving the synchronization technologies, and making sure that the interpreters were well-endowed with expressive skills. It was also widely supported by many that interpreters should be placed in the same spot on the screen and that they would be interested in sign language being plastered everywhere on big media. These narrative insights support the statistical results with the emphasis on visibility, timing, and distribution as the most important factors of sign language accessibility as perceived by users.

DISCUSSION

The outcomes of this research are convincing that the interpretation of sign language is helpful in enhancing accessibility of the media to people with hearing impairments. The average scores on visibility, clarity, and synchronization are continuously high, which can be closely related to past reception research concentrated on the significance of formal parameters in sign-interpreted content (Bosch Baliarda, 2021). The fact that the respondents strongly agree that sign language improves understanding and inclusiveness is an indication of established concepts on accessible media reception, in which effective and prominently placed interpretation yields better understanding and interaction (Bosch-Baliarda et al., 2020). The findings thus follow that comprehensive sign language delivery is not just an extra-curricular activity, but an essential communicative system toward the fair involvement of the media.

The results also support the prevailing literature on the comparison of the understanding of sign interpreted material with and without any other accessibility means. Debevc et al. (2015) demonstrated that sign language is

better understood with captions added to it, but they also found that sign-only formats can provide a significant amount of information. This is supported in our results as it can be seen that although a significant proportion of the participants favoured the most the combination of both modalities, sign language was still more favourable than subtitles alone. This is consistent with the findings of Butler (2019), who argues that captions are not completely able to substitute the absence of visuo-gestural communication as helpful as they are. Moreover, the preference distribution of this research is similar to those found in the international literature, where Gökçe (2018) reported that even in Turkey, deaf viewers were fond of sign language and were frustrated when using it in no situations or with a bad level of use.

Screen formatting and interpreter visibility were identified as the most important factors of perceived accessibility. On the one hand, participants have also noted problems with small interpreter windows and poor lighting that have been echoed by Yi et al. (2021), who discovered that interpreter size, location, and contrast are primary obstacles in broadcasts. Bosch-Baliarda (2021) also underlined that visual details like the size of windows, the speed of signature, and the location determine the effectiveness of the visual processing of the viewer to a significant degree. The conceptual learning of thematic responses that are open ended thus concurs with this research area and the necessity to standardize, viewer-centred formatting principles of broadcast and OTT providers.

In line with this, the synchronization of the movements of the interpreter and the utterance was also pointed out as one of the critical elements affecting understanding and attention. The high level of correlation between timing and focus among the respondents is in line with Costa et al (2023), who recorded the cognitive difficulties that occur when the gestural-visual channels are misaligned with audiovisual stimuli. This synchronization has to be very carefully managed technically, especially when it comes to live shows or fast edited material because delays or mistiming causes an immediate break in viewer understanding. Moreover, Matthews (2016) and Al Atiyat (2018) state that the cognitive load becomes quite high when the deaf viewers have to balance the visual stream with the visual cues that are out of sync, and that decent alignment is not merely a quality issue but a cognitive need.

The favourable ratings of sign language interpretation observed in this paper are also similar to studies in human- computer interaction and access technology. Research by de Godoi et al. (2020) has identified that a common experience of deaf users is the existence of usability barriers due to the inconsistency or suboptimality of interpretive support across interfaces. Our respondents also reported being frustrated by the existing platforms which provide interpretation in the sign language only sometimes, showing structural deficiencies in the policies of digital access. This is reflective of larger issues that have been pointed out by Samčović (2022), who identified ongoing inaccessibility gaps in the digital television services, despite the regulatory attempts. These gaps underscore the necessity to extend the implementation of sign language access in media ecosystems which requires more harmonization.

User satisfaction and inclusion is another dimension that would be backed up by the previous literature. The findings of this study also provided respondents with the feeling of belonging and inclusion, which is consistent with the results of Zarate (2021), who has pointed to the cultural and linguistic significance of available captioning and signing to deaf communities. The feeling of belonging in the data confirms the arguments that have been long held that sign language is not only an informational tool but a medium of culture and identity affirmation (Butler, 2019). This corresponds to the wider discussion on inclusive media design, which promotes the use of multimodal solutions to accessibility as a way of accommodating the requirements of multiple users.

Last but not least, the findings of the cross-tabulation which reveal that people with more severe hearing loss rely more on the use of sign language are also aligned with the empirical research that proves that deaf native signers can be more effective in cognitively processing visual-gestural languages in comparison to captions delivered only with the use of text (Lervåg, 2020). Therefore, sign language is not an additional source of information, but it is the main means of language access among a significant number of users. This emphasizes the need to ensure high quality in the sign language interpretation in any media especially as digital and hybrid media continue to increase. Comprehensively, the results of this research are closely associated with the existing global literature in the field that specifies the best practices of accessible media design. Although the results are a clear sign of the success of the sign language interpretation, the repetitive challenges mentioned by the respondents include the size of the interpreter, the placement of screens, and synchronization, which are also areas where broadcasters and OTT platforms need to work on. Evidence-based standards and joint design processes will address these aspects and make sure that the sign language users will have access to media content in an equal, meaningful, and engaging way.

CONCLUSION

The findings of the presented work show that sign language interpretation is an essential element of media accessibility to the deaf and hard-of-hearing audience. In all dimensions considered, which are visibility, clarity, synchronization, comprehension, inclusion, and overall viewer engagement, the participants gave positive ratings

to the sign language. These results confirm that sign language is not a supportive access method but a first language of linguistic and cultural communication of people with severe hearing impairments. The effective scale and the significant correlations between the variables of accessibility are also strong indicators that the technical quality, user experience, and interpretive accuracy are interrelated in the manner of influencing the viewer satisfaction. The paper also brings to focus the current impediments which obstruct complete inclusive media spaces. Small interpreter windows, poor lighting, inconsistent placement, and lack of synchronization are some of the issues that still disrupt accessibility. These struggles resonate with other issues found in the literature of the world and indicate unresolved holes in the broadcasting standards, digital platform design, and consistency in its implementation.

These inadequacies can only be met by people joining hands to ensure that policymakers, media producers, accessibility experts, and the deaf community all contribute. In addition, the tendency toward multimodal accessibility, which is a mix of sign language and subtitles, implies that complex solutions need to be developed to support the needs of various linguistic and cognitive characteristics of the DHH population. With the media consumption becoming more and more digital and streaming, the need to have scalable, standardised, and user-centred sign language services is more imperative. In the end, this research paper provides empirical data on the need to expand and improve the use of sign language to interpret messages in the media, which validates its strength in ensuring equity, involvement, and quality communication to hearing-impaired individuals.

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