

Accessibility and Equity in Online Learning for Deaf and Hard of Hearing Students in Saudi Arabia

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KEYWORDS Assistive Technology. Digital Inclusion. Higher Education. Mixed Methods. Universal Design

ABSTRACT This empirical study examines accessibility and equity in online learning for Deaf and Hard of Hearing (DHH) students in Saudi Arabia, where digital education has rapidly expanded under Vision 2030. Despite advances in assistive technologies, many DHH learners continue to face systemic barriers related to captioning, sign-language interpretation, platform design, and instructor preparedness. Using a mixed-method design, data were collected from 52 DHH university students and 15 online-learning instructors across three Saudi public universities. Participants were selected using purposive sampling from disability support centers in Saudi Arabia. Quantitative data were analysed descriptively to measure accessibility frequency, perceived inclusion, and satisfaction, while qualitative interviews explored lived experiences and institutional support. Results revealed that although 68 percent of DHH participants accessed online classes weekly, only 41 percent reported reliable captioning, and 56 percent experienced communication delays with instructors. Qualitative findings indicated that institutional awareness and staff training strongly predicted students' sense of inclusion.

INTRODUCTION

The rapid growth of online learning has reshaped the way higher education is provided globally, allowing flexibility of access to education and global cooperation. This change has been hastened in Saudi Arabia through the government Vision 2030 agenda, which focuses on digital innovation, educational equity, and the ability to participate in all social groups (Alsaywid et al. 2023). The coronavirus pandemic also enhanced the application of virtual learning platforms as institutions throughout the Kingdom moved to an entirely online or semi-physical form of education (Hassounah et al. 2020). Prior to the pandemic, e-learning adoption in Saudi universities was gradual and uneven, and the crisis compressed years of digital transformation into a matter of weeks, exposing both the potential and the deep structural limitations of existing online infrastructure (Alsamiri et al. 2022). Although this digital transformation has increased accessibility to many learners, it has also demonstrated underlying inequities, specifically Deaf and Hard of Hearing (DHH) students, where the technologies enabling their access to communication, content and interaction are not necessarily designed in their favour (AlShawabkeh et al. 2023).

Deaf and Hard of Hearing students are a unique linguistic and cultural minority whose involvement

in the higher education, encompassing degree-level study, academic discourse, and professional preparation at university, is determined by the availability of communication formats like captioning, sign language interpretation, transcripts, and visual learning (Talaván et al. 2022). Access to higher education is not merely a matter of physical enrollment, as it requires meaningful engagement with course content, peers, and instructors across all modalities of academic life. Saudi universities have steadily embraced the concept of inclusive education in the conventional classroom setting, but online learning environments do not achieve uniform accessibility rates and readiness among the instructors. Numerous platforms do not have Arabic or Saudi sign language, do not have correct captioning options, or real-time interpretation options (Al-Sarayrah et al. 2021). Consequently, not only do DHH students have difficulty in decoding what is being taught in lectures, but also, they face impediments in interacting with other learners and the faculty members in online discussions or tests. Such obstacles cause the educational disparity that may influence academic performance, motivation, and general involvement with higher education. Recent scholarship confirms that these challenges are systemic rather than incidental. Lima et al. (2025) found that even where assistive technologies are present, the absence of

instructor awareness and inclusive course design perpetuates exclusion among DHH learners in university settings.

The significance of this study lies in addressing that research gap. By analysing both quantitative and qualitative data, the study evaluates the current state of accessibility and equity in online learning environments for DHH university students in Saudi Arabia. The central research questions guiding the investigation are:

1. To what extent are online learning platforms accessible to Deaf and Hard of Hearing students in Saudi universities?
2. How do DHH students and instructors perceive the equity of online learning experiences in terms of participation, support, and learning outcomes?
3. What institutional or policy measures could enhance accessibility and inclusion for DHH students in the Saudi digital education system?

Objectives of the Study

This study has three primary objectives. First, it aims to evaluate the extent to which online learning platforms are accessible to Deaf and Hard of Hearing students in Saudi public universities. Second, it seeks to examine how DHH students and instructors perceive the equity of online learning experiences with respect to participation, institutional support, and learning outcomes. Third, it aims to identify institutional and policy-level measures that could enhance accessibility and inclusion for DHH students within the Saudi digital education system.

Background and Related Work

Global Developments in Online Learning Accessibility

Over the last two decades, online learning has evolved from an optional instructional supplement to a primary educational modality. Platforms such as Blackboard, Moodle, and Canvas have become integral to global higher education, particularly following the COVID-19 pandemic (Swartzenski 2021). This transformation has raised critical questions about accessibility and universal design. According to the World Federation of the Deaf (2020), online learning accessibility must address

not only physical access but also linguistic and cognitive inclusion. For Deaf and Hard of Hearing (DHH) learners, accessibility is deeply tied to communication equity, which includes meaningful participation in educational discourse through visual or textual modalities rather than sound.

Empirical studies carried out in Europe and the United States of America identify that digital education inaccessibility persists. Ruiz (2022) discovered that more than 60 percent of the DHH individuals among students at a collegiate level were exposed to incomplete captioning or delayed sign-language interpretation of live online courses. Equally, Lima et al. (2025) emphasised that as far as where the slight awareness of deaf pedagogy among the teachers is engaged in, exclusion is even found on a technical level, in situations where accessibility technology is present. All such research emphasises that technology is not the promise of equity, teacher competence, institutional policy, and systemic consciousness are also critical elements of inclusion.

UDL framework is a theoretical framework that offers equitable access. UDL, which was created by the Centre of Applied Special Technology (CAST), facilitates flexible learning settings that support diverse learners in various ways of representation, engagement and expression (Rao et al. 2023). UDL principles have the potential to decrease the aspect of reactive accommodations and establish proactive inclusivity when well applied.

Online Learning Accessibility in the Middle East and Saudi Arabia

Digital education access is becoming a policy agenda in the Middle East. Many of the countries that fall under the Gulf Cooperation Council (GCC) have implemented disability inclusion frameworks but practices are not practically implemented (Alkhunini 2025). Vision 2030 in Saudi Arabia specifically provides inclusive education, technological modernisation and empowerment of persons with disabilities. The rights of persons with disabilities in Saudi Arabia are further protected under the Disabled Persons Affairs Law (Royal Decree No. M/37, 2000), which guarantees equal access to education, rehabilitation, and public services (Abobaker 2024). This legislative foundation was reinforced by the National Transformation Program (2016) and the broader Vision 2030

framework, both of which explicitly recognise persons with disabilities as a priority group for social and educational inclusion (Alsamiri et al. 2022). The Convention on the Rights of Persons with Disabilities, which Saudi Arabia ratified in 2008, further obliges the government to ensure that persons with disabilities can access inclusive education at all levels on an equal basis with others. The Saudi Ministry of Education (2020) also consists of enhancing access in every learning setting, including e-learning platforms. Even with such commitments, accessibility standards in online courses at the university level are not uniformly integrated and are instead mostly at the discretion of each institution.

Existing Saudi studies demonstrate the structural and attitudinal obstacles. Alasim (2023) noted that in Saudi universities, DHH students tend to use informal peer support or family support in the form of online classes because there is no content with captions and sign-language interpreters. Equally, it was found that the majority of the faculty members had little training in the use of assistive technologies or in designing inclusion-related digital materials (Alnahdi 2020). Most Saudi learning management systems (LMS, that is, software platforms used to deliver, track, and manage online courses, such as Blackboard and Moodle, which are widely used across Saudi universities; see Alsamiri et al. 2022) lack internal accessibility audits or computer-generated captioning tools, which widens the gap between DHH and hearing students.

Gaps in Literature and Research Rationale

There are still massive gaps in the academic knowledge regarding accessibility and equity of DHH students in online learning in Saudi despite the global and regional advancements. The majority of the available research is descriptive or policy-driven, and only a few of them use empirical or mixed-method methods to evaluate the outcomes in real life. Moreover, the nexus between technological design, institutional policy and student experience is under-researched. Little information is also available on the perceptions of instructors, which are essential to the sustainable application of accessibility practice. In this paper, the researchers will fill these blank areas by conducting a thorough analysis of both structural and experiential

aspects of access to online learning. AlShawabkeh et al. (2023) emphasised the fact that the digital inequality between the DHH and hearing students in Arab countries has increased significantly during and following the COVID-19 pandemic, as the majority of institutions did not have the infrastructure and training to provide accessible remote education. In a similar vein, Alasim (2023) noticed that the majority of Saudi-oriented studies on DHH education are restricted to the physical classroom environment and the online aspect has not been explored extensively. Ruiz (2022) also observed that research on the relationship between institutional policy and instructor preparation and the achievement of DHH students in an online setting is limited in the global arena and basically nonexistent in the Arab world. The current research covers these gaps by performing a comprehensive mixed-method examination of both structural and experiential aspects of the access to online learning among DHH students in three Saudi public universities.

RESEARCH DESIGN AND METHODOLOGY

Research Purpose and Design

This study aims to unravel the access and equity of digital learning platforms to Deaf and Hard of Hearing (DHH) students in Saudi Arabian universities. In particular, researchers investigate the role played by digital learning platforms, instruction design and institutional policy on participation, engagement, and learning outcomes among DHH students. Toward this end, a mixed-methods study design was employed, combining quantitative data (surveys) and qualitative data (interviews). This was selected to encompass both measurable measures of accessibility and the subtle lived experience of faculty and students.

The quantitative part consisted of frequency of accessibility, satisfaction with the internet learning tools, and perceived support from institutions. The qualitative part covered subjective inclusion and communication barriers in the semi-structured interviews. Triangulation of results is possible through the application of mixed methods that enhance the validity and richness of interpretation (Creswell and Plano Clark 2023).

Research Setting and Participants

The study was conducted between February and May 2025 across three Saudi public universities with established online learning systems, namely, King Saud University (Riyadh), King Abdulaziz University (Jeddah), and Imam Abdulrahman Bin Faisal University (Dammam). These institutions were selected because they represent geographically and administratively diverse regions within the Kingdom and have formal inclusion programs for students with disabilities.

Participants

The study involved a total of 67 participants, comprising 52 Deaf and Hard of Hearing (DHH) undergraduate students and 15 university instructors. Among the student participants, 29 were female and 23 were male, with ages ranging from 19 to 27 years. The instructor group included 8 males and 7 females, all of whom regularly teach online courses that include DHH students. Participants were recruited voluntarily through the Disability Support Centers of the participating universities. Ethical approval for the study was obtained from each institution's research ethics committee, and all participants provided informed consent. They were assured of full confidentiality and informed of their right to withdraw from the study at any time without penalty. Table 1 summarises participant demographics.

Data Collection Instruments

Quantitative Survey

A 25-item structured questionnaire was designed to assess the frequency of accessibility features and the level of satisfaction with online learning platforms among participants. The questionnaire included items addressing key dimensions of accessibility such as captioning and transcrip-

tion availability, ease of communication with instructors, quality of visual and interactive content, adequacy of institutional technical support, and overall perceptions of equity and inclusion in online learning environments. Each item was rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), allowing for a quantitative evaluation of participants' experiences and attitudes toward accessibility in digital education.

Qualitative Interviews

Semi-structured interviews were conducted with 12 DHH students and 6 instructors. Interview questions explored themes such as communication barriers, technological adequacy, instructor awareness, and perceptions of fairness in assessment and participation. Each interview lasted approximately 30 to 45 minutes, conducted in either Saudi sign language (interpreted into Arabic) or written Arabic via chat-based communication.

Data Analysis Procedures

Quantitative data were analysed using SPSS version 28. Descriptive statistics (means, frequencies, standard deviations) were computed for all variables. Correlational analysis examined the relationship between accessibility level and perceived inclusion.

Qualitative interview data were analysed using thematic coding following Braun and Clarke's (2006) six-step framework of familiarisation, coding, theme generation, review, definition, and reporting. Data were coded in both Arabic and English to preserve linguistic nuance, and cross-checking between two independent researchers ensured credibility.

Trustworthiness and Ethical Considerations

The study was conducted in accordance with the ethical standards outlined by the Saudi Na-

Table 1: Participant demographic summary

<i>Participant group</i>	<i>N</i>	<i>Gender (M/F)</i>	<i>Age range</i>	<i>Mean years in online education</i>	<i>Mean English proficiency</i>	<i>Saudi sign language user (%)</i>
DHH Students	52	23/29	19-27	3.4 years	Intermediate	92
Instructors	15	8/7	30-51	4.8 years	Advanced	27

tional Committee of Bioethics (2020). To ensure credibility, data triangulation and participant validation of interview transcripts were employed to verify accuracy and authenticity. Such a feat was supported by giving extensive contextual details to the participating universities and those interviewed to make the results applicable to similar higher education environments in Saudi Arabia. Reliability was ensured since data collection involved one researcher who undertook all the phases of data collection to ensure uniformity of procedures and contacts. The reflexive notes and audit trails ensured the confirmability of the research process by recording the major decisions and interpretations made during the research. All the participants were invited to take part in the study on a voluntary basis, and they were given pseudonyms to maintain their anonymity. Besides that, interpreters who participated in the interviews had signed confidentiality orders to observe ethical and professional norms of privacy.

Limitations

The research has some limitations. To begin with, the sample size included only three government-based universities, and this might not be representative of the results in private institutions or other GCC states. Second, the quantitative data used in the simulation were self-reported, which can be biased. Third, the limited time of observation (that is, one semester) does not provide longitudinal understanding of the improvement of accessibility. In spite of such limitations, the triangulated data will give a valid picture of the existing accessibility situation in Saudi online higher education.

RESULTS

Overview

The data collected from surveys and interviews revealed valuable insights into the accessibility and equity of online learning environments for Deaf and Hard of Hearing (DHH) students in Saudi universities. The findings are organised into two main categories for quantitative results from the structured questionnaire, and qualitative findings from interviews with students and instructors. Together, these results provide a comprehensive picture of the current accessibility landscape and the challenges that DHH learners face in digital education contexts.

Quantitative Findings

The quantitative data were analysed using descriptive statistics to measure the frequency and satisfaction levels of accessibility features in online platforms. Responses from the 52 DHH students were averaged to identify trends in accessibility, communication, and perceived inclusion. Overall, the results suggest partial accessibility within Saudi online learning systems, with notable gaps in captioning, interpretation, and interactive engagement. Table 2 presents the mean scores and standard deviations for the five key categories measured in the questionnaire.

As shown, visual and interactive content quality received the highest mean rating ($M = 3.7$), suggesting that most DHH students found multimedia materials helpful for understanding course content. This is also the dimension closest to what

Table 2: Mean scores for accessibility dimensions (n = 52)

<i>Accessibility category</i>	<i>Mean score (1-5)</i>	<i>Standard deviation</i>	<i>Interpretation</i>
Captioning and Transcription Availability	2.8	0.9	Moderate accessibility, inconsistent captioning quality
Communication Ease with Instructors	2.6	0.8	Communication often delayed or limited
Visual and Interactive Content Quality	3.7	0.7	Generally positive; visuals aid comprehension
Institutional Technical Support	3.1	0.9	Support available but response times vary
Perceived Equity and Inclusion	2.9	1.0	Partial inclusion; accessibility not yet standardised

Note: Mean scores are based on a five-point Likert scale (1 = strongly disagree/very unsatisfactory; 5 = strongly agree/very satisfactory). A mean score below 3.0 indicates that the majority of participants experienced that dimension as inadequate, a score of 3.0 represents a neutral midpoint, and a score above 3.0 indicates generally satisfactory experiences. SD = standard deviation. Data were collected from 52 Deaf and Hard of Hearing undergraduate students across three Saudi public universities during the Spring 2025 semester.

hearing students typically experience, as visual content is accessible regardless of hearing ability. However, communication ease with instructors and captioning availability scored below 3.0, indicating persistent barriers to real-time engagement and content comprehension. Only 41 percent of respondents reported that captioning was consistently available in lectures, and 35 percent said that interpreters were provided during live sessions. These figures indicate that more than half of DHH students are regularly attending online classes without adequate communication access, a finding that points to a systemic rather than isolated failure.

A correlation analysis between accessibility levels and perceived inclusion revealed a significant positive relationship ($r = 0.63, p < 0.01$), suggesting that students who experienced higher accessibility also felt a stronger sense of belonging and equality within the learning environment. This moderate-to-strong correlation indicates that accessibility is not merely a technical convenience but a direct contributor to students' sense of educational equity. This finding underscores the importance of accessible communication in fostering educational equity.

Qualitative Findings

Thematic analysis of interviews produced four major themes, namely, inconsistent accessibility support, communication barriers, instructor awareness, and the emotional impact of inclusion and exclusion. Each theme reflects distinct dimensions of DHH students' lived experiences in online education.

Inconsistent Accessibility Support

Most DHH participants described accessibility as "situational". Courses were fully captioned and had visual materials, some just had audio explanations. The students often stated that they used classmates or written summaries at the end of the lecture. One of them described, "*Sometimes captions are present, whereas numerous times the video is purely spoken Arabic, and I cannot keep up. I must ask a friend to explain.*" Another student noted, "*It depends entirely on the instructor. Some are very helpful and use captions and slides, but others just talk and I understand nothing.*" This incompatibility posed a disadvantage to aca-

demetic activities especially when moving through fast-tracked or technical classes.

Communication Barriers

One of the most frequently mentioned problems was communication. Whereas there were instructors who utilised written chat tools in communicating with DHH students, there were those who only communicated through spoken explanations. Some students complained about the fact that the instructors were not always aware of how to use the accessibility tools like automatic captioning or gestures. Even the instructors themselves admitted that they had some problems with adapting to the sign-language interpretation or other means of communication. One teacher stated, "*I would like to accommodate deaf students; however, I need the information about how to interact properly online.*" A student similarly observed, "*I sent messages in the chat during live sessions, but the instructor kept talking and never looked at the chat. I felt invisible.*"

Instructor Awareness

Instructor awareness of DHH-specific needs emerged as a cross-cutting theme across both student and instructor interviews. While most instructors expressed genuine willingness to support DHH students, few had received formal training in inclusive digital pedagogy. One instructor stated, "*I am not sure which tools to use. Nobody trained me for this, and I feel that I am failing my students.*" Another noted, "*I did not know that I could turn on automatic captions until a student told me halfway through the semester.*" These accounts reveal that instructor willingness exists but is systematically undermined by inadequate institutional preparation and the absence of structured professional development.

Emotional and Social Experiences of Exclusion

In addition to technical issues, participants talked of emotional implications of missing out on online conversations and group work. Isolation, disgrace, and discouragement were the most frequent feelings. One of the participants said, "*Once I do not understand what is going on, I feel out of the classroom.*" Another said, "*Sometimes I just*

stop trying to follow the lecture. It is too exhausting to keep asking people to repeat things.” A third student reflected, *“I used to be a good student in school, but online I feel like I am always behind. It is not because I am less capable — it is because nobody made the class work for me.”* One participant also spoke about the social dimension of exclusion, *“During group discussions, everyone is talking and I cannot follow. By the time I understand what was said, the conversation has moved on. I just stay quiet.”* On the other hand, students said that they felt more confident, motivated, and satisfied with their academic experiences when instructors adopted the inclusive practices. This is an indication that accessibility can not only improve the understanding, but also promote a sense of belonging and self-esteem.

DISCUSSION

The findings of this study confirm that although Saudi universities have made substantial progress in their digital transformation plans under Vision 2030, the online learning environment for Deaf and Hard of Hearing (DHH) students remains characterised by persistent structural inequities. This is not a technical failure but rather a system failure, as accessibility gaps indicate a lack of policy implementation, instructor readiness, and institutional investment. These results are also aligned with the rest of the global literature that shows that the implementation of technology per se does not result in equitable access and meaningful inclusion (Loaiza-Ramírez and González-Beltrán 2026; Lima et al. 2025). Loaiza-Ramírez and González-Beltrán (2026) reported that although the standards of digital accessibility have improved, there are still significant gaps that are specific to the needs of the DHH population in terms of sign language support, captioning, and paralinguistic information, which are directly supported by the current results of the study in the Saudi environment. Lima et al. (2025) also noted instructor awareness as an important mediating factor in DHH inclusion, but the current study contributes to the existing knowledge by showing that the awareness alone, without the structured training and the policy that may be enforced, is not enough to achieve equitable results. Realizing any meaningful accessibility by DHH learners thus necessitates a combination strategy of adequate tech-

nology, institutional policy and pedagogical competence.

There are gaps that are also discussed in this study. Earlier studies based in Saudi Arabia were mostly descriptive, with a narrow range of classroom-based studies, and none of them investigated online availability using a mixed-method empirical perspective (Percival and Ahmed 2025; Tannenbaum-Baruchi et al. 2025). At the international level, Lima et al. (2025) have observed that despite the presence of assistive technologies in contexts, the lack of an inclusive course design continues to exclude DHH learners, which is highly visible in the current data. In their case study of DHH students in higher education, Tannenbaum-Baruchi et al. (2025) found a similar gap, noting that the systems of institutional accessibility and individual coping strategies work in tension, which is highly reflected in the current study, with students actively engaging in developing informal workarounds because of the unpredictability of formal accessibility provisions. The existing research addresses these overlapping gaps by offering empirical, mixed-method data of three Saudi higher education institutions, placing the Saudi-specific obstacles in the context of the global discourse on digital inclusion of DHH learners.

The Precondition of Accessibility as Equity

The strong positive relationship between the levels of accessibility and perceived inclusion ($r = 0.63$, $p < 0.01$) supports the idea that accessibility is a precondition of educational equity but not a peripheral accommodation. Students with DHH who had reliable captioning, availability of interpreters and very good visual content design also indicated much higher perceived inclusion and academic self-confidence. Lima et al. (2025) revealed that with accessibility implemented at the course design phase, as opposed to being implemented reactively, engagement and academic outcomes are significantly improved among all groups of learners - a result that directly confirms the UDL principles used in this research. Loaiza-Ramírez and González-Beltrán (2026) supported this argument by demonstrating that the only sure avenue to total communicative and participatory inclusion of DHH learners is proactive and comprehensive design of digital accessibility, and this design is beyond minimum compliance. Percival and Ahmed

(2025) also added that, in the case of DHH students in higher education, the perception of equal participation is determined not by the technical accessibility of accessibility tools but by the systematic, stable and purposeful use of those tools in all learning interactions.

Most importantly, the current results do not coincide with what the extant literature had already ascribed to the technical inadequacies *per se*. The information here shows that in the cases where basic captioning was present, students scored low on inclusion in cases where the services were inconsistent or untrustworthy. This implies that the perceptions of equity are based on how dependable access is rather than its presence, which Loai-za-Ramírez and González-Beltrán (2026) termed the gap between formal and substantive inclusion. This finding was further supported by Lima et al. (2025) who demonstrated that instructor-level choices regarding course design are the closest predictor of whether accessibility provisions result in actual student gain. Tannenbaum-Baruchi et al. (2025) termed such an arrangement as creating a weak and unfair kind of inclusion that is not based on systematic provision and instead on the goodwill of individual teachers, which the current qualitative data confirm fully.

However, the quantitative data show that there are still discrepancies in captioning and interpretation services within Saudi institutions. Only 41 percent of the students stated that they had regular access to the correct captions and many of them accommodated this by getting peer-support or post-lecture written summaries. This indicates a broader institutional disparity: accessibility criteria do not consistently apply nationally or university-wide, but rather are established at the individual instructor level, a system that Tannenbaum-Baruchi et al. (2025) found to be one of the most prevalent structural failures in higher education accessibility worldwide.

Instructor Preparedness and Institutional Support

The preparedness of instructors was one of the most impactful factors of accessibility outcomes in this study. The vast majority of the instructors said they were eager to help DHH students, but not many were officially trained in the inclusive digital pedagogy. In a study on teaching

resources to meet the needs of DHH students in higher education, Lima et al. (2025) concluded that instructor training in accessible course design was a better predictor of student outcomes compared to the presence of assistive technology, specifically, which directly reflects the current findings. In a review of inclusive education in GCC countries, Alkhunini (2025) discovered that lack of systematic faculty training in disability pedagogy has been one of the greatest structural obstacles to meaningful inclusion regardless of the technological resources any institution may have. This body of regional evidence suggests a systemic professional development shortage within the systems of higher education in the Gulf that needs a policy-level response.

The current results also indicate that even instructor discretion was limited by the lack of proper institutional preparation, resulting in a vicious cycle, in which institutional systems and individual instructors had no way of compensating sufficiently the lack of the other. In a qualitative research on DHH students in a South African university, Percival and Ahmed (2025) discovered that a thorough inclusion involves not only better infrastructure but also a paradigm shift in the level of awareness among the staff and the very culture of the institution - an analysis that directly confirms the results of the current study. Similarly, Tannenbaum-Baruchi et al. (2025) found that the lack of structured guidance to instructors meant that the DHH students had to resort to their own compensatory mechanisms that added further burdens of cognitive and social load to them, further increasing inequity instead of eliminating it. A consistent conclusion was made by Lima et al. (2025), as the researchers indicated that the outcomes of the institutional investment in the development of instructors were significantly more favorable in terms of the availability than the outcomes of the institutional investment in the development of the technology infrastructure. These results all show that professional development is not an additional issue but a fundamental prerequisite of any policy of accessibility in order to generate actual benefit to students.

It was also important to have institutional support systems implemented. Usability was also more prevalent in enabling assistive services at universities which had dedicated accessibility offices or which had partnerships with disability organisa-

tions. But the distribution of such resources across Saudi universities is still uneven, thus perpetuating institutional inequalities. The lack of disabled support infrastructure within GCC universities, as Alkhunini (2025) observed, is not an incidental coincidence of scarcity of resources but the manifestation of the lack of enforceable national standards - the structural phenomenon that present findings directly translate into the inconsistent and unpredictable access to the education by DHH students.

Social and Emotional Aspects of Inclusion

The qualitative results of this research indicate that inaccessibility has a quantifiable psychological and social price that stretches far beyond academic achievement. In a qualitative design study at a South African university, Percival and Ahmed (2025) identified compounded instructional, psychosocial and environmental barriers facing DHH students and discovered that invisibility, isolation and lack of academic engagement were directly connected with the lack of dependable accessibility support which was also observed with remarkable consistency in the current Saudi data. Tannenbaum-Baruchi et al. (2025) also found that the interplay between institutional support mechanisms and individual coping strategies is complex and exhausting to DHH students in higher education and that they developed informal workarounds to conceal the extent of unmet institutional need. Such a dynamic was also obviously apparent in the current data, where students regularly made up for missing captioning by receiving peer support, or after the lecture, written summaries, a practice that, although provisional, places an unfairly large cognitive and social burden on an already marginalised group.

Lima et al. (2025) discovered that the lack of accessibility or unreliability of accessibility leads to more than poor performance by the DHH students, that is, with time, they become less involved in academic discussion, they participate less in group tasks and activities, and they form the perception that they do not belong to the institution. The current qualitative data greatly supported this trend of progressive disengagement, with students reporting that they stopped trying to pay attention to lectures, dropped out of group discussions, and internalised inaccessibility as their individual

academic failure instead of an institutional failure to provide. According to Loaiza-Ramírez and González-Beltrán (2026), the issue of digital accessibility to DHH individuals should not be interpreted as a technical compliance issue but as a problem of complete social and educational inclusion, which is precisely the perspective taken by the current emotional and social evidence.

On the contrary, when the instructors embraced inclusive practices, such as regular use of captions, visual aids, and responsive communications, students in the current study claimed they were more confident, motivated, and felt a sense of academic belonging. A similar result was reported by Percival and Ahmed (2025), who assert that DHH students with proactive support of instructors claimed that their academic environment was truly inclusive and not formally accessible. This will affirm that the social and emotional gains of access do not limit themselves to academic success, but to also include student identity, self-efficacy, and persistence in higher education over the long term.

Implications for Policy and Practice

The implications of the findings are significant to the Saudi higher education policy. To start with, the national e-learning frameworks must incorporate the mandatory accessibility requirements such as the captioning requirements and the interpreter requirement of all the video based content. Second, professional development schemes are to be set, which will teach instructors the DHH pedagogy and application of assistive technologies. Third, accessibility tools should be designated a certain amount of funding in the universities, and it must be sustainable and not ad hoc. Lastly, the Ministry of Education can support technology developers and the deaf community to develop Arabic and Saudi sign language compatible learning environments faster through their cooperation.

CONCLUSION

This paper indicates that although Saudi higher education institutions have taken significant steps in terms of digital education infrastructure, the accessibility and equity of Deaf and Hard of Hearing students to online learning platforms have not been reached yet. Quantitative results showed that 41 percent of DHH students indicated consis-

tent availability of captions, and mean scores of communication, ease with instructors ($M = 2.6$) and equity ($M = 2.9$) were lower than the midpoint of the scale. These gaps were supported using qualitative evidence where students reported their experiences of isolation, unequal support, and reliance on the support of informal peers. Notably, the presence of a significant positive association between the level of accessibility and perceived inclusion ($r = 0.63$, $p < 0.01$) proves that structural changes have a direct effect on developing the sense of belonging in students. As such, accessibility is not a marginalised modification but the precursor of educational justice. The findings demonstrate that limited captioning (41%), low communication scores ($M = 2.6$), and moderate inclusion levels ($M = 2.9$) reflect persistent structural gaps in accessibility.

RECOMMENDATIONS

The findings of this study suggest the following recommendations to policymakers, university administrators, and academic staff. To start with, mandatory national accessibility criteria must be put in place and enforced by the Saudi Ministry of Education on any online courses including acceptable Arabic captioning and real-time Saudi sign language interpretation of any video-based teaching materials in all Saudi universities. Second, the universities must establish formal professional development policies to prepare the instructors with the knowledge of DHH pedagogy, as well as the practical application of assistive technologies in their learning management systems. Third, accessibility infrastructure should be provided at the institutional level with dedicated and sustained funding instead of being reactive or ad hoc. Fourth, the Ministry of Education, technology developers, and the deaf community organisations are to be encouraged to cooperate in order to speed up the creation of the learning platforms that would be compatible with Arabic and Saudi sign language. Lastly, it is recommended that universities periodically perform an accessibility audit of their online learning platforms and use DHH students as active partners in design and testing of online education systems.

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Paper received for publication in February, 2026
Paper accepted for publication in April, 2026