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Pedagogical Accessibility for Deaf and Hard-of-Hearing Students in Digital Higher Education

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Abstract

Access to digital learning resources for deaf and hard-of-hearing students raises questions that extend beyond the written rendering of speech. This article compares three approaches: technical accessibility, Universal Design for Learning, and pedagogical and linguistic adaptation. It draws on a targeted narrative synthesis of scholarly publications and guidelines, examined in terms of the barriers addressed, modes of intervention, empirical support, and implementation limitations. The comparison distinguishes access to information, content comprehension, and participation in activities. It shows that the approaches operate at complementary levels, without establishing the overall superiority of any modality. The discussion focuses particularly on the relationship between captioning and sign language, competition among visual sources, the timing of interaction, and assessment equivalence. A decision framework links the barriers encountered, possible adaptations, and evaluation criteria. Three design propositions are advanced: technical compliance is a baseline rather than a measure of pedagogical accessibility; unreviewed automatic captions cannot provide the sole means of access to content covered by assessment; and response time is a primary criterion for synchronous activities. The article advocates an understanding of accessibility grounded in the continuity of learning activities and students' linguistic practices. Its implications for digital higher education in Senegal are proposals to be tested rather than field findings.

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Introduction

A course video may be available at any time yet remain inaccessible to a student who cannot hear the spoken explanations. A virtual classroom may offer a transcript without enabling that student to respond before the discussion moves on to another question. These situations call for a distinction between the availability of a resource, access to its content, and the opportunity to participate in the activity. For deaf and hard-of-hearing students, the issue therefore concerns not only the availability of an alternative to sound, but also the conditions under which that alternative actually supports learning.

Research on transcription and interpreting services cautions against uniform responses. In a survey of 36 students, 22 of whom also participated in an interview,

Elliot *et al.,* (2001) report favorable perceptions of the C-Print transcription system, particularly among participants who were relatively proficient in written English. However, relying on this service as the sole form of support did not suit everyone. This perception study sheds light on the diversity of uses; it does not establish the general superiority of text over interpreting.

More recently, Jolly *et al.,* (2024) analyzed the accounts of 15 deaf and hard-of-hearing students using real-time captioning services in higher education in the United States. Their findings reveal contrasting experiences, ranging from overcoming barriers to resignation. The mere existence of a service therefore does not resolve the difficulties involved in using it effectively. This distinction supports examining tool characteristics alongside the organization of teaching.

Three approaches can routinely be used to address this problem. Digital accessibility standards define verifiable conditions for presenting information. Universal Design for Learning (UDL) provides for diverse learning opportunities from the outset. Pedagogical and linguistic adaptations address the barriers encountered in a specific activity. These approaches are not competing alternatives in the same sense: a technical standard, a design framework, and a set of support practices have neither the same object nor the same scientific status.

This article addresses the following question: what contributions, limitations, and tensions characterize these three approaches in relation to access, comprehension, and participation among deaf and hard-of-hearing students in university digital environments? The objective is to develop a reasoned comparison and derive decision criteria. The central argument is that their complementarity becomes useful when each intervention is linked to an identified barrier and a specific activity. This argument is expressed through three propositions, developed in Section 5.7: technical compliance is a baseline rather than a measure of pedagogical accessibility; unreviewed automatic captions cannot provide the sole means of access to content covered by assessment; and response time is a primary criterion for synchronous activities. Adding formats without examining their use is insufficient to constitute an inclusive response.

Comparative Method

The article adopts a conceptual approach based on a targeted narrative synthesis. This choice enables the comparison of approaches that differ in nature without treating their prescriptions as experimental findings. The need to clarify the role of the frameworks employed is consistent with Jaakkola's (2020) methodological discussion, used here to structure the argument rather than to transpose the objects of her discipline into education.

The literature search combined French and English expressions relating to deafness, higher education, online learning, captioning, transcription, and interpreting: "deaf and hard of hearing students," "higher education," "online learning," "captioning," "speech-to-text," and "sign language interpreting." Sources were identified through Web searches targeting PubMed and ERIC in particular, supplemented by publishers' pages and official W3C and CAST documents. PubMed was used notably to verify the reference to Hornsby (2013), and ERIC to locate the text by Oppong *et al.,* (2018). Verification queries included "site:pubmed.ncbi.nlm.nih.gov Hornsby 2013 hearing aid listening effort mental fatigue" and "site:eric.ed.gov "Academic Experiences" "Winneba" deaf." These were targeted domain searches rather than systematic searches using the databases' native interfaces. The search closed on October 22, 2026. It was neither an exhaustive bibliographic database search nor a systematic review. A second search, conducted on the same date, targeted automatic speech recognition, listening effort among people with hearing loss, and African contexts to address gaps in the initial selection; it yielded four additional sources (Hornsby, 2013; Kushalnagar *et al.,* 2014; Kuhn *et al.,* 2024; Oppong *et al.,* 2018). No Francophone or Senegalese study on deaf and hard-of-hearing students in digital higher education was identified; this observation reflects the limitations of the search and does not demonstrate the absence of such research.

The selected sources provide either direct observations concerning deaf and hard-of-hearing students or a framework required for the comparison. Research involving other populations is used only to clarify a mechanism, without treating it as evidence specifically validated for deafness. Publications for which only the scholarly abstract was accessible are used within the limits of the information it contains. Earlier studies of transcription services remain relevant to the discussion of communication modalities; they cannot establish the performance of current automatic systems.

The analytical framework comprises five dimensions: the barrier addressed, the unit of intervention, the operating

principle, the nature of the evidence, and the limits of transferability. The comparison is then organized around three aims: accessing information, understanding content, and participating in activities. These aims are proposed as analytical categories; they do not constitute a validated scale. The discussion distinguishes findings reported by researchers, requirements set out in standards and guidelines, and propositions derived from comparing them.

The corpus includes perception surveys, comparisons of support modalities, and a recent study of experience narratives. This diversity makes it possible to examine several dimensions of accessibility, but precludes calculating a common effect. Contexts, languages, and indicators differ. The aim is therefore to clarify the conditions informing pedagogical choices, without ranking the approaches according to universal effectiveness.

Hearing-Related Needs and Learning Situations

Diverse Linguistic Practices

The terms “deaf and hard of hearing” refer here to the population concerned without presupposing a single mode of communication. Pedagogical needs must be established with the student: access to spoken language, reliance on writing, use of a sign language, a combination of modalities, or a need for specific support in certain situations. An administrative category alone cannot determine the appropriate format.

In particular, visual perception must not be confused with linguistic comprehension. Reading a transcript requires sufficient proficiency in the written language and disciplinary vocabulary; understanding an interpretation requires knowledge of the sign language used. The W3C explanatory document for Success Criterion 1.2.6 highlights the value of a signed version for some users whose access to written text remains limited (W3C, n.d.-b). This does not mean that all deaf students experience reading difficulties or that all use a sign language.

From this perspective, “hearing-related needs” refers to barriers associated with information or interaction that depends on sound. It does not denote a cognitive impairment. A comprehension difficulty may stem from lack of access to an explanation, the language of the resource, the density of the screen display, or the unfamiliarity of the concept. These possibilities must be distinguished before modifying the content being taught.

Three Distinct Dimensions

Access to information refers to the ability to receive the necessary elements: speech, speaker identity, instructions, and relevant sound events. Comprehension concerns the relationships the student establishes among these elements. Participation refers to the ability to ask questions, respond, contribute to a collective task, and receive useful feedback.

An example clarifies this distinction. In a recorded demonstration, captions may accurately convey the explanation. If the procedure takes place while the student is reading, an essential connection may nevertheless be missed. Finally, if the subsequent activity requires an immediate spoken response with no alternative modality, access to the video will not have resolved the participation difficulty. An adaptation must therefore be evaluated across the entire learning sequence.

Hard-of-Hearing Students and Residual Hearing as a Resource and a Source of Effort

The term “hard of hearing” includes students who use residual hearing, with or without hearing devices, and for whom listening remains possible but effortful. Their barrier lies not in the absence of access to sound, but in the quality of listening conditions: background noise, distance from the microphone, speech rate, and overlapping voices. Captions do not always replace this resource; they may support it, particularly for technical terms and proper names.

This dimension is often overlooked by approaches focused on replacing sound with writing. In an experimental study involving 16 adults with mild to severe sensorineural hearing loss, Hornsby (2013) observed that, without hearing aids, a sustained listening task was accompanied by increasing reaction times over the session, suggesting greater listening effort and fatigue. These adults were not students, and the task was experimental: the study is used here to formulate a hypothesis rather than establish the effect of an educational intervention. The hypothesis is that, during long sessions, audio capture quality and session pacing are as much a part of accessibility as the availability of captions.

Contributions and Limitations of the Approaches

Technical Accessibility and Perceptible Information

WCAG 2.2 provides testable criteria for Web content accessibility. Success Criterion 1.2.1, at Level A, addresses, among other things, alternatives for prerecorded audio-only content; Success Criterion 1.2.2, at Level A, concerns captions for prerecorded synchronized media; and Success Criterion 1.2.4, at Level AA, concerns live captions. Success Criterion 1.2.6, on sign language interpretation for prerecorded synchronized media, is at Level AAA (W3C, 2024). These requirements must be applied within their defined scope and with their explicit exceptions.

Accessibility captions do more than reproduce dialogue. They also convey the sound information required for comprehension and identify speakers when relevant. A separate transcript serves another purpose: it facilitates independent consultation of the content but does not necessarily convey its temporal relationship with the image (W3C, n.d.-a). The two resources can therefore complement one another without being interchangeable for every criterion.

The strength of this approach lies in the possibility of reproducible checks. Its limitation for the present question is that compliance does not measure learning. An accurate caption may contain an unfamiliar scientific term; a perceptible alternative may remain difficult to use in a fast-paced activity. Technical auditing must therefore be supplemented by observation of learning tasks.

Automatic captioning presents a particular problem: it makes compliance easy to claim and difficult to guarantee. Kuhn *et al.,* (2024) independently measured eleven speech recognition services using recordings of university lectures. Accuracy varied considerably across services and recordings; streaming mode, used in live sessions, was significantly less accurate than offline processing. The authors concluded that these services remained insufficiently reliable without human supervision, while deaf and hard-of-hearing users reported persistent accuracy problems. To our knowledge, no equivalent measurement exists for French as spoken in Senegal or for national languages; this gap remains to be documented.

Accuracy is not the only criterion. Kushalnagar *et al.,* (2014) report that lecture speech is rapid, averaging approximately 170 words per minute with peaks above 400, and rich in specialized vocabulary. In an experiment involving 48 students, including 24 who were deaf or hard of hearing, captions collectively produced by non-experts were rated significantly easier to follow than automatic captions, with no significant difference from professional stenographic captioning; eye-tracking data suggest that display fluency matters as much as accuracy. Although this study predates current systems, it usefully shifts the question from textual accuracy to real-time readability.

Universal Design for Learning and Anticipating Variability

The CAST guidelines (2024) propose multiple means of engagement, representation, and action or expression. In particular, they encourage diverse options for perceptual access, clarification of language, and varied communication modalities. UDL thus provides a framework for designing activities, whereas WCAG specifies verifiable characteristics of content and interfaces. The guidelines offer pedagogical directions; consulting them does not demonstrate the effectiveness of a particular intervention.

Applied to the issue examined here, this approach entails planning alternatives before the course is released. For example, we propose jointly preparing a video script, written resources, and arrangements for questions. Simultaneous availability prevents some students from having to wait for an adaptation before beginning the same work. This proposal concerns the organization of teaching and must be assessed within actual production constraints.

Diversification does not, however, mean that all formats must remain visible at all times. Several modalities can be made available while allowing students to select those appropriate to the activity. A limitation arises when choice is merely apparent: a highly abridged document is not an equivalent alternative to a lecture containing the reasoning required for assessment.

Pedagogical and Linguistic Adaptation to Situated Barriers

Adaptation involves adjusting a resource or activity to an identified need: preparing vocabulary, organizing turn-taking, providing interpreting, revisiting an explanation, or modifying the response modality. It does not constitute a single theory. Its unit of intervention is the

situation in which the student encounters a barrier, distinguishing it from a general compliance standard.

Empirical comparisons show why decisions must remain context-specific. Stinson *et al.,* (2009) studied two groups of 48 participants, one in secondary education and the other in higher education.

Among higher education students, they found no difference in retention between the two support types compared, transcription and interpreting, under the conditions studied. Reading proficiency was also associated with retention. These findings therefore do not justify automatically transferring an advantage observed in another group to higher education.

In their experiments on interpreting and text alternatives, Marschark *et al.,* (2006) report findings that vary with presentation conditions. In particular, a real-time text condition produced better performance than the other modalities compared in one experiment. Taken together, the findings call for a contextualized interpretation: modality, arrangement, and the chosen indicator must be considered jointly rather than isolated to advocate a particular tool.

Adaptation enables this detailed consideration but becomes fragile when it depends solely on repeated requests and informal arrangements. We propose linking it to a foundation of accessible design: shared needs are anticipated while specific adjustments remain possible. The student participates in the choice without becoming solely responsible for remedying course accessibility problems.

Comparative Discussion

Complementary Levels and Different Forms of Evidence

The first difficulty in the comparison is the asymmetry of its objects. WCAG identifies certain instances of noncompliance; UDL helps organize possibilities; situated adaptation examines whether a response is appropriate for a person and a task.

Assigning them an overall effectiveness score would obscure these differences. The comparison therefore concerns the distribution of functions among the approaches more than competing options. The useful question is which problem each approach can address and which it leaves unresolved.

This distinction also applies to evidence. A normative requirement is not an experimental conclusion. A favorable appraisal of a service is not equivalent to a measured gain in comprehension. A retention result following one session cannot establish improved persistence in higher education. Each study's contribution must retain its own indicator and timescale.

We infer that a coherent evaluation must combine several levels. A resource check verifies the available information; a task examines its use; and a discussion with the student clarifies barriers and preferences. Agreement among these observations is more informative than an isolated indicator. High satisfaction accompanied by conceptual errors calls for a different intervention from good comprehension achieved through effort considered difficult to sustain.

Comparing the Functions of Captioning and Sign Language

Captioning and interpreting should not be treated as strictly equivalent versions of the same code. The former provides access to synchronized text; the latter uses another language. Their suitability therefore depends on the linguistic repertoire, task, and context of use. The studies by Elliot *et al.,* (2001), Stinson *et al.,* (2009), and Marschark *et al.,* (2006) do not establish the superiority of one modality for all students.

One pedagogical implication is to distinguish the choice of access modality from the choice of activity. A student may prefer interpreting during an explanation and then use text to retrieve a term or prepare an assignment. The value of combining them does not necessarily lie in simultaneous consultation. It may lie in being able to move between modalities at different times.

Complementarity does not remove the need to examine fidelity to the content. A written version that omits objections, examples, or steps in an argument may create the illusion of complete access. Likewise, a signed version must be appropriate to the language the student actually understands. In both cases, the aim is to preserve the necessary conceptual relationships without assuming that a change of format automatically preserves meaning.

Diversifying Without Overloading Visual Attention

Multimedia learning and cognitive load theory provide additional insight. Mayer and Moreno (2003) discuss the selection and organization of information in multimedia

presentations; Sweller *et al.,* (2019) distinguish, among other things, demands arising from the content from those imposed by its presentation. These frameworks do not, by themselves, validate adaptations for deaf students. They enable hypotheses about the processing demands of a learning arrangement.

The research by Marschark *et al.,* (2005) specifically addresses learning and the processing of multiple visual sources in situations involving sign language interpreting.

The experiments do not show video interpreting to be inherently less effective than in-person interpreting under the university conditions studied. They encourage examination of how information is organized rather than attribution of an effect solely to the presence of a screen.

We propose shifting the quality criterion: the aim is not to maximize the number of visible modalities but to enable their coordination. In a video demonstrating a procedure, a pause after the explanation may allow the action to be observed; in a virtual classroom, reading time may precede a question. These are design hypotheses to be tested, not optimal durations established by the cited studies.

It would also be inappropriate to remove essential captions in an attempt to avoid redundancy. Information that is repeated for a hearing student may provide another student's only linguistic access. Redundancy must be assessed in relation to the channels that are actually accessible, rather than solely on the basis of the resource's apparent composition.

Timing as a Condition of Participation

Captioning a recorded lecture and transcribing a live exchange do not pose the same problem. In the former case, students may be able to pause or replay the resource. In the latter, the conversation continues while they read. We therefore propose treating the time required to receive, understand, and respond to information as a dimension of pedagogical accessibility.

A document provided after a session may support revision without restoring the opportunity to ask a question at the relevant moment. This difference is decisive when the objective is to debate, negotiate an answer, or solve a problem collectively. Retrospective access to content does not necessarily compensate for lack of participation in the activity.

The accounts analyzed by Jolly *et al.,* (2024) reinforce the importance of listening to users' experiences of services. We derive a design implication from this: instructors must verify that access modalities work at the moments when contributions are expected. Explicit response time, written restatement of the question, and a procedure for reporting difficulties can be discussed with students. Their suitability must be observed in the actual situation.

Maintaining Academic Standards and Assessment Equivalence

Adaptation should not be equated with reducing disciplinary difficulty. If the objective is to justify a historical interpretation, exclusive reliance on oral discussion may introduce a barrier unrelated to the target competence. A written or signed response may then be considered, provided that the criteria assess the same reasoning.

This issue brings UDL and situated adaptation together. The former supports advance planning of several possibilities; the latter makes it possible to verify their suitability for the student. The technical approach, essential for making instructions and interfaces usable, cannot alone determine the pedagogical validity of an alternative.

The African context illustrates this dependency. Drawing on semi-structured interviews with 14 deaf students from a population of 36 at the University of Education, Winneba, Ghana, Oppong *et al.,* (2018) report that assessment became difficult when sign language interpreters were absent from examination rooms, and recommend recruiting more interpreters and note-takers. The study involves a single institution, a small sample, and self-reported data. Nevertheless, it shows that assessment equivalence depends on the availability of human support during the examination, which neither a technical standard nor advance design guarantees.

Linking Production, Support, and Quality Assurance

Finally, the comparison situates accessibility within a chain of responsibilities. Design determines formats; production ensures their accuracy; facilitation organizes interaction; and support addresses persistent barriers. A breakdown at any stage can compromise the others. Captions that have been prepared but are unavailable in the player used by students do not deliver the expected benefit.

Table.1 Criteria for Analyzing an Adaptation

Barrier	Primary approach	Possible response	Verification
Audio-only explanation	Technical	Synchronized captions; text alternative for audio-only content	Accuracy and completeness of relevant information
Unreviewed automatic captions (specialized vocabulary, numbers, negations)	Technical and adaptation	Human review of concept-bearing passages before release; prepared glossary	Residual errors involving concepts, numbers, negations, and instructions
Insufficient linguistic access	Adaptation	Appropriate signed version; clarification of vocabulary	Student's comprehension of the reasoning
Competition among visual sources	UDL	Pauses, sequencing, adjustable layout	Ability to connect explanation and demonstration
Exchanges that are too rapid	UDL and adaptation	Explicit turn-taking and response time	Ability to contribute at the relevant moment
Use of residual hearing under adverse conditions (noise, microphone, speech rate)	Technical and UDL	High-quality audio capture, individual microphone, moderate speech rate, supporting captions	Comprehension without sustained listening effort reported by the student
Exclusionary response modality; support absent during assessment	Adaptation	Alternative aligned with the same objective; support arranged for the assessment	Disciplinary standards maintained; support actually available

Source: developed by the author from the comparison of approaches.

From this perspective, automatic transcription is a possible production stage, but activating it does not establish the quality of the output: Kuhn *et al.,* (2024) show highly variable accuracy, with lower performance in streaming mode. We propose checking passages containing concepts, numbers, negations, and instructions, followed by synchronization and speaker identification. This is a requirement of fidelity to content, without presuming an error rate for software not examined here. For content covered by assessment, we consider prior human review to be the appropriate rule.

Monitoring can remain concrete: who makes corrections, when, how does the student report a difficulty, and how is the corrected version redistributed? These questions connect the three approaches to institutional operations. Complementarity becomes operational when a responsibility and a verification procedure are defined for each barrier.

Positions Supported by the Comparison

Despite the heterogeneity of the evidence, the comparison supports three positions, which we advance as design propositions rather than empirical findings.

First proposition: WCAG compliance constitutes a baseline rather than an indicator of pedagogical accessibility. Levels A and AA guarantee the presence of captions; they do not establish their accuracy in conveying concepts, their readability at lecture pace, or the possibility of responding in time. An institution reporting compliance alone, without observing learning tasks, would overestimate the accessibility of its courses.

Second proposition: unreviewed automatic captions should not provide the sole means of access to content covered by assessment or to an interactive session. The measurements by Kuhn *et al.,* (2024) and the readability argument advanced by Kushalnagar *et al.,* (2014) converge in making human review, at least of passages conveying concepts, a condition of access rather than an optional improvement.

Third proposition: reception and response time must be treated as a primary criterion for every synchronous activity. A course that is accessible afterwards, but whose exchanges are too fast to follow, leaves the participation barrier intact—a barrier the three approaches address inadequately when considered separately.

These propositions are falsifiable: they would be refuted if comparable tasks showed that unreviewed automatic captions produced the same conceptual comprehension, or that the speed of exchanges did not affect participation.

Decision Criteria and Perspectives for Senegal

A Framework Derived from the Comparison

The following framework translates the argument into design questions. It does not measure an overall level of inclusion and is not an empirically validated model. Its value lies in making decisions open to examination: each adaptation corresponds to a barrier and an observable element.

To illustrate the framework, consider a constructed, rather than observed, example: a 90-minute synchronous session comprising a presentation, a demonstration using screen sharing, a debate, and an oral quiz. During the presentation, the barrier is auditory: captions are necessary, and if they are automatic, verification focuses on concepts, numbers, and negations rather than on their mere presence. During the demonstration, captions and the shared screen compete for visual attention: a pause after each explanation allows the action to be connected to the spoken explanation.

During the debate, timing is decisive: a written restatement of the question, announced response time, and clearly identified turns. Finally, the oral quiz excludes students who do not respond orally for reasons unrelated to the disciplinary objective: a written or signed response, assessed using the same criteria, addresses the barrier. The checks differ at each stage, and the video's WCAG compliance covers only part of them. It is this sequential analysis, rather than an audit score, that the framework seeks to enable.

Conditions for Application to Digital Higher Education in Senegal

For application at UNCHK and FASTEF, the first step would be to document the situations and linguistic practices of the students concerned. The language of instruction, any sign language used, modes of accessing resources, and participation needs must be established with them. The selected international studies cannot establish the prevalence of these practices or describe the services available at these institutions.

A second step would involve examining complete activities: a video followed by an exercise, a synchronous session with a debate, or remote group work. This would enable comparison of access to the resource with access to interaction. Where connectivity is an observed barrier, downloadable text could supplement a video; however, it should not become the sole solution for a student whose linguistic access depends on a signed version.

Automatic captioning requires specific testing before wider implementation: measuring each tool's error rate on UNCHK lecture recordings in French and in disciplinary registers, distinguishing offline processing from streaming as Kuhn *et al.,* (2024) do, and separating errors involving concepts, numbers, and negations from errors that do not affect comprehension.

The research by Mallory *et al.,* (2023), based on a survey of 93 deaf and hard-of-hearing students and a focus group with nine of them, demonstrates the value of examining online learning experiences. Despite the publication date, the data predate the pandemic. This limits their use in characterizing current arrangements and underscores that technological developments cannot be inferred from an article's publication year alone.

Local testing could combine technical checks, comprehension tasks, and interviews about use. It should compare modalities acceptable to participants without depriving a group of necessary support. Indicators would concern concepts understood, opportunities to contribute, and persistent barriers. Correction costs, availability timelines, and continuity of support would inform an assessment of institutional feasibility.

Limitations of the Comparison

The narrative selection prioritizes publications relevant to the argument without guaranteeing comprehensiveness. The empirical studies used come mainly from English-speaking contexts, whose practices and services cannot be assumed to be identical to those in Senegal. Several foundational studies concern older technologies; they illuminate communication functions but do not describe the performance of contemporary tools. Recent automatic speech recognition measurements (Kuhn *et al.,* 2024) partly address this limitation but, to our knowledge, do not cover French as spoken in Senegal or national languages. The corpus remains limited, comprising approximately fifteen

references, and should not be read as a state-of-the-art review.

The evidence is also heterogeneous: perceptions, retention, experimental learning, and experience narratives are not interchangeable measures. Normative documents and pedagogical frameworks must retain their distinct status. Finally, the analysis includes neither local interviews, nor an audit of UNCHK or FASTEF platforms, nor validation of the framework. Its scope is that of a conceptual contribution intended to inform choices and subsequent investigation.

In conclusion, the comparison of technical, universal design, and adaptive approaches shows that pedagogical accessibility for deaf and hard-of-hearing students involves several levels of decision-making. Technical requirements help make information available in an accessible form; UDL organizes diverse possibilities; and pedagogical and linguistic adaptation addresses barriers that persist in a particular situation. Integrating them requires maintaining these distinct functions. The discussion leads to three conclusions. Captioning and interpreting must be assessed in terms of their functions and students' linguistic practices. Diversification should enable coordination among information sources without requiring simultaneous consultation. Finally, access to content must be distinguished from the ability to participate while the activity takes place. These conclusions do not identify a universally superior modality; they specify the questions that a design choice must address. They are accompanied by the three more definitive propositions in Section 5.7: technical compliance as a baseline, human review of content covered by assessment, and response time as a primary criterion.

For digital higher education in Senegal, the research priority is to examine these propositions against the situations experienced by the students concerned. The proposed framework provides a starting point for linking barriers, adaptations, and evaluation criteria. Its validation requires effective student participation and joint observation of comprehension, interaction, and institutional implementation conditions.

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