Design, pilot implementation, and evaluation of a UDL-guided multimodal virtual learning object to support A1 written English skills in deaf LSC users at UNAD

Hector Istmod Devia Robayo

Advisor

Juan Camilo Pérez Hernández

Universidad Nacional Abierta y a Distancia UNAD

School of Education Sciences ECEDU

Master's in Pedagogical Mediation in English Language Learning MPAI

2026

Dedication

"Whatever the man would call each living creature, that became its name."
Genesis 2:19 (*New World Translation of the Holy Scriptures)*

I dedicate this work to Jehovah, the Creator and the source of the human capacity for language. In many ways, this thesis is inseparable from that first act of naming—an act that reflects not only cognition but also relationship, responsibility, and meaning. From the beginning, humanity was entrusted with the ability to think, to name, to recount, and to share what lies within the heart. Through language, faith and knowledge are transmitted from one generation to the next. As I worked with various languages, I became more conscious of how different their structures and sounds could be. But speech is not the only means of communication. Where hearing is absent, the impulse to express and to understand remains undiminished. From this same human endowment emerge sign languages—Colombian Sign Language (LSC), American Sign Language (ASL), and many others—fully formed linguistic systems through which Deaf individuals participate in the exchange of ideas, convictions, and learning. Working alongside Deaf learners has reinforced for me that language does not begin with the voice. It begins with the human need to make meaning visible and shared.

Looking back, it is difficult to separate the academic aims of this project from the deeper conviction that access to language is inseparable from dignity. This work, centred on supporting Deaf learners' access to written English through visual and sign-based resources, represents a modest contribution within that wider reality. It is an offering shaped by study, practice, and faith.

For these reasons, I dedicate this research to Jehovah, acknowledging that the possibility of language itself comes from Him.

Acknowledgments

I am deeply grateful to my family. Throughout this research, they helped me keep a sense of balance, especially at moments when the work felt uncertain or demanding. Their presence during that time meant more than I can easily put into words.

From the beginning, my wife, Margarita, was part of this process in a very real way. Her patience and encouragement sustained me, but she also engaged thoughtfully with the substance of the project. Drawing on her knowledge of Colombian Sign Language, she would often notice nuances I had overlooked. Sometimes it was a short comment that made me pause; other times, a question from her prompted me to rethink assumptions I had not realised I was making. Many of our conversations at home reminded me that this work is not abstract. It concerns real learners and real communities. That perspective stayed with me as the writing progressed.

I am also grateful to my son, Eric, for his understanding during a period that required time, concentration, and many quiet evenings. His maturity during those months did not go unnoticed. The calm he helped preserve at home made a tangible difference. In ways both visible and subtle, their generosity allowed me to remain committed to the work without losing sight of family life.

I am thankful to Professor Edwin Andrés Londoño Alape. During the course Resources Development for English Language Learning, his guidance led to the initial pilot that eventually grew into this thesis. He encouraged me to look beyond the immediate academic requirement and to consider the broader value of the resource for Deaf learners. Looking back, that early encouragement shaped the study more than I fully understood at the time.

I am equally grateful to Professor Juan Camilo Pérez Hernández for his supervision in the course Research, Educational Innovation, and Social Impact. His feedback was careful and demanding in a constructive sense. It required me to revisit assumptions and to articulate methodological

decisions with greater clarity. Over time, that discipline strengthened the study. I am especially appreciative of his work related to CIPAS—Comunidades de Interacción y Participación Social ("Communities of Interaction and Social Participation"). Through this initiative, he introduced AI-based tools that supported the organisation and management of data. These tools did not replace critical reflection; rather, they provided structure that allowed the analysis to develop more rigorously.

Finally, I extend my thanks to all who contributed to this endeavour, whether directly or indirectly. Research rarely unfolds in isolation. It grows through exchange, reflection, and shared commitment. This thesis is the outcome of that collective support.

Abstract

In Colombian higher education, Deaf students who use Colombian Sign Language (LSC) often face structural barriers when learning English because most instructional environments remain strongly audio-centred. The research focused on the design, pilot implementation, and evaluation of a multimodal Virtual Learning Object (VLO) intended to support Deaf university students working with A1-level written English, particularly reading, writing, and grammar, within UNAD's open, distance, online, and hybrid educational model. The project addresses national foreign-language requirements and accessibility gaps that affect Deaf learners in digitally mediated learning environments. From a pedagogical perspective, the project aimed to develop a sign-first digital resource that recognises the linguistic and cultural realities of Deaf LSC users. The VLO design draws on Universal Design for Learning (UDL), bilingual–bicultural Deaf education, and the Common European Framework of Reference for Languages (CEFR). The resource integrates LSC instructional mediation, task-bounded Signed Exact English (SEE) as a visual grammar scaffold, selective SignWriting supports, and visually sequenced micro-tasks implemented through the Lumi/H5P platform as a self-paced learning environment. Methodologically, the study followed a Design-Based Research (DBR) orientation implemented through a single-cycle descriptive mixed-methods pilot. All 54 Deaf LSC users enrolled in English courses at the university were invited to participate, and 29 completed an accessible questionnaire after using the VLO. The instrument included 18 Likert-type items and two open-ended prompts accompanied by short explanatory videos in LSC. Additional qualitative evidence came from six voluntary LSC video contributions describing participants' learning experiences. Quantitative data were emphasised using descriptive statistics, while qualitative responses were coded thematically and integrated through triangulation matrices and a mixed-methods joint

display. Participants reported very positive perceptions of the VLO, with agreement levels above 75% on all survey items, especially regarding accessibility, visual mediation, and usefulness for self-paced learning. The integrated analysis identified the construct “Inclusive Autonomy in Deaf Language Learning.” Results indicate that sign language mediation, technology usability, and clear instructional sequencing supported participants’ autonomy in learning. The findings suggest that a UDL-guided multimodal VLO can facilitate early engagement with written English among Deaf LSC users and inform future DBR refinement cycles at UNAD.

Keywords: Deaf education, Colombian Sign Language (LSC), Universal Design for Learning (UDL), Design-Based Research (DBR), inclusive educational technology.

Resumen

En la educación superior colombiana, los estudiantes sordos que utilizan la Lengua de Señas Colombiana (LSC) enfrentan barreras al aprender inglés, ya que muchos entornos de enseñanza continúan siendo predominantemente audio-centrados. Esta investigación abordó el diseño, implementación piloto y evaluación de un Objeto Virtual de Aprendizaje (OVA) multimodal orientado a apoyar estudiantes universitarios sordos en el aprendizaje de inglés escrito A1, particularmente lectura, escritura y gramática, dentro del modelo educativo abierto, a distancia, en línea e híbrido de la UNAD. El proyecto responde a requisitos nacionales de lenguas extranjeras y brechas de accesibilidad que afectan estudiantes sordos en entornos digitales. Desde una perspectiva pedagógica, el proyecto desarrolló un recurso digital con enfoque en lengua de señas que reconoce realidades lingüísticas y culturales de usuarios sordos de LSC. El diseño del OVA se fundamenta en el Diseño Universal de Aprendizaje (DUA), educación bilingüe-bicultural para personas sordas y el Marco Común Europeo de Referencia para las Lenguas (MCER). El recurso integra mediación instruccional en LSC, Inglés Signado Exacto (SEE) como apoyo visual para gramática, apoyos selectivos de Escritura de Señas (SignWriting) y microtareas visualmente secuenciadas implementadas mediante la plataforma Lumi/H5P como entorno de aprendizaje autónomo. Metodológicamente, el estudio siguió una orientación de Investigación Basada en el Diseño (IBD) mediante un piloto descriptivo de métodos mixtos de un solo ciclo. Los 54 usuarios sordos de LSC matriculados en cursos de inglés fueron invitados a participar y 29 completaron un cuestionario accesible tras utilizar el OVA. El instrumento incluyó 18 ítems tipo Likert y dos preguntas abiertas acompañadas de breves videos explicativos en LSC. Evidencia cualitativa adicional provino de seis contribuciones voluntarias en video en LSC en las que los participantes describieron sus experiencias de aprendizaje. Los datos

cuantitativos se analizaron mediante estadística descriptiva y respuestas cualitativas se codificaron temáticamente e integraron mediante matrices de triangulación y visualización conjunta de métodos mixtos. Los participantes reportaron percepciones positivas del OVA, con niveles de acuerdo superiores al 75%. El análisis identificó el constructo “Autonomía Inclusiva en el Aprendizaje de Lenguas de Personas Sordas”. Los resultados sugieren que un OVA multimodal guiado por el DUA puede facilitar acercamiento temprano al inglés escrito entre usuarios sordos de LSC y orientar futuros ciclos de refinamiento IBD en la UNAD.

Palabras clave: educación de personas sordas, Lengua de Señas Colombiana (LSC), Diseño Universal de Aprendizaje (DUA), Investigación Basada en el Diseño (IBD), tecnología educativa inclusiva.

Resumo

No ensino superior colombiano, estudantes surdos que utilizam a Língua de Sinais Colombiana (LSC) enfrentam barreiras ao aprender inglês, pois muitos ambientes de ensino permanecem predominantemente centrados no áudio. Esta pesquisa abordou o desenho, a implementação piloto e a avaliação de um Objeto Virtual de Aprendizagem (OVA) multimodal orientado a apoiar estudantes universitários surdos no aprendizado do inglês escrito em nível A1, particularmente leitura, escrita e gramática, no âmbito do modelo educacional aberto, a distância, online e híbrido da UNAD. O projeto responde a requisitos nacionais de línguas estrangeiras e a lacunas de acessibilidade que afetam estudantes surdos em ambientes digitais de aprendizagem. Sob uma perspectiva pedagógica, desenvolveu-se um recurso digital com enfoque em língua de sinais que reconhece as realidades linguísticas e culturais dos usuários surdos de LSC. O desenho do OVA fundamenta-se no Desenho Universal para a Aprendizagem (DUA), na educação bilíngue-bicultural para pessoas surdas e no Quadro Comum Europeu de Referência para Línguas (QCER). O recurso integra mediação instrucional em LSC, Inglês Exato Sinalizado (SEE) como suporte visual para a gramática, apoios seletivos de Escrita de Sinais (SignWriting) e microtarefas visualmente sequenciadas implementadas por meio da plataforma Lumi/H5P como ambiente de aprendizagem autônoma. Metodologicamente, o estudo seguiu orientação de Pesquisa Baseada em Design (PBD) mediante um piloto descritivo de métodos mistos, realizado em um único ciclo. Os 54 usuários surdos de LSC matriculados em cursos de inglês foram convidados a participar, e 29 completaram um questionário acessível após utilizar o OVA. O instrumento incluiu 18 itens do tipo Likert e duas perguntas abertas acompanhadas de breves vídeos explicativos em LSC. Evidência qualitativa adicional provém de seis contribuições voluntárias em vídeo, nas quais os participantes descreveram suas experiências de aprendizagem.

Os dados quantitativos foram analisados por meio de estatística descritiva, enquanto as respostas qualitativas foram codificadas tematicamente e integradas mediante matrizes de triangulação e visualização conjunta de métodos mistos. Os participantes relataram percepções positivas do OVA, com níveis de concordância superiores a 75%. A análise identificou o construto "Autonomia Inclusiva na Aprendizagem de Línguas por Pessoas Surdas". Os resultados sugerem que um OVA multimodal orientado pelo DUA pode facilitar o engajamento inicial com o inglês escrito entre usuários surdos de LSC e orientar futuros ciclos de refinamento da PBD na UNAD.

Palavras-chave: educação de surdos, Língua de Sinais Colombiana (LSC), Desenho Universal para a Aprendizagem (DUA), Pesquisa Baseada em Design (PBD), tecnologia educacional inclusiva.

Table of Contents

List of Tables

List of Figures

List of Appendices

Introduction

Context and Background

The right of Deaf students to inclusive education has progressively emerged in Colombia through national legislation and policy development, such as Statutory Law 1618 of 2013 and the National Institute for the Deaf's guidelines (Congreso de la República de Colombia, 2013b; Instituto Nacional para Sordos, 2022). Together, these regulatory frameworks call on higher education institutions to create learning environments and institutional practices that move beyond formal access and actively promote accessibility, equity, and recognition of linguistic and cultural diversity.

Given that the thesis engages with questions of language, identity, and access, a brief note on terminology is necessary from the outset. In this document, the term “Deaf” is used in a sociolinguistic and cultural sense to refer to sign language users whose everyday communication and learning are shaped by visual forms of interaction and by participation in Deaf community practices. As stated by Hafner et al. (2025), people who use sign language and socialise with other sign language users often identify as "Deaf”, where the capital letter “D” signals community identification as a cultural and linguistic minority. This usage is consistent with recent studies that distinguish between cultural-linguistic identity and purely clinical or deficit framings of deafness. According to Peterson (2025), the Deaf community is proud to be deaf and views it as a unique cultural identity. When the text refers to institutional categories (e.g., disability policy) or administrative language, it may also use broader expressions such as “students with disabilities,” yet the analytic focus remains on Deaf learners who use Colombian Sign Language (LSC) as their primary language.

Despite these advances, important implementation gaps persist—particularly in foreign language education for Deaf learners. All Colombian undergraduates are required by Law 1651 of 2013 to study at least one foreign language, typically English (Congreso de la República de Colombia, 2013a). However, this expectation was originally framed with hearing students in mind, and little attention has been given to how Deaf learners experience the same requirement. Their linguistic and cultural context is different, and so are the ways in which they access information.

In this thesis, that difference is treated analytically as a bimodal bilingual profile in which Colombian Sign Language (LSC) is the primary language of access and written Spanish is a dominant literacy resource in higher education. Under these conditions, English functions as an additional language (L3) whose feasibility depends less on learners' inherent capacity and more on whether instructional design provides sign-first, visually mediated pathways into early written form.

In practice, many virtual English courses still assume auditory access through listening-centred tasks, spoken instructions, and audio-dependent interaction routines; when the instructional sequence is built around hearing-based processing, Deaf and hard-of-hearing students can experience access breakdowns that interrupt participation and lead to missing key information (see Appendix A for details).

According to research, Deaf and hard-of-hearing students may struggle with split attention in synchronous online settings (Gehret & Elliot, 2025). Furthermore, it bolsters the claim that accessibility guidelines are often too general and may lack the implementation mechanisms required to ensure their widespread adoption (Loaiza-Ramírez & González-Beltrán,

2026). Therefore, the current study views accessibility as a design condition that needs to be made clear and tested through a pilot intervention, rather than as an add-on.

This study addresses the need for inclusive, multimodal, and bilingual pedagogical tools that support A1 (CEFR) English learning among Deaf students (CAST, 2024b; Council of Europe, 2020; Instituto Nacional para Sordos, 2022). In Deaf higher education, access is inherently visual and language-mediated, so design choices that assume auditory-first processing can reproduce exclusion at the level of the learning environment rather than the learner (Weber et al., 2024).

Given its mission to widen access through distance and online modalities and hybrid scenarios, the Universidad Nacional Abierta y a Distancia (UNAD) offers a particularly relevant institutional context (Consejo Superior Universitario de la Universidad Nacional Abierta y a Distancia (UNAD), 2025; Universidad Nacional Abierta y a Distancia (UNAD), 2025). At present, there is no institutional framework or purpose-built virtual resource specifically designed to support the learning of English as a third language by Deaf students who use Colombian Sign Language (LSC) as their primary language. This claim is documented through an institutional audit of course requirements and built-in accessibility features (as documented in Appendix A).

This gap is consistent with earlier documentary work in Colombian distance higher education, which reported that “no detailed explanation was found in the consulted literature regarding the adaptations, characteristics, and reasonable accommodations that VLO should include” (author’s translation; Devia Robayo, 2017, p. 38). In response to this situation, the research proposes the design and evaluation of a Virtual Learning Object (VLO) tailored to Deaf

learners, integrating LSC and visual grammar tools such as Signing Exact English (SEE) and SignWriting, together with digital authoring platforms (e.g., H5P and Genially).

At this point, one practical clarification helps prevent misunderstandings later in the thesis. In this project, Signing Exact English (SEE) is used strictly as a pedagogical coding system, not as a replacement for Colombian Sign Language (LSC) or as a language of instruction in its own right. SEE functioned as a visual grammatical scaffold to make English morphemes, word order, and sentence structure more explicit in ways that Deaf learners can track visually, particularly in early A1 work where small grammatical markers often remain opaque in conventional text-only explanations (Stryker et al., 2015). LSC remains the primary language of explanation and communication throughout the VLO, while SEE is used as an additional teaching tool in accordance with specific learning objectives.

SignWriting, in turn, is introduced as an additional representational bridge that can help connect signed discourse with written forms through stable, visual notation. In this sense, it "provides a crucial bridge between visual sign representation and precise linguistic analysis", since signs can be recorded as "two-dimensional graphical abstractions" within a logographic transcription system (Sevilla et al., 2025, pp. 1–2). The theoretical underpinnings combine Universal Design for Learning (UDL), bilingual–bicultural education, and technology-mediated pedagogy to align the VLO with Deaf students' preferred modes of communication and learning.

Problem Statement

Significant gaps still exist in online learning environments, despite Colombia's advancements in inclusive education policies for students with disabilities, including the Deaf community, who use sign language. One important area is English as a foreign language (EFL), which is required for undergraduate programmes under Law 1651 of 2013 and applies to Deaf

students. In this context, English is often a third language after written Spanish and LSC, presenting an additional challenge (Velásquez Hoyos et al., 2025). Despite this, the English materials and platforms most widely used online continue to depend on auditory input, spoken interaction, and linear text processing, which are largely inaccessible or pedagogically inadequate for Deaf learners. In institutional practice, such measures "are insufficient to address the full range of pedagogical needs" (author's translation; Devia Robayo, 2024, p. 13).

Deaf students' learning is hampered, their ability to progress academically is limited, and their interest in learning foreign languages is diminished by the absence of carefully crafted materials designed specifically for them. UNAD does not currently provide a virtual English learning tool that incorporates UDL principles, visual grammar systems (SEE, SignWriting), and LSC. This disparity threatens the right of Deaf students to an equitable education and hinders the institution's efforts to provide truly inclusive distance learning.

This research arises from the necessity to design and evaluate a multimodal Virtual Learning Object (VLO) that supports Deaf students in developing basic written English skills at the A1 level. Without resources that are inclusive, bilingual, and multimodal, current inequalities in access, learning outcomes, and participation are likely to continue—both across Colombian higher education and, more specifically, within the UNAD context.

At the same time—and this matters for internal coherence—the problem is not framed as a deficit in Deaf learners' capacity but as a mismatch between institutional language requirements and the design assumptions embedded in mainstream online EFL resources. In this sense, when students' perspectives are centred, "accessibility emerges as a relational and systemic issue that demands institutional transformation beyond basic compliance", including the need to "shift from reactive accommodations to proactive, inclusive design" (Tannenbaum-

Baruchi et al., 2025, p. 15). In other words, the issue is not simply difficulty with English but the lack of sign-first, visually mediated learning pathways that allow Deaf LSC users to engage with A1 written English in ways that are accessible, culturally responsive, and pedagogically meaningful in virtual and hybrid settings.

Research Questions

Main Research Question

How can a UDL-guided, multimodal Virtual Learning Object (VLO) for Deaf users of Colombian Sign Language (LSC) be designed and pilot-evaluated to support engagement in A1-level written English practice (reading, writing, and grammar) in UNAD's open, distance, online, and hybrid contexts, while generating evidence about accessibility, usability, pedagogical usefulness, and refinement priorities as a self-paced learning resource?

Specific Research Questions

What communicative, technological, and pedagogical needs do Deaf LSC users enrolled in English A1 courses at UNAD report in relation to developing written English skills (reading, writing, and grammar) in virtual and hybrid learning contexts?

Which visual, bilingual, and multimodal resources (e.g., LSC videos, Signing Exact English, and SignWriting) can be integrated into the design of a VLO to support A1 written English learning for Deaf LSC users at UNAD?

How do Deaf participants perceive the VLO's accessibility, usability, pedagogical organisation, and perceived usefulness for supporting A1 written English learning (reading, writing, and grammar) in online and hybrid learning environments?

What adjustments and refinement priorities do Deaf participants identify to inform the next DBR cycle of the VLO (e.g., improving clarity and consistency of sign–text mediation, expanding practice opportunities, and addressing device-specific technical accessibility issues)?

Objectives

General Objective

To design and pilot-evaluate a UDL-guided, multimodal Virtual Learning Object (VLO) centred on Colombian Sign Language (LSC) that supports A1-level written English learning (reading, writing, and grammar) for Deaf students at UNAD, promoting accessible and inclusive self-paced learning experiences in virtual and hybrid contexts.

Specific Objectives

To identify the communicative, technological, and pedagogical needs and contextual constraints expressed by Deaf LSC users enrolled in English A1 courses at UNAD, drawing on mixed-methods evidence from the post-use evaluation (open-ended survey responses and LSC-based comments).

To design a VLO prototype integrating LSC, Signing Exact English (SEE), SignWriting, and multimodal digital resources to support A1 written English learning as a self-paced tool.

To implement the VLO with Deaf participants within an ethical, accessible, and digitally mediated learning environment aligned with UNAD's open and distance education model.

To evaluate participants' perceptions of the VLO's accessibility, usability, pedagogical organisation, and perceived usefulness using qualitative and quantitative instruments aligned with inclusive and mediated learning frameworks, and to identify refinement priorities to inform the next DBR cycle.

Given the exploratory, design-based character of the project, no formal null or alternative hypotheses are posed. Instead, the study is guided by the expectation that Deaf participants will report favourable perceptions of the VLO's accessibility, usability, pedagogical organisation, and perceived usefulness for supporting A1 written English learning in self-paced virtual and hybrid contexts. However, consistent with the logic of design-based research, the evaluation is also intended to surface barriers, negative perceptions, and concrete improvement needs that can inform refinement of the VLO in subsequent iterations.

Research Line

The study is situated within the research line "*Bilingualism in Distance Education Supported by Educational Technologies."* Its relevance to this line emerges from the way the project connects pedagogical mediation in English learning with the development of accessible digital resources, while remaining attentive to the linguistic conditions of Deaf students who use Colombian Sign Language (LSC). These elements reflect a broader institutional effort to strengthen inclusive practices within virtual and hybrid programmes.

Consequently, the project is informed by UNAD's Solidarity-Based Heutagogical Model (MHUS 5.0), which places considerable emphasis on learner agency. Rather than assuming a uniform pathway through content, the model recognises that students progress in diverse ways and must be able to make informed decisions about their learning processes (Consejo Superior Universitario de la Universidad Nacional Abierta y a Distancia (UNAD), 2025; Universidad Nacional Abierta y a Distancia (UNAD), 2025). From a heutagogical perspective, this implies that learners are expected to assume responsibility for defining their goals, selecting strategies, and evaluating their own progress (Panta, 2025). Within this framework, the Virtual Learning Object (VLO) developed in the study operates as a flexible environment. It allows Deaf learners

to revisit explanations, engage in structured practice at their own pace, and gradually consolidate understanding through sign-first, visually mediated pathways instead of audio-dependent instruction.

The integration of signed, visual, and written mediations reflects a well-developed understanding of accessibility that transcends basic procedural accommodation. It acknowledged that Deaf students interact with digital environments in ways that differ from their hearing peers. This recognition necessitated that instructional design be intentionally and systematically tailored to address these differences. The study thus contributes to UNAD's continuous institutional efforts to support inclusive bilingual education and develop digital resources that better reflect the diversity found in remote learning settings.

Rationale for the Study

Inclusive higher education for Deaf students is not only a matter of legal compliance in Colombia; it is also a pedagogical and ethical commitment that universities are still learning to fulfil. National laws such as Law 1618 of 2013 ensure that people with disabilities can effectively enjoy their rights, including access to inclusive education and reasonable accommodations (Congreso de la República de Colombia, 2013b). English remains the most common language at all educational levels, and Law 1651 of 2013 emphasises learning foreign languages and supports the country's bilingualism agenda (Congreso de la República de Colombia, 2013a).

However, INSOR cautions that, due to Deaf learners' auditory restrictions, "learning a foreign language can be highly complex and, in some cases, almost impossible" (author's translation; Instituto Nacional para Sordos, 2022, p. 41). In practice, this tension becomes visible when English is taught in ways that rely heavily on listening and oral interaction. At the

international level, the Convention on the Rights of Persons with Disabilities requires States Parties to ensure “an inclusive education system at all levels” and, in the case of Deaf learners, calls for “the promotion of the linguistic identity of the Deaf community” through sign language (United Nations, 2006, Article 24(1), 24(3)(b)).

When these frameworks are viewed together, a clear tension becomes visible. Deaf university students are expected to meet the same English language requirements as their hearing classmates, yet they must do so while navigating very different linguistic and sensory conditions. Although INSOR’s guidance strongly recommends the use of sign language-based resources and multimodal strategies in higher education, the reality is that many online EFL courses still operate as if all learners were hearing. Within UNAD’s ordinary English offer, there are no institutional virtual resources explicitly designed from a sign-first perspective for Deaf LSC users. According to online accessibility research, many digital courses "are not designed effectively for deaf learners and underdeliver on visual linguistic inputs, such as sign languages and captions”, which bolsters this concern (Weber et al., 2024, p. 109). The result is a pattern of exclusion that is not always obvious but that strongly affects Deaf students’ access, participation, and academic success.

From a pedagogical perspective, teaching English to Deaf learners requires far more than simply removing listening components from the curriculum. It means intentionally building on the linguistic resources that Deaf students already use. Bilingual-bicultural approaches to Deaf education emphasise that Deaf learners’ first language must be recognised and valued; as Skliar argues, sign language is “a full, natural language, not an artificial code of communication” (author’s translation; Skliar, 1998, p. 50). From this standpoint, literacy in the majority language—particularly in written form—becomes educationally viable only when sign language

remains the primary language of access and when both languages are made meaningfully accessible through appropriate visual mediation (Skliar, 1998).

Guided by this understanding, the VLO proposed in this research project brings together Colombian Sign Language (LSC), Signed Exact English (SEE), and SignWriting, making the structure and meaning of English visible rather than implicit. SignWriting—described as "a practical writing system for deaf sign languages composed of intuitive graphical-schematic symbols and simple rules for combining such symbols to represent signs" (da Rocha Costa & Dimuro, 2002, p. 202)—provides a stable bridge between signed discourse and written text. Meanwhile, for grammar instruction, the SEE system reinforces this connection by making English words and grammatical markers visually explicit, addressing the need to "visually represent words in a grammatically accurate way" and to provide "'through the air' access" (Stryker et al., 2015, p. 2). More specifically, SEE "utilizes "the morphology of English, both root words and affix (prefix and suffix) markers", foregrounding bound morphemes as visually available components of English form (Stryker et al., 2015, p. 3).

For these reasons, the study is justified on three interconnected grounds: (1) it responds to Colombia's legal and institutional responsibilities to make foreign language education meaningfully accessible to Deaf sign language users; (2) it addresses a documented gap in English-learning resources that treat LSC-first mediation and visual access as starting points rather than afterthoughts; and (3) it aims to generate design-relevant evidence for the development and evaluation of multimodal VLOs in open and distance universities. These premises lead directly into the Literature Review which synthesises (a) evidence on digital inclusion and Deaf higher education, (b) findings on Deaf learners' multimodal preferences in

virtual/hybrid learning, (c) visual and writing-support strategies for early written English, and (d) translanguaging and sign-first mediation as planned pedagogical coordination.

Scope and Limitations

This study intentionally aligned its scope with the ethical, pedagogical, and institutional priorities of UNAD. The project centred on the design and implementation of a multimodal Virtual Learning Object (VLO), followed by its evaluation. It aimed to support Deaf learners who use Colombian Sign Language (LSC) in their initial engagement with written English at the A1 level of the CEFR. By combining LSC videos, Signed Exact English (SEE), SignWriting, and visual scaffolds created using platforms like H5P (via Lumi), Genially, and embedded multimedia, the VLO was intended to serve as an additional learning aid in online and hybrid distance learning settings. The scope did not extend to listening or oral competencies, as these were not aligned with the participants' primary linguistic modalities and communicative practices as Deaf users of Colombian Sign Language (LSC).

Within the framework of design-based research (DBR), the study used a mixed-methods descriptive design (McKenney & Reeves, 2018; Wang & Hannafin, 2005). In this context, the objective was not to measure causal effects or generalise findings to all Deaf students in Colombia, but to document how the 29 participants in the pilot experienced the VLO in terms of its usability, accessibility, and pedagogical contribution. The analysis offered useful, contextualised insights that could inform future institutional innovations at UNAD and guide comparable initiatives in other open and distance learning environments. In practical terms, this corresponded to a pilot, single-cycle DBR implementation: the intention was to generate design-relevant evidence and clear redesign priorities, rather than to claim stable outcomes across multiple iterative cycles (Wang & Hannafin, 2005).

However, it was important to recognise a number of methodological and contextual limitations. First, the sample was geographically dispersed and intentionally small, reflecting the nature of national distance education while limiting opportunities for extended synchronous interaction (Waterhouse et al., 2022). A second limitation has to do with access. While some degree of mobile compatibility was considered, the VLO was developed primarily for computer use in the Lumi/H5P format. The extent of engagement with specific multimodal components may have been affected by variations in participant devices, connectivity, and digital skills (Gudoniene et al., 2025; Waterhouse et al., 2022). Third, the level of iteration within the DBR cycle was shaped by the timing of tool deployment, participant recruitment, and the need for institutional permissions. For this reason, the project did not move into a multi-cycle redesign phase. The VLO was nevertheless refined on the basis of user feedback (McKenney & Reeves, 2018; Wang & Hannafin, 2005).

Furthermore, the study only examined how Deaf students viewed learning in the three areas of English—reading, writing, and grammar—that they could access the most easily in virtual environments. In consequence, the findings should be interpreted as evidence related to written language development rather than comprehensive EFL proficiency. Finally, because the research relied on self-report surveys, short LSC video comments, and reflective feedback, the data may have been influenced by participants' personal experiences, expectations, and levels of familiarity with digital learning environments.

Despite these limitations, the study provided a grounded and contextually meaningful contribution: it documented how a carefully designed, multimodal VLO could support Deaf learners' early engagement with written English in distance education contexts, and it offered evidence-based criteria that could inform future institutional practices in designing accessible,

bilingual, and culturally responsive digital resources. This contribution was strengthened by transparent reporting and reflexive openness in the handling of self-report qualitative evidence—making explicit what the researcher did and how and why they did it—and by keeping interpretations bounded to what an online qualitative survey, grounded in qualitative interpretivist values, could legitimately support (Braun & Clarke, 2025; Thomas et al., 2024).

Literature Review

Introduction to the Literature Review

This literature review situates the present project within current debates on inclusive higher education, Deaf bilingualism, and technology-mediated language learning. It establishes the theoretical and conceptual foundations that justify the Research Design: a Design-Based Research (DBR) pilot, implemented through a mixed-methods approach to design and formatively evaluate a multimodal Virtual Learning Object (VLO) intended to support early A1 (CEFR) written English practice among Deaf university students who use Colombian Sign Language (LSC) as their primary language. In addition, it clarifies the constructs and evidence base used to interpret participants' reported experience and perceptions of the VLO—particularly accessibility, usability, pedagogical organisation, and perceived usefulness as a self-paced learning resource.

Given participants' bimodal bilingual repertoires—LSC as the primary language of access and written Spanish as a dominant literacy resource in higher education—this thesis treats English learning as an additional language (L3). For many Deaf Colombians, English is acquired after Colombian Sign Language and written Spanish (Hoyos Padilla & Ramos Hernandez, 2025, p. 35). It is therefore approached here through sign-first, visually mediated pathways, especially because conceptual knowledge developed through an accessible first language such as sign language can support the development of written forms of additional spoken languages (Olujić Tomazin et al., 2025, p. 1278) and because effective approaches can build on the visual processing skills that Deaf learners develop through the acquisition of their native sign language (Hoyos Padilla & Ramos Hernandez, 2025, p. 50).

From a national perspective, the educational inclusion of Deaf students in Colombian higher education is framed by legal mandates and policy guidelines that recognise both disability rights and linguistic diversity. Among them, Law 1618 of 2013 guarantees the effective enjoyment of rights for people with disabilities, including access to inclusive education; Law 1651 of 2013 requires higher education programmes to include at least one foreign language, typically English (Congreso de la República de Colombia, 2013b, 2013a). INSOR has emphasised that this requirement, while legitimate in principle, may become counterproductive for Deaf students and that, due to hearing-related restrictions, "learning a foreign language can be highly complex and, in some cases, almost impossible" (author's translation; Instituto Nacional para Sordos, 2022, p. 40).

In this thesis, INSOR's warning is read less as a claim about Deaf learners' inherent capacity and more as a diagnosis of what happens when foreign language provision remains designed around auditory assumptions and linear text-heavy delivery, rather than being adequately designed for access. While much instruction still heavily relies on auditory approaches that may not be accessible to DHH learners, research with Deaf and Hard-of-Hearing learners shows that appropriately adapted teaching methods can improve success in foreign language learning (Olszak & Borowicz, 2025). Consistent with this, "hearing impairment is not directly related to cognitive impairment" (Olszak & Borowicz, 2025, pp. 1, 3, 10). In other words, the "almost impossible" risk is tied to conditions of access and pedagogy, not to Deafness as such. Those tensions form the structural backdrop against which the present project is conceived.

At the same time, international and institutional frameworks insist that sign languages are not merely compensatory tools but full-fledged languages; as Oviedo (2001) notes, "sign

languages are natural languages because, in many respects, they display structures similar to those of spoken languages" (p. 31, author's translation). The Council of Europe explicitly states that "Sign languages are not … gesturally-based communication … [nor] simply a … medium through which a spoken language is expressed … [They] are human languages in their own right" (Council of Europe, 2020, p. 252). This reinforces the legitimacy of using Colombian Sign Language (LSC) not as a support add-on, but as a primary medium of instruction and mediation in English learning for Deaf students.

Within the university, UNAD's Solidarity-Based Heutagogical Model (MHUS 5.0) frames teaching and learning as processes that foster autonomy, collaboration, and inclusion across hybrid and distance environments, recognising that "hybridity supports … social inclusion and disciplinary diversity … [through] multidimensional, multicultural, and multi-contextual approaches" (author's translation; Consejo Superior Universitario de la Universidad Nacional Abierta y a Distancia (UNAD), 2025, Article 2). That institutional emphasis matters here because the VLO is explicitly designed as a self-paced resource within open and distance education realities, where autonomy is not a slogan but a daily condition.

This project responds to the resulting gap: Deaf students at UNAD must meet English requirements through courses and materials largely designed for hearing learners, while a targeted contextual scan and needs analysis conducted for this study found only limited institutional digital resources (e.g., Digital Educational Resources/DER, Virtual Informational Objects/VIO, and Virtual Learning Objects/VLO) that provide partial translation or accessibility support but did not identify an institutional VLO specifically designed for English learning and explicitly tailored to Deaf students' linguistic profiles and visual learning patterns (see Appendix A).

The literature review therefore pursues three main aims. It begins by synthesising empirical data on Deaf students' access to virtual and hybrid learning, paying special attention to written literacy supports, multimodal resources, and signed mediation. Second, it explains the theoretical position adopted in this study, drawing on the CEFR's action-orientated and mediation-based view of language learning, Universal Design for Learning (UDL), and plurilingual competence. Specifically, under sign-first, visually mediated conditions, accessibility, usability, multimodal mediation, and perceived support for A1 written English learning (reading, writing, and grammar) are emphasised. Third, it describes the conceptual frameworks that the researcher operationalises in the VLO's design and perception-based assessment.

By weaving together these strands, the literature review provides a coherent foundation for the methodological decisions presented in the Research Design—particularly the choice of a DBR orientation (implemented as a pilot iteration), the use of mixed methods, and the emphasis on accessible, sign-led, multimodal tasks aligned with the communicative needs of Deaf LSC users in an open and distance university.

State of the Art

Where the introduction establishes the institutional problem, this State of the Art narrows the evidence base to the empirical and institutional findings that most directly inform the present project's objectives, research questions, and design decisions. It addresses four interrelated areas: (a) digital inclusion and higher education for Deaf students; (b) virtual and hybrid learning preferences among Deaf and Hard-of-Hearing learners; (c) tools and strategies for facilitating written English learning with visual and multimodal support; and (d) translanguaging and sign-

first mediation as pedagogical approaches for English learning in Deaf and Hard-of-Hearing contexts.

Digital Inclusion and Deaf Students in Higher Education

Building on the policy rationale outlined above, this section shifts from legal recognition to the practical conditions that shape Deaf university students' access to inclusive higher education and digitally mediated learning. Colombian legislation affirms that Colombian Sign Language (LSC) is the natural language of the country's signing Deaf community and recognises its linguistic completeness, as established in Law 324 of 1996, Decree 2369 of 1997, and Constitutional Court Ruling C-128 of 2002 (Congreso de la República de Colombia, 1996; Corte Constitucional, 2002; Presidencia de la República de Colombia, 1997). In line with this position, INSOR and the Caro y Cuervo Institute define sign language as a natural language with its own grammar, syntax, and vocabulary, used by a specific community (Instituto Nacional para Sordos & Instituto Caro y Cuervo, 2016, p. xiv).

Nevertheless, the practical realisation of inclusive higher education remains uneven. Despite the establishment of legal recognition, institutional preparedness and implementation circumstances differ depending on the context. National guidelines emphasise that institutions must adopt practical strategies to make an inclusive higher education system viable. Additionally, they emphasise the significance of institutional adaptability in addressing social and cultural diversity (Ministerio de Educación Nacional, 2013).

Within this regulatory landscape, INSOR's orientations for Deaf students in higher education suggest that the foreign language requirement established by Law 1651 may become counterproductive if implemented without Deaf-sensitive adjustments. The document therefore encourages institutions to consider the individual interests and learning possibilities of Deaf

students when planning foreign language pathways and to strengthen instruction through visual resources, ICT integration, and a stronger emphasis on reading and writing (Instituto Nacional para Sordos, 2022). This recommendation directly underpins the decision in the present project to prioritise a digital, visually based VLO that strengthens reading, and writing engagement, rather than audio-dependent skills.

Visual limitations and language access barriers may exacerbate these general challenges for Deaf students, such as processing a large amount of written material (Yessengaliyev et al., 2025, p. 24). According to some research, learning environments may present additional attentional challenges due to multiple competing visual stimuli (Yessengaliyev et al., 2025, p. 32). When taken as a whole, these elements contribute to the explanation of why generic hybrid designs might not be adequate and why a purpose-built accessible VLO—one that is purposefully structured around visual language access by design rather than retrofitted as an afterthought—is required.

Virtual/Hybrid Learning Preferences and Multimodality for Deaf Learners

Deaf and hard-of-hearing students consistently favour visual, sign-led digital resources, according to empirical data. A recent study found that the most beneficial learning formats for Deaf and Hard-of-Hearing participants were educational materials delivered via video and sign language (Yessengaliyev et al., 2025, p. 31). The same study highlights the significance of mobile devices for students' digital practices, noting that smartphones are the most popular devices for accessing educational resources (Yessengaliyev et al., 2025).

Even when the primary authoring tool is more desktop-orientated, these results support a sign-first, video-forward, mobile-responsive logic in resource design. Crucially, this design reasoning is in line with sign language media accessibility guidelines, which place a high priority

on visual clarity and consistent signer visibility (e.g., contrast, lighting, adequate signing space, and making sure the signer is large enough for legible hand and facial details) (Devia Robayo, 2017; World Wide Web Consortium (W3C), 2024).

However, virtual and hybrid environments are not automatically accessible. Percival, Ahmed, and Khan report that Deaf university students still encounter severe visibility problems in face-to-face and blended classrooms. One participant observed, “Some lecturers use a projector and turn off the lights, and since it’s a visual language, it becomes a challenge” (Percival et al., 2025, p. 10). This evidence highlights that visual access is not a secondary aesthetic detail; it is a pedagogical requirement.

Accordingly, WCAG guidelines require captions for pre-recorded audio content in synchronised media (World Wide Web Consortium (W3C), 2025). Captions function as synchronised visual or textual alternatives that convey the audio information necessary for understanding media content, and they must be positioned so that they do not obstruct relevant visual information in the video (World Wide Web Consortium (W3C), 2025). In the present project, these guidelines are translated into explicit visibility standards for the VLO and its hybrid use, including a stable signer window of sufficient size, high-contrast visual conditions with solid-colour backgrounds, minimal visual clutter with limited on-screen text, and practical guidance on lighting and projection when the VLO is used alongside synchronous sessions. These standards are aligned with Colombia’s national web accessibility directives, which adopt WCAG 2.1 Level AA as the reference standard for web content and institutional portals (Devia Robayo, 2017; Ministerio de Tecnologías de la Información y las Comunicaciones (MinTIC), 2020; World Wide Web Consortium (W3C), 2024, 2025).

Writing-Support Tools and Visual Strategies for English Literacy

For Deaf university students, written English learning often requires deliberate visual mediation rather than an expectation that grammar will be inferred from audio explanations or dense text. Empirical accounts from Deaf university learners in English as a Foreign Language contexts suggest that grammatical understanding is strengthened when form is explicitly displayed and revisited. As one participant in Rezvani et al.'s (2025) study explains, "I need to see everything visually … grammar points, and work on them multiple times" (p. 18).

In many English language courses, the primary subjects of instruction are oral production and listening comprehension. Deaf students' access to the educational process may be limited by this emphasis (Pires Silva et al., 2024). These methods may not provide Deaf students with sufficient visual, paced, and sign-inclusive pathways to written language. A multinational scoping review indicates that teaching Deaf students sign language and visual learning techniques significantly enhances their comprehension at the synthesis level (Dostal et al., 2024, pp. 481–482). Collectively, these findings support a design logic that prioritises visual and sign-mediated support in literacy-oriented foreign language instruction for Deaf students in higher education.

Two complementary tools are particularly relevant in this context: Signing Exact English (SEE) and SignWriting. SEE was developed to visually represent English lexicon and grammatical structure in a way that reflects Standard English morphology and syntax, thereby offering visual access to its formal organisation (Stryker et al., 2015). SignWriting, by contrast, functions as a practical writing system for sign languages, using structured graphical symbols and systematic conventions to represent handshape, movement, location, and other sign

parameters (da Rocha Costa & Dimuro, 2002; Thiessen, 2011). The following discussion clarifies their distinct roles within the pedagogical design logic of the VLO.

Signing Exact English (SEE) as Visual Grammar Access

Because early written English learning often requires explicit visual support, Signing Exact English (SEE) is incorporated in this project as a constrained pedagogical scaffold rather than as a language; as Rendel et al. (2018) emphasise, "S.E.E. is not a language; it is an invented system that encodes English" (p. 25). Its role is strictly task-bound: to make written English forms more visually legible for learners—for example, by highlighting selected function words and inflectional endings, and by supporting vocabulary recognition through consistent sign–word alignment.[1] Importantly, SEE is always framed through LSC-led explanation: LSC is the primary language of access and meaning-making, while SEE is used as an instructional bridge in short Pre-A1/A1 micro-tasks to reduce ambiguity and strengthen noticing of targeted English forms (Stryker et al., 2015).

This design choice responds to a well-described access problem in English literacy for Deaf learners: key grammatical elements can be auditorily low-salience and therefore difficult to perceive through speech and speechreading alone. Stryker et al. note that Deaf and Hard-of-Hearing learners cannot always hear components of English such as pronouns, articles and bound morphemes (Stryker et al., 2015). In instructional terms, SEE can support a controlled, word-by-word alignment—not as an ideology, but as a form-focused scaffold—so that learners can visually attend to grammatical markers that are easily missed in text-heavy explanations,

[1] Rendel et al. (2018) note that SEE manual forms overlap with widely disseminated sign lexicons (e.g., the early SEE "yellow book") and that "roughly 75% of the signs are common to ASL, S.E.E., and PSE/CASE" (p. 20). This overlap is mentioned only as contextual background: it does not imply that SEE is treated as a community language in the VLO, where LSC remains the instructional language.

consistent with SEE's criterion of "one sign for one English free morpheme or 'word'" and its aim of making "words and word parts (i.e., bound morphemes) … visually obvious" (Rendel et al., 2018, p. 20). In cognitive terms, this controlled alignment is intended to increase noticing of low-salience grammatical morphemes that may be overlooked in print-only instruction. Here, the project's position is deliberately narrow: SEE is used to foreground selected English forms when that visual cueing can support accuracy and confidence in brief written tasks, while interpretive access and metalinguistic explanation remain grounded in LSC (Stryker et al., 2015, pp. 3–4).

Figure 1

Visual Representation of English Morphemes Using Signing Exact English (SEE)

THE	**BOOK**	**IS**	**INTEREST**	**-ING**
T-handshape: palm-in; twist (forearm rotation) to palm-out; no contact; no spatial travel.	Both hands (5-handshape): palms together (palm-to-palm); hands open/rotate outward to end palms-up; no spatial travel.	I-handshape: index finger touches the chin; then moves straight forward while maintaining the handshape.	Both hands (5 → 8): 5-hands with thumb and middle finger contacting the chest (one hand above the other); both hands move forward while closing into 8-hands; end palm-in.	I-handshape: palm-in; moves in a slight downward arc to the right while twisting; ends palm-out.

Note. The figure illustrates how Signing Exact English (SEE) makes visible morphosyntactic elements of written English that do not have direct lexical equivalents in Colombian Sign Language (LSC). In LSC, *The book is interesting* would typically be expressed in a more condensed form (e.g., BOOK… INTEREST…), without explicit markers for articles, the copula, or inflectional suffixes such as –ing. SEE does not replace LSC; rather, it serves as a visual

scaffold that supports form–meaning mapping by rendering relevant grammatical morphemes perceptible during early language learning (Gustason et al., 1993). Handshape descriptions are included for documentation clarity only. This figure provides the literature-based design rationale; detailed VLO specifications appear in Research Design.

SignWriting as a Sign-Based Writing System and Literacy Bridge

SignWriting, by contrast, offers a way to represent signs in a stable written form. It is defined as "a practical writing system for deaf sign languages… [with] intuitive graphical-schematic symbols… and… simple rules… to represent signs" (da Rocha Costa & Dimuro, 2002, p. 202). From a linguistic standpoint, signed messages are not reducible to hand movements alone: signs integrate "handshape, orientation, place of articulation, movement, and non-manual components" (Ineichen, 2025, pp. 9, 47–48; Oviedo, 2001, pp. 56–64).

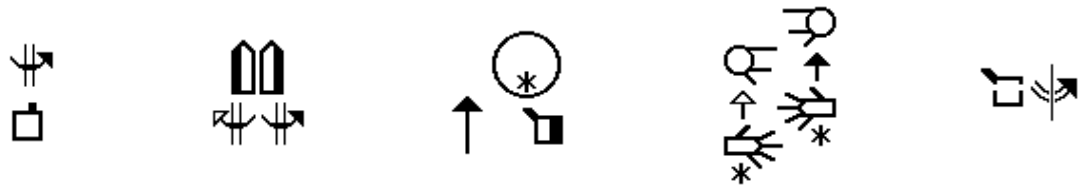
In that sense, one reason SignWriting is pedagogically attractive is that it is explicitly designed to encode the multimodal structure of signing; as Ineichen (2025) explains, it "encodes various aspects of signing … in a spatially intuitive and compact manner" (pp. 47–48), and it has been argued that even "complicated facial expressions or mouth movements can be relatively easily written" (Thiessen, 2011, p. 151). Because its function is representational rather than tied to a single community language, it can, in principle, be adapted to encode different signed systems: SignWriting "can record not just one, but any, signed language", and "the transcriber need not know the language being transcribed" (Martin, 2007, p. 6). Consistently, Sutton describes SignWriting as a system that "can be used to write any sign language in the world" (Sutton, 2011, as cited in Galea, 2014, p. 29).

Within the VLO, SignWriting functions as a stabilising visual reference that complements sign-first mediation during brief, self-paced literacy tasks. In the VLO,

SignWriting is positioned as a visual anchor that supports the sign–text relationship, especially when learners need to revisit meaning without repeatedly replaying video. This matters pedagogically in short literacy micro-tasks because a writing system—unlike an ephemeral signed performance—supports retention and return: it is used “for the purpose of communicating and remembering the meaning” of a linguistic event (van der Hulst & Channon, 2010, as cited in Galea, 2014, p. 99). In practical terms, SignWriting can stabilise access to a signed message while learners attend to the corresponding English written form, reducing the interpretive back-and-forth across modalities. Notably, SignWriting is not treated here as merely theoretical: SignWriting textbooks, newspapers, literature, and dictionaries are already being published (Ineichen, 2025), which supports its feasibility as a durable reference format rather than a one-off transcription tool.

Figure 2

SignWriting as a Writing System for Representing Signed Language Structure



THE	BOOK	IS	INTEREST-	-ING
Handshape: thumb held between the index and middle fingers. **Orientation:** initial palm-in. **Movement:** forearm rotation (twist) to palm-out; **Contact:** none; **Displacement:** none.	**Handshape:** both hands in Flat Hand. **Orientation:** palms in contact and rotate to end palm-up. **Movement:** rotation only (no spatial travel).	**Handshape:** one hand in little finger extended. **Contact:** little finger touches the chin. **Orientation:** palm-left. **Movement:** straight forward from the contact position, maintaining the handshape.	**Handshape:** both hands with five fingers spread. **Contact (initial):** chest contact with thumb and middle finger. **Movement:** both hands move forward in parallel. **Contact (final):** thumb-to-middle-finger contact between both hands in front of the body.	**Handshape:** little finger extended. **Orientation:** initial palm-up. **Movement:** curved path to the right with simultaneous forearm rotation. **Orientation (final):** palm-down.

Note. SignWriting is a visual writing system that represents the phonological and grammatical components of signed languages—handshape, movement, location, spatial relations, and non-manual features—through standardized graphic symbols (Sutton, 2014, 2025). In the VLO, it functions as a stabilising visual resource that allows signs to be revisited and compared over time. In the example *THE BOOK IS INTEREST-ING*, SignWriting makes individual sign components and their sequential organisation visually explicit, supporting recall and form–meaning alignment as learners transition from sign-based comprehension to written English. Handshape descriptions are included for reader clarity and do not imply phonological transcription. This figure provides the literature-based design rationale; detailed VLO specifications are presented in Research Design.

Importantly, the VLO does not assume participants are already fluent in SignWriting; instead, the design introduces it gradually as a light scaffold, always under LSC-led explanation and only insofar as it strengthens the sign–print connection.

Both tools (SEE and SignWriting), in different ways, operationalise the broader principle that Deaf learners often benefit from visually explicit mediation when building literacy in an additional language. While some supporting evidence is frequently drawn from younger learners, the rationale is not inherently age-bound: what must remain explicit is that the visual-mediation claim should be interpreted as a pedagogical design principle to be verified and refined in adult contexts, rather than as a fixed developmental assumption.

Alongside these visual mediation tools, writing-support technologies are relevant to the extent that they lower access barriers and reduce frustration during short, form-focused writing tasks without displacing learners' own meaning-making. Chomicz (2025) found that using such tools enhanced participants' vocabulary, grammar, coherence, and writing confidence in a study involving Deaf learners. The study does, however, caution against over-reliance, pointing out that it may impede the development of autonomous language skills and that digital tools should be used to enhance rather than replace active participation in the learning process (Chomicz, 2025). This balanced perspective informs the current project's choice to employ digital aids like dictionaries, prompts, and glossaries as useful but non-replacing resources.

Translanguaging, Sign-First Mediation, and Teacher LSC Proficiency

In this section, translanguaging is adopted as a conceptual lens to clarify why sign-first mediation should be understood not as an accessibility add-on, but as a pedagogical orientation for Deaf learners engaging with written English in digitally mediated contexts. Adigun et al. (2025) describe translanguaging as an inclusive fulcrum in Deaf education that has the potential

to reframe learners' repertoires as resources rather than deficiencies. Similarly, Wolbers et al. (2023) argue that translanguaging should be grounded in an asset-orientated view of language and learners, encouraging students to mobilise their full communicative repertoires in meaning-making. At the same time, they caution against treating translanguaging as a generic inclusion label, noting that it does not automatically secure equitable learning and may even lead to fragmented language experiences when semiotic resources are not carefully coordinated across space and time.

Taken together, these claims—both enabling and cautionary—are central to this thesis. Translanguaging is therefore invoked to justify sign-led instructional mediation for Deaf LSC users, while also underscoring that such mediation must be deliberately designed, coherently orchestrated, and pedagogically accountable.

Translanguaging in Deaf Education: Framework and Limits

A useful starting point is Wolbers et al.'s (2023) Translanguaging Framework for Deaf Education (TFDE), which re-theorises pedagogy in Deaf education by encouraging educators to adopt an asset-orientated view of language use and learners' communicative repertoires. It emphasises treating learners' communicative repertoires as the starting point for instruction rather than positioning them as deficits. This perspective holds that the framework recognises a range of communicative practices, including signed language, print literacy strategies, and embodied semiotics, as legitimate ways to create meaning and supports multimodal and multilingual communicative processes in Deaf education (Wolbers et al., 2023). For the present thesis, TFDE provides a defensible rationale for treating sign-first mediation as a learning condition rather than an optional accommodation, because it centres instruction on Deaf learners' accessible repertoires and the pedagogical coordination of those resources.

The synthesis work emphasises that translanguaging is increasingly recognised in Deaf education as a means to enhance language development, particularly when employed through multimodal approaches rather than designs limited to a single modality. Adigun et al. (2025) describe translanguaging as an inclusive fulcrum in Deaf education in a systematic review, suggesting that it can improve Deaf students' language skills when implemented through multimodal strategies. Collectively, this review and the Translanguaging Framework for Deaf Education (TFDE) advocate for viewing translanguaging as a cohesive pedagogical approach rooted in asset-based, multimodal meaning-making (Adigun et al., 2025; Wolbers et al., 2023), rather than merely a rhetorical term associated with accessibility measures.

However, Deaf education scholarship also stresses an important boundary condition: translanguaging is not automatically inclusive by virtue of being mixed. Wolbers et al. (2023) specifically caution that when semiotic resources are not coordinated in both space and time, translanguaging may result in a fragmented language experience and does not ensure an inclusive experience for learners. Swanwick (2017) approaches translanguaging with a similar caution, asking how—and under what conditions—it can genuinely enhance learning and teaching in deaf education. She also cautions that uncritical combinations of spoken and signed language may generate pedagogical difficulties rather than address them. In this sense, translanguaging becomes constructive only when it is deliberately coordinated to protect Deaf learners’ access to meaning and participation. This is the exact design-sensitive caution Swanwick highlights, and TFDE reiterates when it calls for avoiding pitfalls that could cause harm if translanguaging is implemented improperly (Wolbers et al., 2023).

Finally, this conditional, design-aware stance is consistent with broader theoretical accounts that treat translanguaging as a practical theory of language and communication rather

than superficial code alternation. Li (2017) frames translanguaging as a view that reconceptualises language as a multilingual, multisemiotic repertoire and emphasises meaning-making that can transcend boundaries between named languages and other semiotic systems. This theoretical anchor helps keep the concept analytically focused while allowing it to align with Deaf education frameworks that prioritise multimodal repertoires and carefully coordinated pedagogical mediation (Li, 2017; Wolbers et al., 2023).

Teacher LSC Proficiency in Sign-First Mediation

Within Deaf and Hard-of-Hearing English learning, the literature consistently suggests that interpreter provision—while necessary in many settings—does not by itself satisfy the full pedagogical demands of language teaching. In interpreted instruction, access is often gained through a structurally indirect interaction where a third party mediates the teacher's instructional strategies, feedback, and moment-by-moment contingencies. According to research, role ambiguity may arise when educators fail to recognise the unique responsibilities of Deaf teachers and interpreters (Guynes & Wood, 2024). This problem is significant because teaching languages requires not only the transfer of knowledge but also the ability of the teacher to scaffold student work in ways that support emergent language development, as well as timely formative feedback and mutual meaning negotiation.

From an institutional perspective, interpreter-mediated access can expand into role substitution rather than role complementarity. In remote university contexts, Castañeda Villamizar and Palomino Solera (2025) warn against “assigning the interpreter functions beyond their professional profile, turning them into the Deaf student’s support and advisor” (p. 38; author’s translation). Read as an institutional diagnosis, this warning implies that interpreters are sometimes positioned as the default pedagogical interface when teaching staff are not prepared to

sustain direct instructional interaction. Consistent with that reading, the authors add that “another urgent task concern training teaching staff, since many of these professionals across educational levels lack specific preparation to work effectively with Deaf students and to collaborate with interpreters in the classroom” (p. 40, author’s translation). Together, these claims support a structural point in this thesis: interpreters may remain essential for access, yet the pedagogical responsibilities of language instruction—and accountability for learning design—cannot be transferred to interpretation without diminishing instructional coherence.

A related limitation is that interpreted education can unintentionally position the interpreter as the *de facto* language model, even though interpreters are not tasked or trained to function as the primary pedagogical agent. Guynes and Wood (2024) emphasise that the educational interpreter is primary, often the only, sign language model for many Deaf students. Yet they also warn that, under business-as-usual conditions, ensuring high-quality access at scale is fragile; they characterise the situation as one in which “qualified educational interpreting services seems nearly impossible” (p. 279). Read together, these points support the claim that interpreter provision can become a structural dependency: it may secure minimal access while leaving the instructional relationship insufficiently sign-led for robust language pedagogy.

Complementary evidence from the same remote interpreting context highlights a second, related gap: implementation is often under-specified at the policy level even when interpreter provision is formally guaranteed. Castañeda Villamizar and Palomino Solera (2025) note that regulations may ensure the presence of interpreters but frequently do not define the conditions required for effective implementation. Within this under-specification, teacher preparedness becomes a practical vulnerability in everyday practice. Many instructors lack specific preparation for working effectively with Deaf students and collaborating with interpreters (Castañeda

Villamizar & Palomino Solera, 2025). For a thesis centred on Deaf learners' access to written English learning through sign-led mediation, the implication is straightforward: interpreter availability alone is not a sufficient proxy for pedagogical quality. Instructional coherence depends on who holds pedagogical authority, how interaction is structured, and whether sign-led mediation is embedded within the learning ecology.

Studies of communicative practices in Deaf education underline the importance of teachers' fluency in a signed language for effective sign-mediated instruction. In a study of writing conferences, Holcomb et al. (2025) found significant differences in participation and interactional dynamics between interactions held in spoken English and American Sign Language (ASL). ASL conferences were more frequently student-centred, with teachers clearing up misconceptions and directly addressing students' contributions to foster a more dialogic exchange. Conversely, student participation in spoken language conferences was lower, and fewer attempts were made to address communication breakdowns. These findings suggest that interactional practices such as clarification, elaboration prompts, and sign-led scaffolding play an important role in making instruction accessible, particularly for learners developing written language skills.

Evidence from a university-level English context further illustrates this issue at the tertiary level. Abata Checa and Proaño León (2024) describe situations in which teachers lacked proficiency in sign language, a limitation that constrained direct communication and led to sustained reliance on interpreters throughout instruction. They consequently argue for the importance of training teachers in sign language to strengthen pedagogical effectiveness and interaction.

Within this thesis, the implication is not that interpreters are dispensable, but that sign-first mediation achieves pedagogical coherence when the instructional voice itself is sign-led. In practical terms, this means that teacher proficiency in LSC—or its functional equivalent through carefully planned and recorded LSC-led instruction—cannot be treated as an optional enhancement. Rather, it is structurally embedded in what inclusive language pedagogy requires.

Operationalising Pedagogical Translanguaging Inside a VLO

Because the intervention is a Virtual Learning Object (VLO), teacher presence is operationalised through recorded LSC explanations, structured feedback elements, and stable signed mediation embedded in the resource. This reasoning is consistent with Cenoz and Gorter's (2021) understanding of pedagogical translanguaging, which refers to forms of classroom instruction deliberately organised by the teacher through planned strategies that draw on students' resources from their whole linguistic repertoire. In a VLO, that planned dimension is enacted through design choices—sequencing, prompts, feedback routines, and stable multimodal cues—rather than through spontaneous alternation.

This planned orchestration becomes even more consequential in mediated environments, because meaning-making is shaped not only by language choice but also by the stability and coordination of multimodal cues across time and platform constraints. In this respect, Sindoni, Ho, and Li (2025) underscore that "the choices parents make are not solely shaped by platform affordances; instead, they draw from a variational range of semiotic resources that are socially and culturally meaningful" (p. 1). Building on this perspective, Sindoni et al. (2025) conceptualise translanguaging in mediated action as the coordinated mobilisation of semiotic, linguistic, and technological resources within digital environments. The VLO's instructional architecture operationalises this principle pedagogically by organising LSC explanations, written

prompts, visual anchors, and feedback loops in a stable semiotic configuration. As a result, learners encounter consistent meaning-making pathways that can be revisited across interactions, rather than needing to reconstruct meaning from scattered cues each time.

Accordingly, translanguaging in this VLO is not treated as a random mixture of codes. It is conceptualised as a structured process in which LSC-led mediation and emergent written English are deliberately coordinated to support early A1 engagement, while SEE and SignWriting function as visual bridges within tightly scoped micro-tasks. This view aligns with the argument that translanguaging extends beyond surface code alternation. Putra et al. (2025) emphasise that pedagogical translanguaging involves the deliberate construction of a translanguaging space, rather than simple code-switching. They further explain that teacher-led pedagogical translanguaging can help reduce extraneous cognitive load for EFL learners by structuring this space pedagogically. Similarly, Zhou et al. (2025) describe teachers as learning designers who shape experiences that promote agency through collaborative, multimodal, and multilingual practices. This perspective aligns with design-based approaches to learning design, where instructional arrangements are intentionally engineered. In the present thesis, this design logic is operational: translanguaging is treated as planned pedagogical coordination, rather than incidental alternation, because the aim is to make sign-led mediation and early written English engagement reliably learnable across repeated VLO interactions.

Lastly, research from online English courses indicates that when pedagogical design and technical quality are in sync, VLOs can enhance a sense of teaching presence. According to Tamayo-Cano et al.'s (2025) study, students found that videos, texts, and podcasts helped them learn English, and they appreciated the automatic feedback in interactive exercises for helping them identify errors. These findings are especially pertinent to Deaf learners working across

multiple modalities. They indicate that translanguaging within a VLO needs to operate as a coordinated mediation process—carefully planned in pedagogical terms and supported by stable technological conditions—so that meaning-making remains clear and accessible.

State of the Art Synthesis

Across the empirical studies and institutional orientations reviewed, four converging lines of evidence define the design problem addressed in this thesis. First, although Colombian policy recognises LSC and frames inclusion as an institutional obligation, implementation in higher education remains uneven; in this context, the foreign-language requirement risks becoming misaligned with Deaf learners' access conditions unless it is adapted through Deaf-sensitive, visually mediated pathways (Instituto Nacional para Sordos, 2022; Ministerio de Educación Nacional, 2013). Second, hybrid and virtual environments frequently reproduce accessibility barriers because visual language access is not consistently treated as a core pedagogical condition (e.g., visibility, lighting, screen layout, and interactional legibility), even when access is nominally provided through general accommodations (Gudoniene et al., 2025; Ministerio de Tecnologías de la Información y las Comunicaciones (MinTIC), 2020; Percival et al., 2025; World Wide Web Consortium (W3C), 2024, 2025). Third, Deaf learners' reported preferences and practices point to a stable design implication: sign-led, video-forward, multimodal resources—often accessed via smartphones—are experienced as more usable for comprehension and participation than text-heavy or audio-dependent formats (Yessengaliyev et al., 2025). Fourth, evidence suggests that written English development in Deaf and Hard-of-Hearing contexts is better supported when the learning ecology makes linguistic form visually inspectable and revisitable; in this respect, SEE, SignWriting, and writing-support technologies are defensible as scaffolds when they remain pedagogically bounded, transparently explained

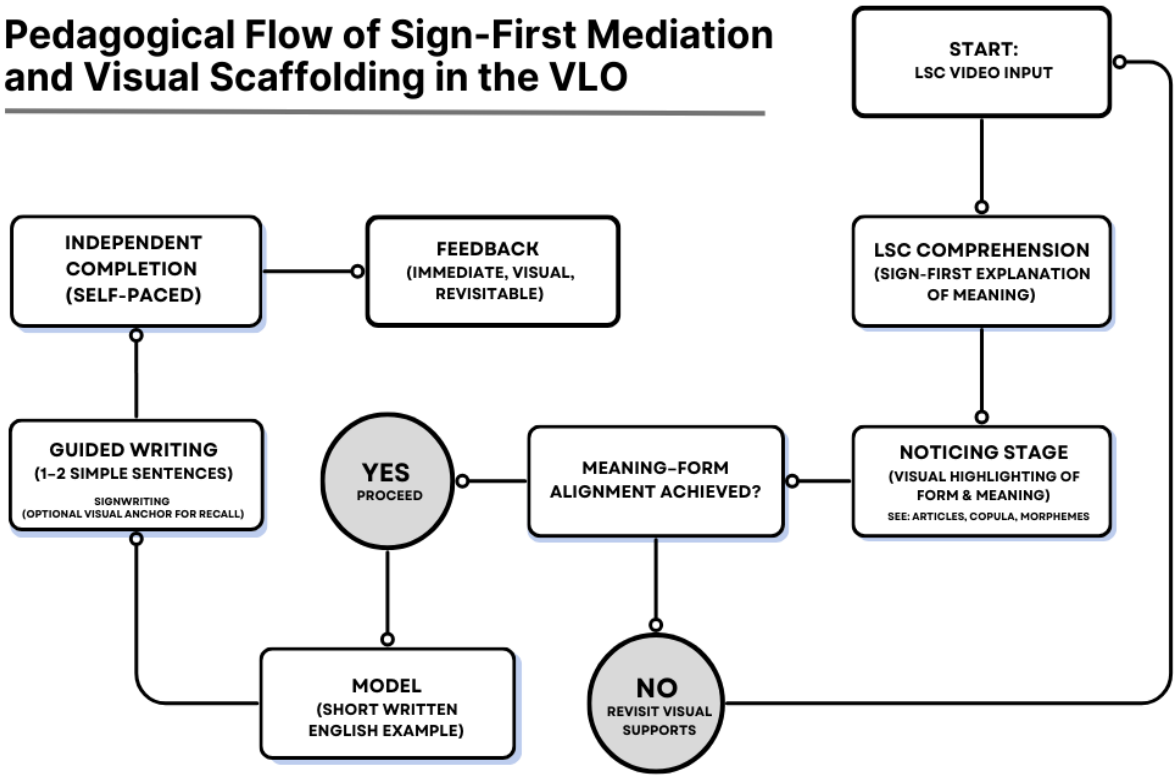
through LSC, and orientated toward strengthening—not replacing—independent meaning-making (Chomicz, 2025; H. Dostal et al., 2024; Ineichen, 2025; Rendel et al., 2018; Stryker et al., 2015).

Under these conditions, translanguaging is better seen as a matter of coordinating semiotic resources with intention, rather than simply combining codes. The literature reviewed does not treat sign-first mediation as a technical adjustment for access alone. Instead, it frames it as a pedagogical stance that places responsibility on instruction itself. This means paying attention to how resources are coordinated across space and time and ensuring that teaching presence remains sign-led, rather than drifting toward a reliance on interpreters as substitute instructional figures (Cenoz & Gorter, 2021; Swanwick, 2017; Wolbers et al., 2023). This orientation manifests itself practically in a VLO: LSC explanations are consistent, prompts follow a purposeful order, visual anchors recur, and feedback is structured to allow learners to revisit it as needed throughout repeated interactions (Putra et al., 2025; Tamayo-Cano et al., 2025; Zhou et al., 2025).

Seen in this light, the State of the Art justifies an intervention that is LSC-led, visually explicit, and attentive to mobile access, focused on early (Pre-A1/A1) written English engagement within UNAD's institutional conditions. These priorities are translated into UDL-informed design decisions and CEFR Pre-A1/A1 alignment (Council of Europe, 2020). The design is then examined through a DBR-orientated mixed-methods pilot, with attention to learners' reported experience and their perceptions of pedagogical value.

Figure 3

Sign-First Micro-Mediation Sequence for Guided Written Production in the VLO



Note. This flowchart summarises the pedagogical logic of the VLO rather than a technical system process. It represents a sign-first mediation cycle in which Colombian Sign Language (LSC) provides primary access to meaning, followed by a noticing stage supported by visual scaffolds such as Signing Exact English (SEE). Decision points reflect learners' perceived meaning–form alignment and trigger re-mediation through visual supports (e.g., replay, cues, worked examples) rather than error correction. SignWriting may serve as an optional visual anchor to support recall during guided writing. The cycle emphasises self-regulated task completion through immediate, visual, and revisitable feedback. The figure functions as a literature-based design rationale; detailed VLO specifications and operational indicators are presented in the Research Design.

Theoretical Framework

Having established the design problem and the evidence base in the preceding section, this theoretical framework clarifies the conceptual lenses that justify the VLO's sign-first, multimodal orientation, and that structure how participants' reported experience is interpreted within a pilot DBR logic. The theoretical framework delineates the main conceptual lenses that inform the design of the VLO and the interpretation of participants' reported experience during a pilot evaluation: (a) the CEFR's action-orientated and mediation-focused approach, including Pre-A1/A1 descriptors; (b) plurilingual competence and translanguaging in Deaf education; (c) Universal Design for Learning and multimodal learning; and (d) Design-Based Research and mixed-methods integration as methodological frameworks.

CEFR: Action-Orientated Approach, Mediation, and Pre-A1/A1

The present study adopts the CEFR's action-orientated approach, which conceptualises language users/learners as social agents who mobilise competences and resources to accomplish meaningful tasks in context (Council of Europe, 2020). The Companion Volume highlights that this orientation "broadens the perspective of language education" through its vision of the user/learner as a social agent and through the inclusion of mediation and plurilingual/pluricultural competences (Council of Europe, 2020).

Mediation occupies a central position in this framework. Building on the CEFR's earlier formulation, the Companion Volume conceptualises mediation as an activity in which the language user or learner acts as an intermediary, not primarily to convey personal meanings but to enable communication between others. The construct is further developed through an expanded set of mediation descriptors (Council of Europe, 2020, pp. 90–91). Since mediation may entail switching between languages, varieties, or modalities and building bridges across

them—for instance, switching between spoken and signed discourse—this interpretation of mediation is consistent with cross-modal meaning-making (Council of Europe, 2020, pp. 91–92). In applied terms, Kremmel et al. explicitly note that a mediator may translate a written text into another language "in speech, sign or writing", and that mediation constructs may require different operationalizations depending on whether the interaction involves spoken, signed, or written forms (Kremmel et al., 2023, p. 76). In the VLO, this is operationalised as sign-to-text mediation micro-tasks in which LSC video segments and visual scaffolds support learners in producing very short English phrases and sentences.

For Deaf university students beginning English as an additional language, Pre-A1/A1 is especially relevant because the Companion Volume frames A1 as the lowest level of "generative language use" (beyond a finite rehearsed repertoire), and it also clarifies that beginners may still accomplish "a range of specific tasks" using "a very restricted range of language", with objectives that can be scaled below Level A1 (Council of Europe, 2020, p. 37). Illustrative tasks at this stage include filling in uncomplicated forms and writing very short, simple messages (Council of Europe, 2020, p. 37).

Accordingly, Pre-A1/A1 descriptors are used here as a design compass for task selection and for clarifying what learners are being invited to do at the earliest stages. Finally, the Companion Volume notes that many descriptors were written in a modality-neutral way and that some were modified to better accommodate sign languages, supporting the use of CEFR constructs in Deaf sign-first designs (Council of Europe, 2020, p. 143).

Plurilingual Competence and Translanguaging in Deaf Education

The CEFR's concept of plurilingual competence treats an individual's languages as a single, dynamic repertoire rather than as compartmentalized systems. In this view, users draw on

their integrated resources “in order to accomplish tasks”, including paralinguistic resources such as gesture and facial expression (Council of Europe, 2020, p. 30). For Deaf students in higher education learning English as an additional language, this framing legitimizes sign-led meaning-making and the strategic use of multimodal resources—such as mouthing, fingerspelling, and visually anchored paraphrase—during written English learning, not as deviation, but as repertoire-based task accomplishment.

Work in Deaf education has increasingly approached translanguaging as pedagogically meaningful when it is deliberately structured and grounded in ethical considerations. In this vein, Adigun et al. (2025) characterise translanguaging as an inclusive fulcrum and suggest that multimodal approaches may contribute to strengthening learners’ language development. At the same time, translanguaging is not treated here as a celebratory formula. In Deaf education research, it is more accurately understood as a pedagogical orientation that requires direction, boundaries, and attentiveness to power relations. Wolbers et al. (2023) frame translanguaging as explicitly asset-orientated, yet their framework also makes clear that access alone does not guarantee equitable learning unless semiotic resources are deliberately coordinated for comprehension and engagement (see also Rezvani et al., 2025).

In this thesis, plurilingual competence provides the CEFR-aligned rationale for recognising learners’ integrated repertoires, while translanguaging functions as a pedagogical lens for explaining how the VLO links LSC-first access with emerging written English. In practice, additional resources are introduced as scaffolds to support form awareness and meaning-making, rather than as competing languages of power. Sign-first mediation sets the instructional direction (Rezvani et al., 2025; Sindoni et al., 2025; Zhou et al., 2025).

Universal Design for Learning (UDL) and Multimodal Learning

Universal Design for Learning (UDL) was adopted as the guiding accessibility framework for the design and evaluation of the VLO. In CAST's UDL Guidelines version 3.0, UDL promotes modifying the learning environment so that barriers to participation are reduced and learners can engage in rigorous and meaningful learning (CAST, 2024a). In this thesis, that principle is operationalised by designing the VLO around predictable variability rather than treating access needs as after-the-fact accommodations, ensuring that participation and evidence of learning remain feasible across diverse learner profiles. The 3.0 update, released in July 2024, also emphasises addressing structural barriers such as systemic bias and exclusion and explicitly frames learners' identities as part of variability (CAST, 2024a). This emphasis aligns with the project's commitment to sign-first, visually mediated access, and culturally responsive design choices.

Consistent with CAST's framing, the VLO follows the three UDL principles as an integrated design logic: engagement addresses the why of learning, representation the what, and action and expression the how (CAST, 2024a). The overall goal is learner agency—purposeful and reflective, resourceful and authentic, and strategic and action-orientated—so that learners can actively make choices in service of learning goals (CAST, 2024a).

At the level of implementation, multiple means of representation were enacted through (a) LSC video segments for explanation and guidance, (b) written English input as the target literacy channel, (c) selectively deployed SEE-based markers to foreground targeted grammatical and morphological forms in written English, and (d) SignWriting as an optional visual cueing resource to support revisiting during independent work (CAST, 2024a, 2024b; Rendel et al., 2018; Stryker et al., 2015). Multiple means of action and expression were operationalised

through typed production micro-tasks, short structured activities for form-focused work, and optional sign-based rehearsal routines embedded in the task flow (CAST, 2024a, 2024b). Finally, multiple means of engagement were supported through clear micro-goals, predictable task cycles, and embedded guidance designed to sustain effort and persistence during self-paced interaction. This design choice is consistent with research on online learning that highlights the importance of clear weekly structure and explicit guidance that learners can revisit as needed (Seymour, 2024).

Multimedia Learning and Cognitive Load in Sign-First VLOs (Design Rationales)

The implementation choices described above should be understood as design considerations rather than claims about learning outcomes. Studies on self-paced multimedia learning show that presenting content in short segments can support comprehension (Liu, 2024). This evidence supports the use of short sign videos, limited on-screen text, and predictable activity cycles as accessibility-oriented design constraints that help reduce unnecessary processing demands during independent study.

This rationale becomes more consequential in Deaf and Hard-of-Hearing learning conditions where the visual channel carries the main access burden. Participants in a recent study noted visual overload as a significant obstacle when interacting with learning materials in a foreign-language setting with Deaf and Hard-of-Hearing learners (Olszak & Borowicz, 2025). This supports conservative interface choices like clear screens, transparent navigation, replayability, and pacing control. The availability of support also influences feasibility in Deaf higher education contexts. For instance, Percival et al. (2025) point out that interpreters are crucial in facilitating participation, highlighting the significance of stable, controllable, and visually readable materials when human mediation is unpredictable. Finally, disability-inclusive

online learning literature frames UDL as structurally relevant to equity. Utami et al. (2025) argue that UDL principles can function as a foundational framework for promoting equitable access to education (p. 94). This perspective supports treating accessibility-focused structure and flexibility as design-relevant conditions rather than cosmetic preferences.

Visual Scaffolds for Self-Regulated Learning (SEE and SignWriting)

Within this sign-first design, rehearsal and scaffolding are framed as supports for self-regulated task completion (planning, monitoring, revisiting) rather than as direct measures of Self-Regulated Learning (SRL) gains. The VLO therefore embeds guidance, feedback, and revisitable explanations so that learners can regulate pace and re-access meaning supports while completing tasks independently. In adult Deaf English as a Foreign Language writing contexts, Chomicz (2025) provides compatible evidence for the plausibility of technology-mediated supports. The study reports that technology-supported writing tools were associated with improvements in clarity, coherence, and accuracy in learners' written production (Chomicz, 2025), while also highlighting constraints that justify structured and revisitable scaffolds in adult learning trajectories.

SEE is positioned as a task-bounded form-highlighting scaffold, used selectively to make specific English morphemes and function words more visually inspectable during early writing tasks (Rendel et al., 2018; Stryker et al., 2015). This form-focused orientation is consistent with synthesis evidence indicating that signed-language–based literacy interventions often work by making form available for deliberate attention; Dostal et al. (2025) note that "the incorporation of sign language … appears to improve many facets of literacy learning" (p. 24), which supports the broader rationale for explicit, visually accessible scaffolding when learners must revisit and

inspect form–meaning relations. SignWriting is included as an optional visual cueing resource for revisiting during self-paced work.

Empirical findings support a visual and multimodal orientation in Deaf education. For example, Ramadhani and Hufad (2024) observe that Deaf learners "have a visual learning type, and the use of various learning media can help improve their language acquisition" (p. 185). In this thesis, however, specific interface heuristics (e.g., one-target-per-screen, limited text density, predictable cycles) are justified primarily as accessibility and usability constraints for self-paced, video-forward learning environments rather than as claims derived from a single study or population. This positioning aligns with multimedia evidence on structured presentation conditions (Liu, 2024) and with Deaf -focused evidence emphasising both the risk of visual overload (Olszak & Borowicz, 2025) and the role of access conditions in higher-education participation and feasibility (Percival et al., 2025).

Design-Based Research (DBR)

As the preceding framework establishes the need for Deaf-accessible, visually mediated English learning designs in authentic higher-education ecologies, the methodological stance must be coherent with intervention work conducted under real constraints. DBR is introduced here not as a procedural component, but as a theoretical orientation that legitimises research-through-design and bounded pilot cycles as sources of warranted, design-relevant knowledge.

DBR as Research-Through-Design: Rationale and Fit.

Design-Based Research (DBR) is adopted as the overarching methodological orientation because this thesis does not merely describe a pedagogical-access problem; it develops and studies a practical intervention under authentic higher-education conditions. In this sense, DBR is not "evaluation appended to a product," but inquiry conducted through design. Schmalenbach

and Ashouri (2025) capture this premise directly: “Research happens through design and cannot be separated from it” (p. 4). In technology-mediated learning environments, this stance is especially pertinent because what must be understood is not only whether an innovation “works,” but how it functions in context, under real constraints and real use.

Anchoring the present study’s logic, Wang and Hannafin (2005) define DBR as follows: “Design-based research is a research methodology aimed to improve educational practices through systematic, flexible, and iterative analysis, design, development, and implementation, based upon collaboration among researchers and practitioners in real-world settings, and leading to design principles or theories” (p. 2). This dual-purpose orientation fits a Deaf-accessible VLO where the research contribution is expected to be both practical (a refined intervention) and conceptual (context-sensitive guidance that informs subsequent design).

Core Characteristics: Intervention, Iteration, Context, Collaboration, and Theory

DBR is fundamentally interventionist: it begins with real problems in practice and designs solutions that can be enacted in authentic learning ecologies. DBR operates through iterative cycles involving design, enactment, analysis, and redesign (The Design-Based Research Collective, 2003). This is not a stylistic preference; it reflects an epistemic commitment to learning from enactment. Accordingly, DBR assumes complexity rather than attempting to control it away. Brown (1992) reminds researchers that work in real classrooms involves “an increasing trade-off between experimental control and richness and reality” (p. 152), and that “components are rarely isolatable” (p. 166). In inclusive education designs—where accessibility, multimodality, and pedagogy operate as an integrated system—this complexity is not a limitation to conceal but a reality to manage and report transparently.

DBR is also collaborative and contextually embedded. Wang and Hannafin (2005) explicitly include “collaboration” and “real-world” settings in the core definition (p. 2). Likewise, the Design-Based Research Collective (2003) argue that DBR must account for how designs function in “authentic settings” (p. 5), because enacted interventions are shaped by contextual conditions. This is consequential for Deaf learners in hybrid/virtual university contexts, where accessibility and usability are inseparable from institutional routines, platform constraints, and students’ lived access conditions.

Finally, DBR is simultaneously theory-driven and theory-generating: it is grounded in prior research while also aiming to produce warranted, design-relevant knowledge. In Wang and Hannafin’s (2005) formulation, DBR is expected to lead to “design principles or theories” (p. 2). This thesis adopts that dual aim in a bounded and defensible manner, as clarified below.

Iteration and the Meaning of a Pilot Iteration in DBR

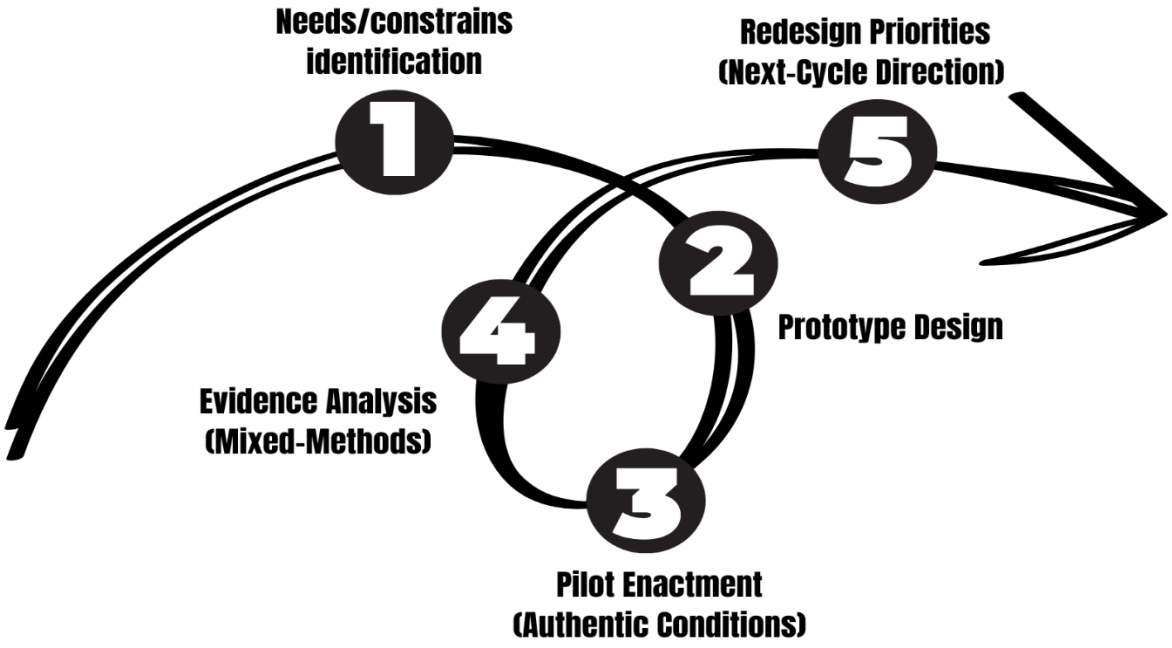
A frequent concern is whether a study can legitimately claim DBR with a limited number of full-scale cycles. Here, it is essential to distinguish (a) DBR’s iterative logic from (b) the practical scope of a single thesis cycle. DBR processes are typically iterative and interconnected rather than strictly linear (Obczovsky et al., 2025), and the literature also highlights the pragmatic necessity of scoping decisions, particularly when determining what aspects of the intervention can be examined within the limited timeframe of a study (Obczovsky et al., 2025, p. 526). In other words, iteration is not reducible to the number of completed cycles; rather, it refers to how enactment evidence is used to refine conjectures, criteria, and redesign priorities.

Accordingly, in this thesis DBR is operationalised as a pilot iteration: a bounded design–enactment–analysis cycle whose primary purpose is to generate design-relevant evidence and a concrete agenda for redesign (rather than to make final effectiveness claims). This scoping is

consistent with DBR reporting realities; for example, Tinoca et al. (2022) note that "it is also common to find studies reporting only one of the intervention cycles" (p. 17). In this sense, the pilot iteration is methodologically legitimate when it clearly demonstrates systematic grounding, enactment-based use of evidence, and traceable decision-making.

Figure 4

DBR Pilot Iteration Scope Map: From Design Evidence to Redesign Priorities



Note. This figure summarises how Design-Based Research (DBR) is operationalised in this thesis as a bounded pilot iteration. The cycle moves from needs/constraints identification to prototype design, then to pilot enactment under authentic conditions, followed by evidence analysis based on mixed-methods design evidence. The final node (redesign priorities) represents the explicit refinement agenda derived from the pilot evidence; it is reported as the next-cycle direction rather than as a completed redesign within the present thesis. This figure functions as an operational scope map that bridges the DBR framework to the study's methods; the enacted

procedures, instruments, and analytic steps are specified in the Research Design. This figure is conceptually based on the DBR cycle described by Fraefel (2014).

Evidence Logic: Design-Relevant Evidence and Mixed-Methods Triangulation

The evaluation logic in DBR is not limited to summative proof; it is orientated to understanding mechanisms, contextual contingencies, and improvement pathways. For that reason, DBR commonly rejects overly narrow evaluative models. Obczovsky et al. (2025) state that "Simple pre–post evaluations are not sufficient to make statements about learning processes or to understand why a design worked or not" (p. 528). Instead, DBR values multi-source evidence connected to enactment. The Design-Based Research Collective (2003) note that DBR "typically triangulates multiple sources and kinds of data" (p. 7), precisely to connect outcomes to the processes and conditions that produced them.

Aligned with this stance, the pilot cycle reported in this thesis is supported by a mixed-methods evidence logic appropriate for accessibility- and usability-sensitive designs. Tinoca et al. (2022) state that "Usually, a DBR approach requires both quantitative and qualitative methods" (p. 1). In the present study, participant-reported experiences are treated as legitimate design evidence because access, usability, and multimodal comprehensibility are inherently experiential and context-dependent in Deaf-access conditions. (The detailed instruments and analytic procedures are presented in the Research Design.)

Rigor, Traceability, and Decision Documentation

Because DBR takes place in complex contexts, rigor depends heavily on transparent design reasoning and traceability. A DBR account describes not only what was built but also the reasoning behind design decisions, how context and theory supported them, and how they were adjusted in light of new information. Obczovsky et al. (2025) explicitly foreground this

requirement, emphasising the importance of "awareness of design decisions as well as their groundings" (p. 523). Within a pilot iteration, such traceability is not secondary reporting; it is part of the research contribution, because it enables warranted claims about how design choices interacted with contextual constraints and user experience.

Expected Outcomes: Refined Intervention and Emerging Design Principles

DBR outcomes are commonly framed in dual terms: (1) a refined intervention usable in practice and (2) theoretical or heuristic contributions that inform future design. In Wang and Hannafin's (2005) definition, DBR is expected to lead to design principles and/or theories. Recent DBR syntheses further underline that articulating design principles can strengthen the transparency of design reasoning; for example, Feulner et al. (2026) report that application of design principles mainly seeks to improve transparency and traceability. In this thesis, the immediate outcome is therefore a set of empirically grounded redesign priorities for a Deaf-accessible VLO under UNAD-like conditions; the secondary outcome is a set of emerging, context-sensitive design implications that may be formulated as provisional design principles to guide subsequent iterations.

DBR Pilot-Cycle Mapping and Scope Statement

Operationally, the DBR pilot iteration reported in this thesis aligns with the design logic through which the VLO was produced: (a) needs and constraints identification in a Deaf higher-education context; (b) design and development of a multimodal VLO; (c) pilot enactment with Deaf students under authentic access conditions; and (d) mixed-methods analysis used to generate design-relevant evidence for refinement. Critically, the pilot evaluation is not positioned as a final verdict of effectiveness. Instead, it functions as the evidence base for redesign—supporting the refinement of design conjectures and criteria and establishing a defensible agenda

for subsequent improvement cycles. The Research Design specifies the enacted procedures, instruments, and analytic steps that operationalise this mapping.

Mixed Methods and Data Integration

The project also adopts a mixed-methods approach. Here, mixed methods is treated not as the simple coexistence of quantitative and qualitative techniques, but as the intentional integration of both strands to address the same design-focused questions and to support more defensible inferences than either strand could generate alone (Johnson & Onwuegbuzie, 2004). This positioning is methodologically orthodox: in applied educational research, mixed methods is strongest when it is built into the heart of the inquiry—especially into the framing of questions, constructs, and interpretive aims—rather than appended as an afterthought. At the same time, contemporary mixed-methods scholarship increasingly treats integration quality as a central criterion of rigor—i.e., whether the study is designed so that integration is possible at the levels of questions, design, methods, results, and interpretation (Fàbregues et al., 2024; Fetters et al., 2013; Guetterman et al., 2015).

Accordingly, the logic for mixing in this thesis is primarily complementarity and expansion: quantitative summaries clarify the distribution of participants' perceptions, while qualitative evidence explains the meanings, conditions, and frictions behind those distributions (Fàbregues et al., 2024; Greene et al., 1989). This is particularly relevant in user-experience and accessibility–usability contexts, where the same numeric trend can reflect very different underlying reasons, and qualitative accounts are often what makes the statistic interpretable rather than merely reportable. Integration is therefore planned a priori through aligned construct decisions and then made visible in reporting through explicit integrative moves (e.g., joint

displays and narrative meta-inferences) that connect patterns across strands (Fetters et al., 2013; Guetterman et al., 2015; Peters & Fàbregues, 2024; Younas et al., 2025).

A more comprehensive understanding of how Deaf students experience the VLO is obtained by combining quantitative methods (e.g., Likert-type items on accessibility, usability, pedagogical organisation, and perceived usefulness) with qualitative evidence (open-ended responses and brief LSC-based comments). Salmona et al. stress that careful design decisions are necessary for mixed-methods research to generate high-quality inquiry (Salmona et al., 2020), and this project operationalises that requirement by making sure that questionnaire domains map directly onto the analytic categories used to interpret participants' explanations. By making it possible to code, summarise, and compare qualitative data with quantitative distributions, Dedoose facilitates integration in practice. Cousins et al. characterise this quantitization capability as both potent and user-friendly (Cousins et al., 2024; SocioCultural Research Consultants, 2025). Crucially, tool-supported integration is viewed as methodological support rather than a replacement for interpretive rigour; quantitative trends are interpreted by clearly connecting them to explanatory evidence, and qualitative meaning-making is maintained rather than reduced to counts.

In this project, mixed-methods integration is used to connect numerical trends (for example, high agreement on clarity or navigation) with explanatory qualitative evidence (why it felt clear, what still caused friction, and what learners want improved). Reporting therefore prioritises inferential transparency: the reader should be able to see exactly how qualitative themes illuminate, nuance, or qualify quantitative distributions, including cases where qualitative comments complicate a seemingly positive trend. This emphasis remains consistent with the project's purpose: the study is orientated to participants' perceptions and interpretations of the

VLO experience, not to demonstrating causal gains in English proficiency. That alignment is deliberate because it fits the research questions and the ethical and practical constraints of a pilot design in an open and distance context.

Conceptual Framework

Finally, by transforming the theoretical lenses into operational constructs and indicators, the conceptual framework arranges the instrument domains, coding categories, and joint displays used in the pilot evaluation. While the theoretical framework explains the main interpretive lenses guiding this study, the conceptual framework explains the constructs and indicators that guide the VLO design, data collection, and analysis, clarifying how these components structure the intervention and its perception-based evaluation. The framework focuses on five key constructs: digital inclusion, mediation, multimodality, accessibility and usability, and perceived support for learning A1 written English.

Core Constructs and their Operationalisation

Detailed operational indicators, item wording, and scoring procedures are presented in the Research Design to keep the literature-based construct definitions distinct from the instrument specifications.

Digital inclusion is defined as the extent to which Deaf LSC users can access, navigate, and meaningfully benefit from the VLO under actual device availability and connectivity conditions. This recognises that inclusion depends not only on access but also on enabling conditions for meaningful participation (e.g., connectivity and devices, user-centred design aligned with accessibility guidance, and support initiatives that build digital skills and confidence) (Lironi & Demofonti, 2024; Ure-de-Oliveira & Bonilla-Algovia, 2025). It is

operationalised using learner-reported barriers and facilitators influencing participation and engagement, as well as access and use indicators (such as device type and connection stability).

Mediation refers to the transformation and relaying of meaning from LSC to written English within Pre-A1/A1-orientated tasks, consistent with the CEFR view of mediation as intermediary meaning-making (rather than primarily expressing one's own meaning) that can involve shuttling across languages and modalities (Council of Europe, 2020, pp. 90–92). In this project, mediation is operationalised through micro-task sequences in which learners move from sign-based comprehension (LSC video) toward short written outputs (phrases or sentences), guided by visual scaffolds (e.g., SEE markers, SignWriting cues, and targeted visual prompts). Importantly, rather than being evaluated as a test result, mediation is seen as a design pathway that students go through and can evaluate based on their stated perceptions of clarity, viability, and utility.

Multimodality, which is defined as the intentional coordination of semiotic resources to prevent fragmented meaning-making rather than a simple accumulation of media, refers to the coordinated orchestration of LSC, written English, SEE markers, SignWriting, images, and icons within the VLO (Wolbers et al., 2023). It is evidenced at the level of screen design (sign-first entry, visual supports, brief written input, consistent iconography) and is further reflected in learners' reported perceptions of clarity, cognitive load, and relevance.

Accessibility and usability refer to how feasible it is for Deaf students to perceive, understand, and interact with the VLO as intended (accessibility), and to the extent to which they can use it to achieve learning tasks with effectiveness, efficiency, and satisfaction in a specified context of use (usability) (International Organisation for Standardization, 2018; World Wide Web Consortium (W3C), 2025). They are captured in the evaluation through Likert-type items

and qualitative comments on concrete aspects such as signer visibility, caption quality, contrast, navigation, pacing, and error recovery, with accessibility indicators aligned to WCAG-orientated criteria and usability indicators aligned to ISO 9241-11:2018 dimensions (International Organisation for Standardization, 2018; World Wide Web Consortium (W3C), 2025).

Perceived support for A1 written English learning is defined as participants' reported sense that the VLO helps them engage with and practice early written English at CEFR Pre-A1/A1 levels (reading, writing, and grammar) in ways that feel understandable, doable, and relevant. This construct is anchored in CEFR Pre-A1/A1 as a task compass, recognising that beginners may still accomplish specific, bounded tasks with a very restricted linguistic repertoire at this stage (Council of Europe, 2020, p. 37). Accordingly, perceived support is captured through self-report ratings and qualitative feedback on usefulness, clarity of explanations, and the perceived value of sign-led and visual scaffolds (LSC, SEE, SignWriting, worked examples) for completing short, simple A1-orientated micro-tasks.

Design Principles for the VLO

These constructs were embedded in concrete design principles applied across the VLO:

Sign-First Entry. Each learning unit began with a concise signed segment that previewed the target structure or function, treating sign as the primary instructional language rather than as an after-the-fact translation, consistent with the view that "sign languages are human languages in their own right" (Council of Europe, 2020, p. 252). *(Operationalised: mediation; multimodality; accessibility.)*

Micro-Mediation Sequence. Activities followed a predictable cycle—LSC comprehension → noticing of key items and patterns → modelled short English text → guided production of one or two simple sentences—consistent with planned pedagogical

translanguaging that strategically mobilises learners' repertoires in instruction (Cenoz & Gorter, 2021). SEE appeared as a visual grammar scaffold when relevant (Rendel et al., 2018; Stryker et al., 2015), while SignWriting appeared as a stabilising cue supporting recall and visual anchoring of signs (da Rocha Costa & Dimuro, 2002; Ineichen, 2025). *(Operationalised: mediation; multimodality; perceived support.)*

One Target per Screen. Each VLO screen presented only one grammatical or lexical pattern (e.g., *be + adjective, there is/there are, can + verb*). This organisation allowed learners to work through the material step by step in a self-paced format (Liu, 2024). It also supported accessibility in Deaf learning contexts, where excessive visual information can create additional processing demands (Olszak & Borowicz, 2025). Presenting one target at a time therefore aligned with UDL principles by keeping the visual input clear and easier to follow (CAST, 2024b). *(Operationalised: accessibility/usability, multimodality, and perceived support.)*

Desktop-First, Mobile-Usable Interface (Constraint-Led). The VLO was created in H5P using Lumi. In practice, these activities are easier to complete on a desktop computer, where the layout remains stable and the text is easier to read. For that reason, the interface was designed mainly for desktop use. At the same time, it can still be used on mobile devices, which many Deaf and Hard-of-Hearing students rely on to access learning materials, particularly through smartphones (Yessengaliyev et al., 2025, p. 28). *(Operationalised: digital inclusion; accessibility/usability.)*

Visibility Standards. Signers were shown with adequate lighting, neutral backgrounds, and consistent framing; text appeared in high contrast and large font; and guidance was provided for hybrid use so that projector and lighting choices did not undermine visual access—an issue captured when a Deaf participant noted, "Some lecturers use a projector and turn off the lights,

and since it’s a visual language, it becomes a challenge” (Percival et al., 2025, p. 10). *(Operationalised: accessibility; usability.)*

Assistive-not-Substitutive Tools. Digital resources such as dictionaries, glossaries, and pattern prompts were added as supplemental materials rather than replacing students' own language engagement. The recommendation to adopt "a balanced approach that incorporates technology as a complement to, rather than a replacement for, foundational language learning practices" is consistent with this choice (Chomicz, 2025, p. 6). Their role in the VLO was to make participation easier and reduce frustration during tasks, while still allowing learners to remain actively involved in the learning process. *(Operationalised: perceived support; usability; digital inclusion.)*

Feedback and Reflection. Learners received quick, instantaneous, and visually accessible feedback, and they were occasionally prompted to consider clarity and strategy. As a reminder that signed-language proficiency is directly related to effective sign-first instruction, this VLO operationalised teaching presence and feedback through recorded sign-led explanations and embedded cues (Mariana, 2025). *(Operationalised: perceived support; usability; mediation.)*

Mechanism of Action and Anticipated Outcomes

Conceptually, the VLO was hypothesized to support engagement in early Pre-A1/A1 written English practice through the following mechanism:

Input Alignment. Learners received input through LSC videos and visual representations aligned with their primary language access and visual learning pathways, under real conditions of device availability (desktop and mobile) and connectivity typical of open and distance education.

Guided Mediation. Micro-tasks invited learners to move from signed meaning toward short written English outputs, supported by visual scaffolds (including SEE markers for grammar visibility and SignWriting cues where relevant).

Multimodal Orchestration. The interface coordinated sign, text, and imagery to reduce unnecessary processing demands and to make key patterns visually noticeable during self-paced work (e.g., one target per screen and predictable micro-task cycles).

Accessible Feedback. Learners received immediate, visually legible feedback intended to support continuation, adjustment, and persistence during independent task completion.

DBR Refinement. The study collected mixed-methods evidence on accessibility, usability, pedagogical organisation, and perceived usefulness to identify redesign priorities for subsequent iterations, consistent with DBR's "systematic" and "flexible" logic (Wang & Hannafin, 2005, p. 2).

Proximally, the evaluation documented participants' perceived accessibility and usability, as well as their reported clarity and confidence when engaging with Pre-A1/A1 micro-tasks supported by sign-led and multimodal mediation. Distally, the study aimed to contribute design-relevant evidence for more inclusive English learning support for Deaf university students at UNAD and to inform future institutional resources in similar Latin American distance education contexts.

Table 1

Operational Definitions and Where each Construct is Operationalised

Construct	Operational definition	Operationalisation source (Literature Review / Research Design / Instrument)
Accessibility	The extent to which Deaf LSC users can perceive and access VLO content (sign visibility, captions/text legibility, contrast, navigation access) under real device/connectivity conditions.	Literature Review (UDL and WCAG rationale); Research Design (VLO design specifications and visibility standards); Instrument: Likert items and open-ended comments on visibility, captions, readability, and access barriers.
Usability	The degree to which learners can use the VLO effectively and efficiently with satisfaction (clarity, navigation, pacing control, error recovery) to complete micro-tasks.	Literature Review (ISO 9241-11 framing); Research Design (task flow and interface logic); Instrument: Likert items on ease of use and clarity, with qualitative responses on friction points.
Mediation (LSC → written English)	A structured pathway where learners move from sign-based meaning (LSC input) to short written English outputs through guided micro-steps and supports.	Literature Review (CEFR mediation); Research Design (micro-sequence design; mediation map); Instrument: items on clarity and feasibility of the task sequence, with qualitative explanations of how the pathway supported learning.
Multimodality	Planned coordination of LSC video, written English, images/icons, and optional SEE/SignWriting cues so meaning is coherent and revisitable (not fragmented).	Literature Review (multimodal and translanguaging rationale); Research Design (screen design: one target per screen; media coordination); Instrument: items on clarity and cognitive load, with open-ended feedback on multimodal supports.
Sign-first mediation	LSC is the primary instructional channel (not an add-on): each unit begins with LSC explanation that frames meaning before written English practice.	Literature Review (policy and linguistic legitimacy of sign languages); Research Design (VLO sequencing: Start → LSC comprehension); Instrument: items on the

Construct	Operational definition	Operationalisation source (Literature Review / Research Design / Instrument)
		usefulness of LSC explanations, with qualitative comments on sign-led guidance.
SEE (visual grammar cues)	A task-bounded scaffold that makes English function words and bound morphemes visually noticeable (e.g., *the*, *is*, *-ing*) without replacing LSC meaning-making.	Literature Review (SEE section; SEE overview figure); Research Design (placement of SEE in noticing and modelling screens); Instrument: targeted items or prompts on the usefulness of grammar-visibility supports, with open-ended responses.
SignWriting (optional visual anchor)	A stabilising sign-based writing cue that allows signs to be revisited/compared over time, supporting recall and sign–print alignment in self-paced tasks.	Literature Review (SignWriting section; SignWriting overview figure); Research Design (optional support during guided writing and review); Instrument: optional prompt item (e.g., "Did SignWriting help you recall or revisit meaning?"), with qualitative comments.
L3 framing (English as additional language)	English learning is interpreted as an additional language built through LSC access and Spanish literacy resources; implications are sign-led and reading–writing focused (not audio-first).	Literature Review (learner profile and rationale); Research Design (task scope: Pre-A1/A1 writing and reading; no claims regarding oral listening and speaking); Instrument: background items, with an interpretive layer in analysis and meta-inferences.

Research Design

Introduction to the Research Design

This section explains how the study was structured and carried out, tracing the stages from the initial design of the Virtual Learning Object (VLO) to the way data were gathered, integrated, and analysed. In practical terms, the study documented how Deaf university students who use Colombian Sign Language (LSC) experienced a multimodal, sign-led resource designed to facilitate engagement with early A1-orientated written English micro-tasks aligned with the Common European Framework of Reference for Languages (CEFR). Because the project is formative and perception-based, methodological decisions prioritised feasibility and accessibility under the same asynchronous conditions in which participants typically study within UNAD's open and distance education model. Throughout the process, procedures were selected on a fit-for-purpose basis to ensure that the design remained workable and coherent while still addressing the study's focal dimensions of perceived accessibility, perceived usability, and perceived pedagogical value (Cohen et al., 2018, p. 42).

To provide an overview of how the study was organised, Table 2 summarises its main components. The research followed a mixed-methods descriptive design framed within a Design-Based Research (DBR) logic operationalised as a single pilot iteration. In practice, the VLO was designed and shared with learners, evaluated through an accessible instrument, and the resulting evidence was used to define refinement priorities for a subsequent iteration rather than to claim redesign completion within the present study.

The design was informed by preliminary documentation and resource-development records describing Deaf learners' experiences with virtual English materials (see Appendix A). On that basis, the VLO was developed as a fully visual, self-paced learning object bringing

together LSC-led explanations, SEE-supported grammatical visualisations, subtitles, and short animations. These elements were treated as implementation features with direct relevance to accessibility and mediation, particularly in areas where English forms are not transparent for LSC users (e.g., selected pronouns and function words, copular forms of *to be*, and sentence-level linear ordering). The evaluation reported here does not claim to establish learning gains or performance outcomes; rather, it examines how participants perceived the clarity, accessibility, usefulness, and organisation of the resource as experienced under authentic study conditions.

Two methodological priorities shaped the plan. First, it was necessary to document learners' experiences with the VLO under the same asynchronous conditions in which they normally study at UNAD. Second, the data-collection process needed to be genuinely accessible so participants could respond without depending on Spanish literacy mediation or external assistance. For this reason, each questionnaire item was paired with an explanatory video in LSC, and the VLO incorporated SEE-based visual scaffolding to make selected written English features more perceptible.

The combination of quantitative and qualitative evidence made it possible to capture both general tendencies and the nuances behind them. Descriptive statistics were used to summarise patterns in participants' ratings across key aspects of the VLO, while qualitative comments helped clarify how participants explained those ratings—particularly in relation to visual clarity, pacing, navigation, and the perceived usefulness of specific supports.

The project is therefore framed explicitly as a DBR pilot iteration. The VLO is treated as a working prototype; it is evaluated through user-centred feedback. Accordingly, the outcomes of the design process at this stage are reported as design-relevant evidence and refinement priorities

intended to guide a subsequent iteration rather than as confirmation of effectiveness or finalisation of the artefact.

Table 2

Overview of the Research Design

Component	Description
Design Orientation	Mixed-methods descriptive design aligned with a Design-Based Research (DBR) single pilot iteration, emphasising design-relevant evidence and refinement priorities based on learner feedback.
Population & Sampling	A census-style invitation was sent to 54 Deaf UNAD students who use LSC; participation was voluntary; 29 participants (n = 29) completed the evaluation between April and December 2025 (data collection closed on December 22, 2025).
Pedagogical Intervention	VLO *Start the Conversation LSC–EN*, built with Lumi/H5P, integrating LSC-led instruction, SEE-based scaffolding, SignWriting, subtitles, videos, and interactive tasks (see Appendix H and Appendix I)
Data Sources	Accessible Google Forms instrument with 18 Likert items and two open-ended prompts; plus, a small supplementary post-use LSC video dataset (n = 6) (three spontaneous comments and three informal interview-style reflections) used to contextualise and explain questionnaire patterns (see Appendix B).
Instrument Accessibility	LSC video prompts for all items; subtitles and visual scaffolds; clear step-by-step instructions delivered through the VLO environment.
Key Analytic Dimensions	Five analytic dimensions used for reporting and integration: Educational Technology and Accessibility (Q1–Q4), Visual and Bilingual Mediation (Q5–Q8), Pedagogical Principles and Learning Organisation (Q9–Q11), Knowledge Management and Self-Regulation (Q12–Q15), and Comparative Experience and Cultural Relevance (Q16–Q18). These dimensions were also mapped to the four reporting domains required by the evaluation guide where applicable.

Component	Description
Analysis Strategy	Descriptive statistics (frequencies, medians, agreement rates) combined with qualitative thematic coding; integration through triangulation matrices and a joint display (see Appendix G).
Ethical & Accessibility Protocols	No direct identifiers were collected in the questionnaire; voluntary participation; restricted-data storage; anonymisation for analysis/reporting; full visual-signed accessibility respecting Deaf cultural and linguistic norms.
Outcome Orientation	Formative evaluation to inform a subsequent DBR iteration, focusing on perceived usability, perceived accessibility, and perceived pedagogical value.

Methodological Design

A mixed-methods approach was used to examine Deaf learners' experiences with the VLO during this pilot stage. The design made it possible to summarise numerical tendencies from a structured questionnaire while also incorporating participants' explanations expressed through open-ended comments and the small supplementary post-use LSC video dataset (n = 6). In practical terms, the design aimed to document what participants reported about accessibility and usability and how they explained those perceptions, which is particularly relevant when user experience depends on visually mediated communication and sign language access. Consistent with methodological guidance on mixed-methods research, both quantitative and qualitative components were selected because they directly addressed the study's research questions and served complementary analytic purposes (Cohen et al., 2018).

The qualitative strand drew primarily on the open-ended survey responses (Q19–Q20) and the small supplementary post-use LSC video dataset (n = 6), which comprised three participant-initiated spontaneous opinion clips and three informal interview-style reflections produced voluntarily after VLO use. Although these videos were not elicited through a separate formal interview protocol, they were treated as qualitative data for thematic coding and were used selectively to contextualise and clarify patterns observed in the questionnaire.

The quantitative component was examined descriptively, consistent with the pilot and formative nature of the project. For each of the 18 items, frequencies, medians, and agreement rates (scores 4–5) were calculated to show how participants perceived different aspects of the VLO (e.g., accessibility, navigation, clarity of explanations, and pedagogical organisation) (see Appendix J). Given the sample size (n = 29) and the purpose of supporting iterative improvement

rather than statistical generalisation, the analysis remained descriptive and inferential statistics were not prioritised.

The mixed-methods design included an explicit integration plan. Triangulation matrices and a joint display were used to align item-level quantitative patterns with qualitative explanations. Integration was conducted at the level of analytic dimensions and relevant item clusters, enabling selected qualitative excerpts (see Appendix E) to be read alongside the corresponding quantitative indicators. This approach supports transparent linkage between patterns in ratings and participants' accounts of what facilitated or constrained their experience.

Methodological alignment with DBR was maintained by treating the study as a mechanism for collecting design-relevant feedback that can guide a subsequent iteration. In practice, this involved documenting perceived clarity and barriers, identifying recurring usability concerns, and highlighting which multimodal supports participants experienced as most useful for engaging with early written English micro-tasks.

Research Method and Study Procedure

To document participants' perceptions of the VLO under authentic study conditions, the study followed a sequence consistent with use in an open and distance model. Operationally, this DBR pilot iteration consisted of: (1) prototype development of the multimodal VLO, (2) pilot implementation under authentic study conditions, (3) user-centred evaluation through an accessible mixed-methods instrument, and (4) translation of the resulting evidence into refinement priorities for a subsequent iteration.

First, participants interacted with the VLO asynchronously, using their own devices and studying under conditions similar to their usual learning routines at UNAD. Access to the VLO was provided through a shareable link distributed via institutional email, accompanied by brief

step-by-step instructions in an accessible format, which participants opened independently and completed in a self-paced manner on their own devices (smartphones or computers). The pilot version implemented in the study, including its technical specifications and visual documentation, is described in Appendix H. Only after completing the VLO were participants invited to answer an accessible Google Forms questionnaire composed of 18 Likert-type items and two open-ended prompts. Each item was accompanied by a short explanatory video in LSC to ensure that participants could understand the meaning of each question and respond autonomously, without relying on an interpreter or high levels of Spanish literacy.

In addition to the open-ended survey responses, the small supplementary post-use LSC video dataset (n = 6) comprised three participant-initiated spontaneous opinion clips and three informal interview-style reflections produced voluntarily after VLO use. These recordings were analysed as qualitative data, and no additional participant communications beyond the questionnaire responses and the small supplementary post-use LSC video dataset (n = 6) were included in the analysis.

Data integration was conducted after descriptive statistics and thematic coding were completed. Item-level quantitative indicators (medians, distributions, and agreement rates) were mapped alongside illustrative excerpts through triangulation matrices and a joint display. This structure allowed quantitative patterns to be viewed alongside participants' comments—for example, high agreement scores on visual clarity could be considered together with remarks describing which sign-led explanations or SEE-based supports participants found helpful, while more mixed ratings could be examined alongside comments pointing to points of confusion, pacing issues, or requests for additional examples.

The procedure therefore aligns with the DBR logic of pilot evaluation: it documents participants' reported experiences with the VLO as used in real study conditions and organises their feedback in a form that can inform subsequent refinement of the artefact.

Research Approach

Consistent with the mixed-methods design described in the Methodological design section, this section outlines the analytic stance used to examine participants' reported experiences with the VLO under authentic, asynchronous UNAD conditions. Quantitative evidence is treated descriptively (frequencies, medians, and agreement rates) to summarise tendencies in perceptions, while qualitative evidence (open-ended responses and the small supplementary post-use LSC video dataset (n = 6)) is coded thematically to clarify how participants explained those perceptions.

Integration is conducted through explicit linkage between questionnaire patterns and qualitative explanations using triangulation matrices and a joint display, enabling connections to be examined across the quantitative and qualitative strands (Maxwell & Chmiel, 2014). Within this scope, the study does not test effectiveness, does not make causal claims, and does not interpret findings as learning gains; instead, integrated analysis is used to generate design-relevant evidence and refinement priorities for a subsequent iteration of the prototype.

Context of the Research

The study was carried out within the academic, technological, and sociolinguistic conditions that shape learning at the Universidad Nacional Abierta y a Distancia (UNAD). As an open and distance institution, UNAD relies heavily on asynchronous interaction, flexible pacing, and virtual learning environments. For Deaf students who use LSC, these conditions can be both enabling and constraining. Asynchronous study supports autonomy and repeated review, yet

many higher-education digital resources remain designed primarily for hearing audiences and frequently rely on audio, dense written Spanish, or rapid text-based explanations, as documented in the audit of UNAD English A1 course materials (see Appendix A). In this context, the need for an accessible, visually mediated VLO became evident, together with the practical conditions under which the evaluation took place.

The project ran across several academic periods from April to December 2025. Deaf LSC users studying English at different levels (A1 to B2) were invited to participate. The resulting participant group reflected the diversity typical of adults in open and distance programmes: varied experience with English, varied time availability due to work and family responsibilities, and varied access to devices and stable connectivity.

Within this context, resource-development records indicate that meaning-making in the VLO was supported through (a) LSC as the primary language of explanation and instruction, (b) systematic lexical pairing strategies for English vocabulary visualisation through sign-based resources aligned with SEE conventions, and (c) SEE-based scaffolding for making key English grammatical features visually explicit, complemented by subtitles and visual supports to bridge structural gaps between LSC and written English. These design choices position the virtual environment not only as a delivery medium but also as an active component of the pedagogical approach.

At an institutional level, the study was implemented using tools already available within UNAD's digital ecosystem, specifically Lumi/H5P and Google Forms. Using these platforms supported practical feasibility and allowed the study to be carried out with tools familiar to the institutional environment. The design also assumed that participants would access the VLO from different locations and devices, often under variable connectivity conditions and with limited

study time, which is typical in open and distance learning contexts. These conditions shaped several implementation decisions, including asynchronous access to the VLO, self-paced navigation, and the use of an accessible post-use questionnaire (see Appendix B).

Population and Sampling Procedures

The study focused on Deaf users of Colombian Sign Language (LSC) enrolled in UNAD's English courses across proficiency levels from A1 to B2. In line with the inclusive orientation of the project and the size of the accessible population, a census-style recruitment strategy was adopted: all 54 eligible Deaf LSC users linked to the English programme were invited to participate, consistent with Gray's definition of a census as "the measurement of a complete population rather than a sample" (Gray, 2014, p. 741). This decision reflects the logic of research in real institutional settings, where sampling procedures should be responsive to the characteristics and size of the population that can realistically be reached. When researchers are unable to easily obtain a complete sampling frame, probability sampling techniques may pose practical challenges (Gray, 2014, p. 192).

Participation in the study was voluntary. Data were collected between April and December 2025 (data collection closed on December 22, 2025), and 29 participants completed the questionnaire after working through the VLO. The participants were enrolled in different stages of the English programme. Some were beginning learners, while others had already completed several levels. Many reported juggling work, family obligations, and other personal commitments in addition to their studies. Such circumstances are typical in distance education, where learners frequently combine academic activities with employment and family obligations (Waterhouse et al., 2022, p. 58).

Although the effective sample represents slightly over half of the invited population (29/54 = 53.7%), it still provides a useful descriptive snapshot of Deaf LSC users engaging with English through digital resources. In distance education, participation is influenced by schedules, access to devices, and personal circumstances. Rather than treating this solely as an external limitation, the study acknowledges it as part of the institutional and lived conditions within which the VLO is meant to function.

Two guiding principles shaped recruitment and sampling. First, maximising accessibility: the invitation remained open for several months, was shared through channels familiar to Deaf students, and was accompanied by multimodal guidance in LSC and SEE-aligned supports to facilitate autonomous participation. Second, respecting learner autonomy: no reminders were framed as obligations, and participants decided when and whether to respond, consistent with UNAD's emphasis on self-regulated learning. These choices preserved diversity of experience and context while ensuring that the analytic sample came from sincere willingness to participate.

Ethical Considerations

The study followed UNAD's ethics guidelines for research with human participants, and these guidelines shaped practical decisions throughout the project. Given the low-risk, formative character of the evaluation in an open and distance learning context, the study implemented core ethical safeguards consistently across recruitment, data collection, analysis, and reporting, in accordance with institutional research ethics expectations.

Participation was voluntary, and invitations were prepared in accessible formats so Deaf students could follow them without relying on external interpretation. No participant received incentives, and participants could stop the questionnaire at any point.

To protect confidentiality, the questionnaire was configured to avoid collecting direct identifiers (e.g., names, email addresses, institutional IDs) and focused only on item responses and optional comments. For analysis and reporting, responses were handled as confidential research data and were coded using neutral participant labels. Only de-identified, coded files were used for descriptive and interpretive work. Original datasets and analytical materials were stored in digital folders with restricted access in compliance with institutional policies for responsible handling and secure storage.

Accessibility functioned as an ethical requirement rather than a design preference. The questionnaire included short videos in LSC to support independent participation (see Appendix B). Where excerpts were used to illustrate findings, personal identifiers were removed or softened. Any excerpts included in reporting were anonymised and, when translated into English for clarity, were presented without identifying markers.

Overall, the ethical commitments were straightforward and consistently applied: voluntariness, confidentiality, accessible participation, and respectful treatment of Deaf learners' contributions across collection, storage, analysis, and reporting.

Data Collection Techniques

The study relied on two complementary techniques to gather post-use information after participants interacted with the VLO. The primary source was an accessible Google Forms questionnaire, which included 18 Likert-type items (Q1–Q18) and two open-ended prompts (Q19–Q20). To enable independent participation, each item was supported by a short explanatory video prompt in Colombian Sign Language (LSC). These embedded prompts were part of the instrument and were not treated as qualitative data.

In addition to the questionnaire responses, a small supplementary post-use LSC video dataset (n = 6) was collected in Colombian Sign Language (LSC). This dataset comprised three participant-initiated spontaneous opinion clips and three informal interview-style reflections, produced voluntarily after VLO use and capturing spontaneous reflections and evaluative judgements in participants' first language. They were treated as qualitative data (in LSC as the participants' primary language) while remaining supplementary in scope and used primarily to contextualise and explain questionnaire patterns.

Each video was interpreted, transcribed, and coded using the same analytic procedures applied to the written open-ended responses, supporting parity across modalities. This approach aligns with ethical and methodological recommendations in Deaf research that recognise sign languages as legitimate media of data production rather than subordinating them to written or spoken forms (Instituto Nacional para Sordos, 2022). Broader international frameworks that support linguistic rights and accessible participation in research contexts reflect similar principles (United Nations, 2006; Weber et al., 2024).

No additional participant communications beyond the questionnaire responses and the small supplementary post-use LSC video dataset (n = 6) were included in the analysis; the instruments are described and justified in the section titled "Description and rationale of the instruments."

Description and Rationale of the Instruments

The main instrument was an accessible questionnaire designed in Google Forms for Deaf users of Colombian Sign Language (LSC). It included 18 Likert-type items (1–5) and two open-ended prompts. The instrument covered five analytic dimensions aligned with the study's conceptual framework: (1) Educational Technology and Accessibility (Q1–Q4), (2) Sign-first

and bilingual mediation (Q5–Q8), (3) Pedagogical Principles and Learning Organisation (Q9–Q11), (4) Knowledge Management and Self-Regulation (Q12–Q15), and (5) Comparative Experience and Cultural Relevance (Q16–Q18). Two open-ended questions (Q19–Q20) elicited explanations and suggestions to contextualise the ratings. The mixed format was intentional: Likert items provide structured indicators that allow patterns to be observed, while open-ended prompts allow participants to explain what supported or hindered their experience.

The questionnaire was not simply translated into LSC; it was designed around Deaf learners' communicative realities. Each item was paired with a short explanatory video in LSC to reduce the linguistic load imposed by dense written text and to allow participants to focus on meaning rather than decoding. The intent was to support autonomous participation without requiring an interpreter or advanced literacy in English, consistent with the project's emphasis on inclusive mediation and learner agency.

In this study, English is the target language in its written form, while sign-based systems operate as pedagogical mediation tools. LSC functioned as the primary language of explanation and access. SEE was used as a visual scaffold to support attention to specific features of written English that may not map transparently onto LSC. In addition, a sign-based lexical pairing strategy was used for vocabulary visualisation, aligned with the lexical pairing practices documented in the resource-development records and reflected in practical design decisions during VLO development. Because Deaf Colombian learners often engage in lexical pairing between Spanish and LSC in everyday educational practice, they frequently expect English vocabulary to be paired with a stable sign-based representation. Widely disseminated signing resources for English frequently provide such representations through SEE-based manual forms historically influenced by established sign lexicons and sometimes adapted with systematic

markers (e.g., initialisations) to make English morphology visually explicit. For that reason, English–SEE-based pairing was treated not as a shift in instructional language but as a mnemonic and visualisation support to strengthen recognition and recall of English words and selected grammatical features in a fully visual learning environment.

In addition to the open-ended survey responses, the small supplementary post-use LSC video dataset (n = 6) was incorporated into the qualitative strand. This dataset comprised three participant-initiated spontaneous opinion clips and three informal interview-style reflections produced voluntarily after VLO use; it was coded thematically alongside Q19–Q20. Analytically, it was used selectively to clarify, support, or qualify patterns observed in the questionnaire, strengthening interpretive depth without altering the primary evaluation structure.

Finally, the VLO itself functioned as the pedagogical artefact under evaluation, rather than as a separate instrument. Its activities, videos, explanations, and layout embody the project's design assumptions about accessibility, sign-first mediation, and self-paced learning. Participants were therefore asked to complete the questionnaire only after working through the VLO under authentic study conditions. This sequencing increases the descriptive value of the data because responses are grounded in direct experience rather than hypothetical judgments.

Validation Procedures

The questionnaire underwent formative checking focused on clarity and accessibility before full administration. Prior to implementation, the course instructor reviewed the draft questionnaire items and the accompanying signed explanations to ensure that the prompts were understandable for Deaf LSC users and that the intended focus of each item was clear. During the development process, the researcher also conducted informal consultations to clarify aspects of accessibility and item wording.

Content alignment was also addressed through consultation with the supervising professor. This review examined whether the items matched the purpose of the evaluation (perceived accessibility/usability and perceived pedagogical value), whether they reflected the structure of the VLO, and whether they aligned with the evaluation criteria used in the project. This step therefore functioned as a practical content check to ensure that the questionnaire remained closely connected to the design goals established during development.

Once the questionnaire was deployed, early submissions functioned as an informal usability check of the delivery format. Although this stage was not treated as a separate validation phase, initial responses made it possible to verify whether LSC videos loaded correctly, whether participants could navigate the form without assistance, and whether any item appeared consistently unclear. Minor presentational refinements were made where necessary (e.g., simplifying the signing of a prompt and re-recording a video affected by visual noise) to improve accessibility without changing the analytic content of the instrument.

In this project, validation is therefore understood in a practical and formative sense, referring to procedures aimed at ensuring clarity of the items, accessibility of the signed explanations, and alignment between the questionnaire prompts and the aspects of the VLO being evaluated. These steps supported the instrument's suitability for capturing participants' reported experiences without implying formal psychometric validation.

Pedagogical Intervention and Application

The pedagogical intervention consisted of the design and use of a multimodal Virtual Learning Object (VLO) centred on the topic *"Introducing ourselves in English"* at an early A1 orientation. The resource was created for Deaf university students who use Colombian Sign Language (LSC) and study in UNAD's open and distance programmes. The VLO was conceived

as a pedagogical artefact that learners could use alongside their regular English courses, particularly when they needed structured, visually mediated exposure to basic vocabulary, sentence patterns, and simple grammar related to personal information.

The VLO invited learners to move through short sections combining LSC-led explanations, SEE-based visualisation of selected grammatical features, and written English. Learners were guided from recognition of common self-introduction frames (e.g., “My name is…,” “I am from…”) to controlled practice and short production-oriented tasks. These tasks formed part of the pedagogical design of the VLO artefact; however, in the pilot evaluation reported here, they function primarily as contexts for participants’ perceptions—that is, how clear, manageable, and useful the tasks appeared to learners—rather than as direct measures of written English performance.

The intervention respected UNAD’s asynchronous study conditions. Learners could progress at their own pace, rewatch LSC videos, repeat activities, and revisit sections as needed. This pacing is particularly relevant in visually mediated instruction, where comprehension depends on clarity of signed explanation, visual layout, and manageable cognitive load.

Application was straightforward but deliberate. Students were asked to work through the VLO first in a setting that matched their usual study conditions (typically at home, using their own devices). Only after this interaction were they invited to complete the questionnaire. In that sense, the evidence collected reflects the lived experience of using the resource rather than reactions to screenshots or descriptions. What is evaluated, therefore, is the practical experience of engaging with the VLO in a real virtual learning context.

Sign-First Mediation and Linguistic Scaffolding (LSC + SEE-Based English Coding)

For analytic purposes, and consistent with the terminological clarification presented in the Introduction, Signed Exact English (SEE) was treated strictly as a pedagogical coding system rather than as a natural language or a language of instruction. In this project, LSC functioned as the primary language of explanation and instructional mediation, while SEE was incorporated selectively to make certain features of written English visually explicit.

Specifically, SEE-based representations were used to highlight written English elements that do not map transparently onto LSC structure, such as selected pronouns, forms of *to be*, possessive markers (-'s), and common inflectional endings (-s, -ing, -ed). Within this design, SEE functioned as a visual grammatical scaffold that supported noticing and recall of written English forms within a fully visual learning environment.

To maintain consistency, the manual representations used for SEE were selected from established SEE learning resources (e.g., dictionaries and instructional apps). Because SEE conventions historically draw on widely circulated sign lexicons while adding systematic markers to encode English morphology, the VLO treated these forms as part of the SEE scaffold rather than as an additional instructional language. LSC therefore remained the language used for explanation and meaning-making, while SEE provided a structured visual pathway for representing English form.

Pedagogically, this design also reflects a learning pattern frequently reported in Deaf Colombian educational contexts: learners commonly engaged in lexical pairing between Spanish and LSC, and many expected English vocabulary to be paired with a stable sign-based representation that supports recognition and memory. In the VLO, lexical pairing was implemented through SEE-based manual representations that act as visual anchors for

vocabulary recall and selective grammatical noticing, while LSC continued to carry explanatory and metalinguistic functions.

In practice, the VLO maintained a sign-first mediation logic (LSC-led explanation) while incorporating SEE-based representations when the instructional focus requires explicit attention to English morphology and sentence-level form. This configuration remains open to refinement in later DBR cycles, particularly if future feedback indicates that more LSC-centred lexical strategies could increase clarity, reduce confusion, or strengthen cultural-linguistic alignment for specific learner profiles.

Development of the Application

The development of the VLO was iterative rather than linear. The resource was developed in Lumi/H5P, which provided the main environment for interactive activities and multimodal presentation (Reinoso Caisa et al., 2025). This platform was selected because it is compatible with common educational technology practices in UNAD and supports flexible deployment strategies that can be more resilient in contexts where connectivity may be unstable—for example, allowing the resource to be hosted and accessed with varying levels of online dependence.

From the outset, the design process centred on the needs of Deaf LSC users. The first step was to outline the learning sequence for “Introducing ourselves in English” and identify which parts of the content required explicit mediation through LSC, SEE-based grammatical visualisation, or both. Draft versions of activities and texts were examined formatively to strengthen clarity and accessibility. The VLO developer, who serves as the LSC inclusion instructor responsible for supporting Deaf students across courses at UNAD, together with two colleague educators familiar with LSC-mediated instruction, examined early versions of the

materials and provided formative feedback during development. Their observations informed concrete revisions such as slowing down certain explanations, clarifying the visual layout, and re-recording selected LSC videos to improve visibility (signing space, framing, background clarity, and pacing).

Technically, the VLO combined several H5P activity types (e.g., interactive presentations, fill-in-the-blanks, and multiple-choice checks) with static supports such as images, icons, and on-screen arrows that guide attention and navigation. The goal was not to "gamify" the resource, but to improve usability and reduce confusion through clear visual cues. Each design choice was evaluated against a guiding question: Will this help a Deaf learner perceive, understand, and use this element of English more confidently within a visual, self-paced environment?

Deployment during the study also functioned as part of the development cycle. As learners used the resource and later commented on it in the questionnaire and the voluntary LSC video recordings, their observations were documented as feedback that may inform future refinement. Some participants noted technical or access issues (for example, occasional video loading problems on specific devices), while others requested more examples, clearer LSC explanations in certain segments, or additional practice opportunities. These comments were considered as descriptive feedback within the pilot study and as potential input for later design iterations, consistent with the DBR orientation of the project.

In this way, the VLO is treated not as a finished product but as a working prototype within an explicit DBR cycle. Operationally, this cycle includes: (1) prototype development of the multimodal VLO, (2) pilot implementation under authentic study conditions, (3) user-centred evaluation through an accessible mixed-methods instrument, and (4) interpretation of findings to

identify possible refinement priorities for future iterations. This section documents that cycle and provides the methodological basis for examining accessibility, usability, and perceived pedagogical value in UNAD's virtual environment. The analytical procedures used in this cycle are detailed in the section titled "Data Analysis and Integration Procedures."

Data Analysis and Integration Procedures

Quantitative data (Likert Q1–Q18) were analysed descriptively to match the pilot scope of this single-cycle DBR implementation. For each item, frequency distributions, medians, and percentage of agreement (ratings 4–5) were calculated. Item means were computed for descriptive reference only and reported in the quantitative appendix to avoid overinterpretation of ordinal responses (Cohen et al., 2018).

Qualitative data (open-ended Q19–Q20 and the small supplementary post-use LSC video dataset (n = 6)) were analysed through thematic coding in Dedoose using a structured codebook aligned with the questionnaire dimensions and the analytic domains used for reporting and integration (Salmona et al., 2020; SocioCultural Research Consultants, 2025). This supplementary dataset was used primarily to contextualise and explain questionnaire patterns. The codebook began as a deductive scaffold and was refined inductively through constant comparison and memo writing until stable code families were established (Cousins et al., 2024).

For traceability during analysis, survey respondents were labelled P-XX, and excerpts from the separate LSC video dataset were labelled Est-XX. These identifiers protect confidentiality while enabling cross-reference across data sources.

Integration followed a convergent mixed-methods logic. Quantitative patterns indicated where additional qualitative explanation could clarify participants' perceptions, and qualitative excerpts were used to illustrate why certain items showed comparatively lower endorsement or

higher neutrality. Joint displays and triangulation matrices were used to connect the two strands and to inform possible refinement priorities for a subsequent DBR iteration (Fetters et al., 2013; Guetterman et al., 2015; Peters & Fàbregues, 2024).

Data Analysis and Results

Introduction to Data Analysis

The quantitative strand was examined descriptively. For each item, frequencies and medians were calculated, together with the percentage of agreement (scores 4–5). In addition, item means were computed for descriptive reference only (as a complementary index of central tendency) and were reported in the quantitative appendix to reduce the risk of overinterpreting ordinal Likert responses (see Appendix J). These indicators were used to summarise participants' reported perceptions of key user-experience constructs related to the VLO—accessibility, sign-mediated bilingual support, pedagogical organisation, self-regulation support, and comparative experience. Items were then grouped into five dimensions that reflected the instrument's conceptual structure: Educational Technology and Accessibility; Visual and Bilingual Mediation; Pedagogical Principles and Learning Organisation; Knowledge Management and Self-Regulation; and Comparative Experience and Cultural Relevance (see Appendix F).

For clarity, these five questionnaire dimensions served as analytic umbrellas for reporting the quantitative strand, while the five Dedoose code families mirrored the same domains using simplified labels (e.g., Educational Technology and Accessibility ≈ Technological Access; Visual and Bilingual Mediation ≈ Multimodal Mediation for English). This parallel structure enabled direct integration across strands during interpretation, particularly through triangulation matrices and joint displays.

In parallel, the qualitative material was coded thematically. Open-ended responses and the six participant-produced LSC video recordings were imported into Dedoose and coded using a structured codebook aligned with the questionnaire's domains and the study's conceptual framing. The codebook began as a deductive scaffold (based on instrument dimensions and

accessibility/UDL commitments) and was refined inductively as new nuances emerged through constant comparison and memo writing. Through this iterative process, codes were organised into five stable families and a core category labelled Inclusive Autonomy in Deaf Language Learning, integrating technological, linguistic, pedagogical, and affective aspects of participants' experience.

Throughout this chapter, results are reported in an integrated way: descriptive indicators summarise general tendencies, while selected quotations and coded patterns provide depth and explanation. Integration was conducted using explicit decision rules. First, quantitative items with comparatively lower agreement and/or larger neutral bands were treated as integration triggers. Second, qualitative excerpts were retrieved within the corresponding analytic dimension and selected using maximum variation (supportive, neutral, and critical comments), prioritising segments that named a concrete feature and an actionable suggestion. Third, a refinement priority was recorded when a theme appeared across at least two sources and could be translated into a specific design action. This procedure reduced interpretive arbitrariness and strengthened traceability from ratings to design recommendations (Appendix G), in line with principles for transparent integration in mixed methods research (Fàbregues et al., 2024; Fetters et al., 2013).

Given the consistently high endorsement across items, interpretation emphasised distributional shifts (especially the size of the neutral band) and qualitative explanations, rather than central tendency alone, to reduce the risk of ceiling-tendency overinterpretation. Rather than seeking statistical generalisation, the analysis was orientated towards an exploratory, formative interpretation that could inform the next cycle of design-based refinement of the VLO.

Table 3

Research Question, Data Source, and Analysis Alignment Matrix

Research Question	Data sources	Analytic procedure(s)	Where it is answered
Main Research Question. How can a UDL-guided, multimodal Virtual Learning Object (VLO) for Deaf users of Colombian Sign Language (LSC) be designed and pilot-evaluated to support engagement in A1-level written English practice (reading, writing, and grammar) in UNAD's open, distance, online, and hybrid contexts, while generating evidence about accessibility, usability, pedagogical usefulness, and refinement priorities as a self-paced learning resource?	Likert Q1–Q18; open-ended Q19–Q20; post-use LSC video dataset (n = 6); design documentation.	Mixed-methods integration (descriptive + thematic); triangulation/joint display logic; DBR-informed synthesis across the study.	Design rationale (Research Design), integrated results (Integrated View of the Findings), and discussion, implications, and conclusions (Discussion and Conclusions).
SRQ1. What communicative, technological, and pedagogical needs do Deaf LSC users enrolled in English A1 courses at UNAD report in relation to developing written English skills (reading, writing, and grammar) in virtual and hybrid learning contexts?	Open-ended responses (Q19–Q20); participant-produced LSC video dataset (spontaneous opinion clips and informal interview-style reflections).	Thematic coding in Dedoose; code families + cross-cutting tags; memoing within the integration logic.	Needs-related excerpts across categories (Qualitative Categories and Core Category), together with the interpretive discussion of needs (Discussion and Conclusions).

Research Question	Data sources	Analytic procedure(s)	Where it is answered
SRQ2. Which visual, bilingual, and multimodal resources (e.g., LSC videos, Signed Exact English, and SignWriting) can be integrated into the design of a VLO to support A1 written English learning for Deaf LSC users at UNAD?	Resource-development records; VLO artefacts (screens and activities); design notes.	Documentary analysis + design rationale synthesis (descriptive, DBR-oriented).	Design section (Research Design) + design implications and rationale-linked interpretation (Discussion and Conclusions).
SRQ3. How do Deaf participants perceive the VLO's accessibility, usability, pedagogical organisation, and perceived usefulness for supporting A1 written English learning (reading, writing, and grammar) in online and hybrid learning environments?	Likert Q1–Q18 (n = 29); open-ended Q19–Q20; LSC video comments.	Descriptive statistics (frequencies, medians, % agreement [4–5]; means for descriptive purposes) + qualitative coding organised by analytic dimensions; mixed-methods integration (triangulation/joint display logic).	Quantitative–qualitative integration based on descriptive patterns, qualitative categories (including the core category), and their integrated interpretation.
SRQ4. What adjustments and refinement priorities do Deaf participants identify to inform the next DBR cycle of the VLO (e.g., improving clarity and consistency of sign–text mediation, expanding practice opportunities, and addressing device-specific technical accessibility issues)?	Items with comparatively lower endorsement (e.g., Q3, Q8, Q11, Q15); open-ended responses; LSC video comments; implementation notes (where applicable).	Pattern identification (quantitative + qualitative); mixed-methods integration using triangulation/joint display logic; narrative synthesis of refinement priorities.	An integrated synthesis of the findings, followed by design-relevant implications for the next DBR cycle and by recommendations and conclusions (Discussion and Conclusions).

Data Management Procedures

The data management procedures followed the same principles of transparency, accessibility, and confidentiality described in the Research Design and are summarised here in relation to the present analysis. All questionnaire responses were exported from Google Forms into spreadsheet format and checked for completeness, duplicate entries, and obvious inconsistencies. The survey did not request names, emails, or other direct personal identifiers. For analytic traceability, each response record was nevertheless assigned a neutral anonymised code (P-01–P-29) prior to analysis.

All Likert items (Q1–Q18) were completed for the final analytic sample (n = 29), resulting in no missing item-level data for the quantitative strand. By contrast, the two open-ended prompts (Q19–Q20) were optional and therefore produced partial nonresponse: five participants did not answer either open-ended question, and one participant answered Q19 but did not answer Q20. These responses were retained and analysed using an available-case approach, meaning that each participant contributed to qualitative analysis only for the question(s) they answered; accordingly, qualitative reporting specifies the response count (n) for each open-ended question (Q19: n = 24; Q20: n = 23).

All exported files (spreadsheets, analytic matrices, and graphs) were stored in restricted-access digital folders, and only the researcher had access to the working dataset during cleaning and analysis.

In addition, six participant-produced LSC video recordings—shared voluntarily via private messages outside the questionnaire form after VLO use—were treated as qualitative data. Prior to analysis, participants provided explicit permission in LSC (signed consent) for their post-use videos to be used for research purposes within this thesis; participants were already

aware that the project formed part of a research process and agreed to share their reflections in this format. The use of these voluntary, supplementary video reflections was treated as descriptive qualitative material and handled under standard ethical expectations for online qualitative and mixed-methods research, including explicit permission, secure storage, and anonymised reporting (Braun & Clarke, 2025; Costello et al., 2023). Videos were stored in restricted-access folders and excerpted only in anonymised form (no visual identifiers were reproduced in the thesis). Each recording was interpreted by the researcher through repeated viewing and documented as an interpretive transcript for analysis. To facilitate coding, reporting, and the presentation of illustrative excerpts, the interpreted content was first expressed in Spanish and then translated into English. Accuracy and meaning preservation were supported through repeated replay checks and multiple revision passes to enhance coherence and precision. Every excerpt quoted in the thesis was re-checked against the original video prior to final inclusion (see Appendix E).

Open-ended written responses to Q19 and Q20 were preserved in meaning and lightly edited only for readability (e.g., punctuation, segmentation, and clarification of implicit subjects where needed), without altering intent. These Spanish versions (edited for readability) were then translated into English for qualitative analysis and reporting. All qualitative materials were handled in anonymised form, stored under the same restricted-access procedures, and used solely for descriptive and interpretive purposes aligned with the study aims. No qualitative materials beyond the open-ended survey responses (Q19–Q20) and the supplementary post-use LSC video dataset (n = 6) were included in the analysis.

For the quantitative strand, each item-level response (1–5) was organised into matrices to calculate:

Frequencies for each Likert category (1–5)

Median per item

Mean per item (computed and reported descriptively; see Appendix J)

Percentage of agreement (combined scores 4–5)

These indicators were used to build tables and graphs that make the distribution of responses visible and interpretable.

Table 4

Frequencies by Item (Likert 1–5), Share of Agreement (4–5), and Median (n = 29).

Item	n1	n2	n3	n4	n5	%4–5	Median
Q1 The videos, quizzes, and interactive elements worked properly.	1	0	2	9	17	89.7	5.0
Q2 The VLO was easy to navigate, with clear signs and instructions.	0	1	2	8	18	89.7	5.0
Q3 The content was accessible with Colombian Sign Language and SEE.	0	0	7	9	13	75.9	4.0
Q4 The layout and design helped me stay focused and engaged.	0	0	2	10	17	93.1	5.0
Q5 I learned new English words and grammar through visual support.	0	2	2	8	17	86.2	5.0
Q6 The activities helped me practice reading and writing in English.	1	0	3	8	17	86.2	5.0
Q7 SEE and sign videos helped me understand English sentence structure.	0	2	1	9	17	89.7	5.0
Q8 I feel more confident introducing myself in English.	1	1	3	10	14	82.8	4.0
Q9 The lessons followed a clear structure and logical order.	0	0	4	8	17	86.2	5.0

Item	n1	n2	n3	n4	n5	%4–5	Median
Q10 The VLO included different types of activities (quizzes, videos, etc.).	0	0	4	6	19	86.2	5.0
Q11 The quizzes helped me check my understanding.	1	1	4	8	15	79.3	5.0
Q12 The topics were useful and clearly explained.	1	0	2	8	18	89.7	5.0
Q13 The resource helped me reflect on how I learn English.	0	1	2	10	16	89.7	5.0
Q14 The VLO encouraged me to study and learn on my own.	1	0	0	12	16	96.6	5.0
Q15 I could connect what I learned with my daily life.	1	0	5	7	16	79.3	5.0
Q16 Compared to other English resources I have used before, this VLO was easier to understand.	0	1	3	7	18	86.2	5.0
Q17 I feel more comfortable using this VLO because it is specially designed for Deaf learners.	0	0	2	8	19	93.1	5.0
Q18 I wish more English learning materials were designed like this one.	0	0	2	8	19	93.1	5.0

Note. Key descriptive patterns. All 18 items reached ≥ 75% agreement (scores 4–5), indicating consistently positive evaluations across the instrument's analytic dimensions. Agreement was not fully uniform: Q3 showed the lowest level (75.9%), followed by Q11 and Q15 (79.3%). Median values clustered at 5.0, with Q3 and Q8 at 4.0, indicating a strong positive skew and a likely ceiling tendency—common in pilot evaluations where a resource addresses a previously unmet

accessibility need and is perceived as “finally accessible.”

Accordingly, refinement decisions prioritised (a) the size of neutral response bands and (b) qualitative explanations of friction points, rather than central tendency alone. Results are interpreted descriptively, given the exploratory scope and sample size (n = 29), and the quantitative strand primarily informs redesign priorities rather than psychometric sensitivity or inferential testing.

For the qualitative strand, open-ended responses and the six participant-produced LSC video recordings were compiled and imported into Dedoose. A structured codebook was used, centred on an Inclusive Autonomy (Core) category and five main code families, complemented by a cross-cutting set of analytic tags. Together, the code families, subcodes, and tags captured aspects such as technological access, visual layout, sign-mediated support for written English, pedagogical organisation, self-study, real-life transfer, and cultural comparisons related to Deaf-friendly design. The codebook was refined as new nuances emerged in the data, particularly when participants’ messages pointed to tensions between accessibility and linguistic precision—for example, when a sign was perceived as incomplete or when caption–subtitle alignment created ambiguity.

Table 5

Code Families and Example Subcodes Used in the Analysis

Qualitative Coding Structure	
Inclusive Autonomy (Core)	Self-Regulation & Relevance
Technological Access	4.1 Useful topics (Q12)
1.1 Smooth video playback (Q1)	4.2 Learning reflection (Q13)
1.2 Simple navigation (Q2)	4.3 Self-study (Q14)
1.3 Clear LSC/SEE & captions (Q3)	4.4 Real-life transfer (Q15)
1.4 Visual layout & engagement (Q4)	Comparison & Cultural Relevance
Multimodal Mediation for English	5.1 Easier than other resources (Q16)
2.1 Visual support for vocabulary/grammar (Q5)	5.2 Deaf-friendly design (Q17)
2.2 Guided reading–writing practice (Q6)	5.3 Want more like this (Q18)
2.3 SEE as syntax bridge (Q7)	Cross-Cutting Tags (Transversal Markers)
2.4 Confidence to self-introduce (Q8)	6.1 UDL (Representation / Action–Expression / Engagement)
Pedagogical Organisation	6.2 Language components (Reading / Writing / Grammar)
3.1 Clear sequence (Q9)	6.3 Modality of mediation (LSC / SEE-based manual coding / Text–Captions / Video–Interface; plus SEE resource-based lexical variants when applicable)
3.2 Varied activities (Q10)	6.4 Perceived impact (Access / Comprehension / Motivation–Autonomy / Transfer)
3.3 Comprehension quizzes (Q11)	

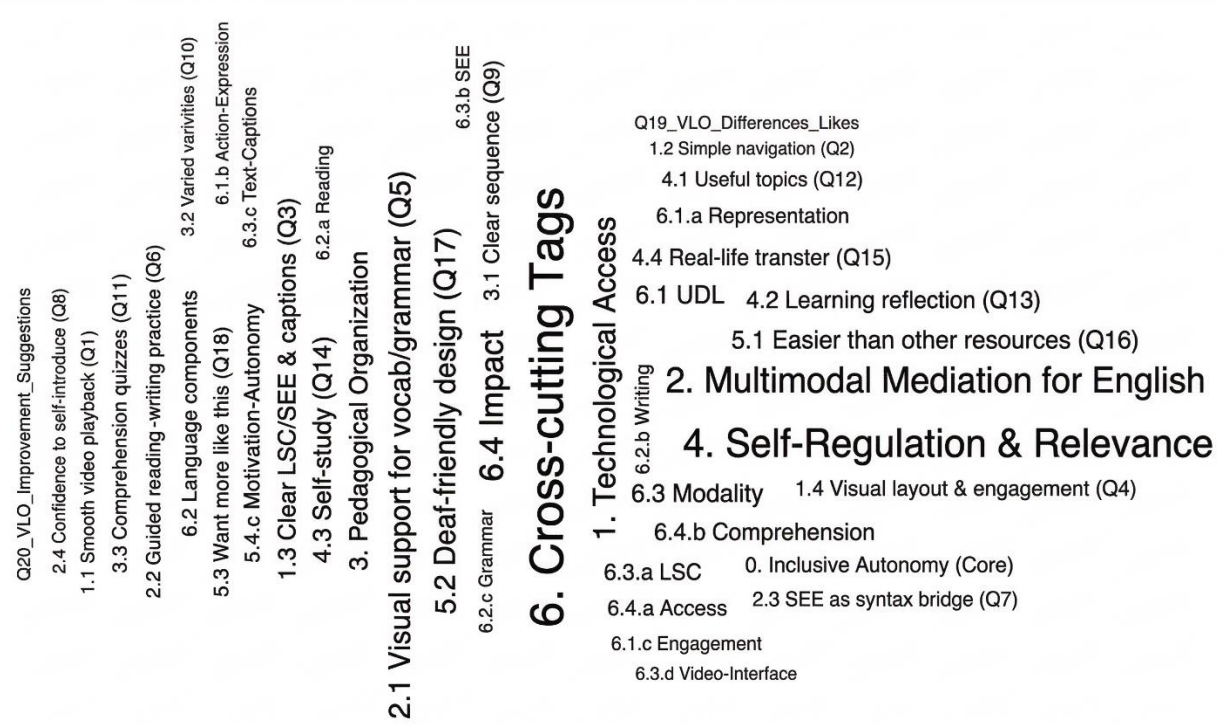
Note: Tag salience weights. Cross-cutting tags were applied using a 3-point ordinal scale (1–3) to indicate the relative salience of each transversal dimension within an excerpt. This weighting functioned as an analytic aid to distinguish brief mentions from strongly foregrounded meanings within the same segment, enabling a more fine-grained interpretation of how participants framed their experience, through which channel, and with what perceived impact. Unless otherwise specified, tables and matrices report application counts (i.e., the frequency with which a tag or

code was applied), rather than weighted sums; when weighted totals are reported, this is stated explicitly in the corresponding note.

In an additional step, codes were visually explored using Dedoose descriptor–code matrix charts and the Packed Code Cloud. This exploration helped confirm the relative frequency of each category (based on coded excerpt applications) and supported the identification of Inclusive Autonomy as a central construct in the project.

Figure 5

Packed Code Cloud of All Coded Categories and Their Theoretical Connections.



Note. This Packed Code Cloud displays the full set of categories generated through thematic analysis in Dedoose. Term size reflects code count (i.e., the number of excerpts assigned to each code across the dataset). In addition to thematic categories, the visualisation includes cross-cutting tags (e.g., alphanumeric labels) used as transversal analytic markers to track patterns across categories, rather than as hierarchical subcodes. Prominent terms (e.g., *Self-Regulation &*

Relevance, *Multimodal Mediation for English*, and *Technological Access*) indicate areas of higher coding density and support interpretation of the project's core constructs in relation to the study's conceptual framing (Acosta Calderon et al., 2024; Gray, 2014; Huertas Torres & Oyola Gamboa, 2017; Marín et al., 2023). **Source:** Author's analysis based on data analysed in Dedoose (2025). Visual adapted for improved chromatic legibility with AI assistance (Gemini, 2026).

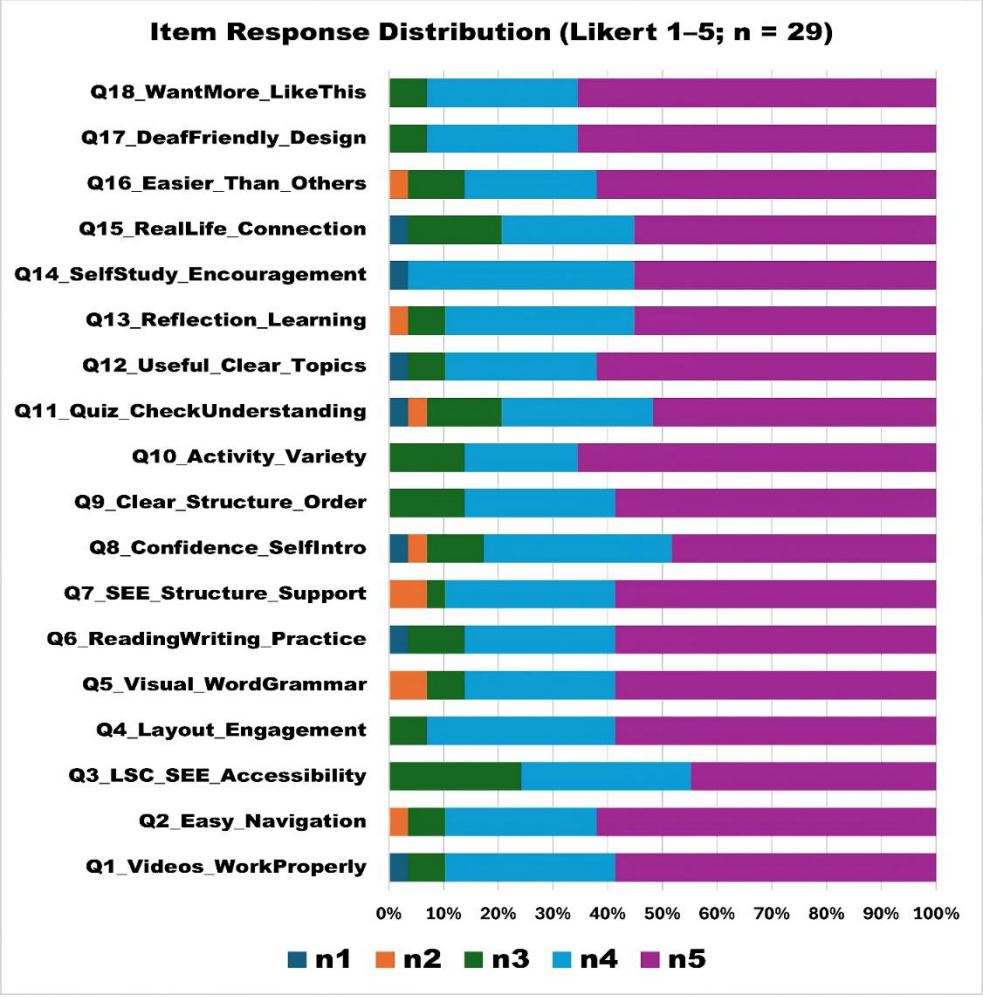
Results

Quantitative Descriptive Patterns

The descriptive analysis of the 18 Likert items indicates a consistently positive participant-reported evaluation of the VLO across its main dimensions. The median score was 5.0 in 16 of the 18 items, while only two items—LSC/SEE accessibility (Q3) and confidence in self-introduction (Q8)—showed a median of 4.0. In terms of agreement, all 18 items reached ≥ 75% endorsement at the 4–5 level, with the lowest agreement observed for Q3 (75.9%), followed by Q11 and Q15 (79.3%). Overall, the pattern reflects strong perceived usability and pedagogical value, while also indicating targeted areas for refinement, particularly in the precision and consistency of sign-mediated accessibility and in self-reported confidence for output-orientated tasks.

Figure 6

Horizontal Stacked Bar Chart: Item Response Distribution (Likert 1–5; n = 29).



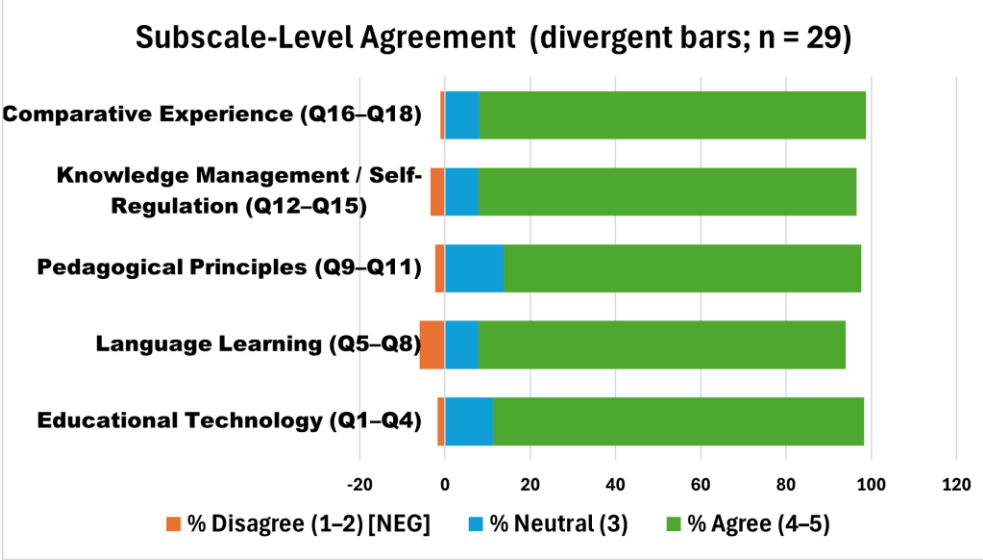
Technical access and layout-related items (like video playback, navigation, and visual organisation) received consistently high ratings, with agreement (scores 4–5) often surpassing 85%. Overall, participants perceived the VLO as dependable and easy to use. These distributions demonstrate that most participants thought the VLO was visible, stable, and helpful. On the other hand, the item (Q3) that dealt with LSC-led accessibility supported by SEE scaffolding and caption/subtitle clarity had a more moderate profile, with a larger neutral segment. This distributional shift supports a refinement-orientated interpretation: neutral responses may reflect

moments where sign–caption clarity, consistency, or technical continuity reduced the smoothness of access—an inference that is examined further through qualitative excerpts related to sign-level precision and media interruptions.

When items are grouped by subscale, the overall pattern remains clearly favourable. Agreement is higher in items related to comparison and cultural relevance. In particular, participants tended to rate positively statements indicating that the VLO is easier than other resources, Deaf-friendly, and worth continuing. Knowledge Management and Self-Regulation also show strong endorsement, especially where participants emphasised the usefulness of topics, opportunities for reflection, and encouragement for self-study.

Figure 7

Agreement by Subscale (Divergent Bars; n = 29).



Subscales related to Educational Technology, Language Learning, and Pedagogical Principles likewise show positive trends, although some items include slightly larger neutral segments. This distribution suggests that, while the resource is widely accepted, participants still perceived room for clearer instructions in specific tasks and for more extensive practice in

selected areas. Crucially, these subtleties support an improvement-oriented interpretation rather than a negative assessment because they mostly show up as slight expansions of the neutral band rather than shifts toward disagreement.

Taken together, these descriptive results indicate that the VLO was broadly experienced as accessible, visually coherent, and motivating for initial written-English engagement. At the same time, the patterns observed—especially the comparatively larger neutral responses for sign-mediated accessibility (Q3) and the lower central tendency for self-reported confidence in self-introduction (Q8)—identify concrete priorities for refinement that are further specified through the qualitative analysis.

Qualitative Categories and Core Category

The qualitative analysis produced five main categories (code families) and one core category that help interpret the numerical trends observed in the Likert data. As new excerpts were added, the five families remained stable as organising lenses: Technological Access, Multimodal Mediation for English, Pedagogical Organisation, Self-Regulation and Relevance, and Comparison and Cultural Relevance. Together, they converge in the core construct Inclusive Autonomy in Deaf Language Learning.

A note on mediation terminology. Consistent with the sign-first mediation framework and the definition of SEE as a coding scaffold established in the Introduction, LSC functioned as the primary language of access and explanation. SEE was used strictly as a pedagogical coding scaffold to make selected aspects of written English structure visually explicit (e.g., function words, bound morphemes, and word order). To support vocabulary visualisation, the VLO also uses SEE-based lexical pairing drawn from consistent SEE reference materials, providing a stable manual representation intended to support recognition and recall of English lexical items.

Where alternative manual realisations for the same English item appeared across SEE reference sources, these were treated as scaffold variants (i.e., variants within the SEE-coded representation) rather than as alternative target-language forms or as evidence of mixing instructional languages. Importantly, the target language remains written English, and meaning-making and metalinguistic explanation remain LSC-led throughout. Accordingly, SEE in this study is not emphasised as a language variety but as a design feature that supports visual noticing of written English.

Technological Access (Q1–Q4). Refers to how learners experienced the technical side of the VLO, including video playback, navigation, captions/subtitles, and visual layout. Several comments link comprehension directly to the presence of captions. As one participant put it: “If there are only signs and there are no subtitles, I end up not understanding the English” (Est-02). At the same time, a few excerpts point to issues at the level of the signs themselves. For example: “The signs for ‘she’ and ‘he’ are the same and incorrect” (P-15). These observations help make sense of the comparatively lower agreement in Q3, where not only the presence of sign support, but also its precision and consistency, seem to be relevant.

Multimodal Mediation for English (Q5–Q8). It reflects how sign-led explanation (LSC), SEE scaffolding, SEE-based lexical pairing (as implemented through established SEE learning resources), written text, images, examples, and captions/subtitles worked together to support vocabulary learning, basic grammar noticing, and guided reading–writing practice. Learners described the multimodal combination as facilitative, for example: “The video with signs and subtitles makes the process easier. Connecting sign language with the text is very useful” (Est-02). Others emphasised clarity in visual access to written English: “I like how it allows me to see and learn English clearly” (P-08). These excerpts align with the strong

endorsement observed in items connected to visual support for vocabulary/grammar and mediated comprehension.

Pedagogical Organisation (Q9–Q11). It gathers comments about sequencing, clarity of structure, activity variety, and opportunities to check understanding (e.g., quizzes). Participants repeatedly framed the experience as structured and progressive: “This VLO helps me learn English step by step” (P-17). Likewise, clarity and non-confusion were explicitly contrasted with other resources: “Unlike other virtual resources, this one is very clear and not confusing” (P-28). Such statements help explain why items related to structure and clarity show strong endorsement, while also leaving room to refine quiz instructions and feedback loops where neutrality was slightly higher.

Self-Regulation and Relevance (Q12–Q15). It shows how learners worked with the VLO in practice. They reported going back to sections, adjusting their pace, and reflecting on their progress, often linking the content to practical uses. At the same time, some excerpts point to conditions that limit this process. One participant noted: “I have to go to the UNAD university library to access the internet and study” (P-26), indicating that independent study depends, in some cases, on external access constraints. There are also indications that continuing the process is not always easy. For example: “I would like more support to continue with the basic learning process” (P-09). This does not contradict the generally positive evaluations, but it suggests that further support—especially for sustained practice—may help learners maintain continuity in their work.

Comparison and Cultural Relevance (Q16–Q18). It captures the perception that the VLO was designed “for Deaf people”, highlighting Deaf-friendly design and the cultural-linguistic value of sign-first mediation. Participants contrasted the VLO with other contexts

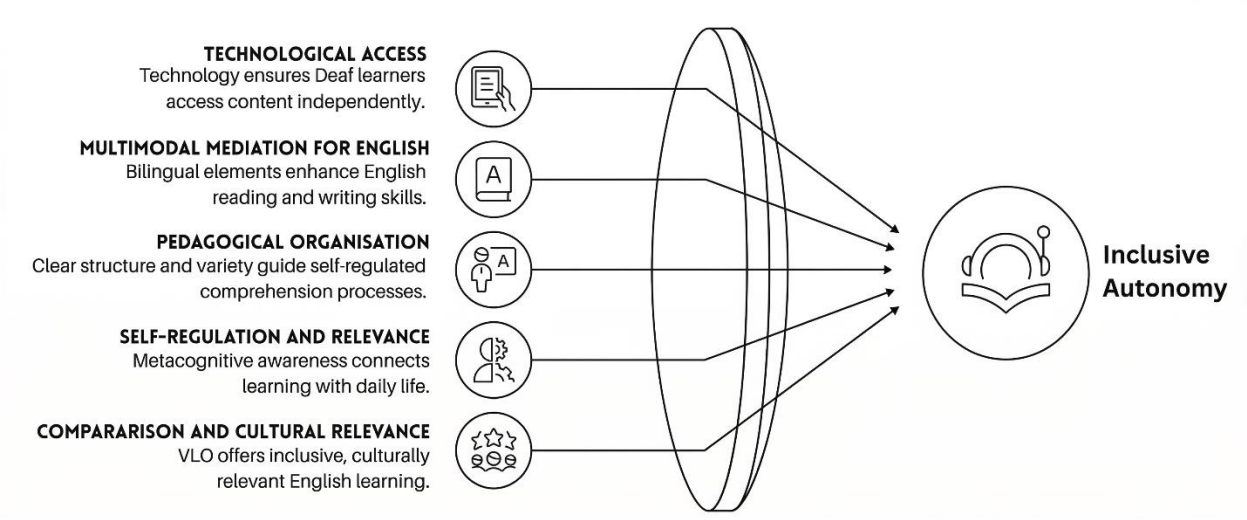
where sign language access is limited: “The virtual English course is difficult because there is no interpreter” (P-05), and then directly evaluated the resource more favourably: “The VLO is better” (P-05). In addition, learners emphasised visually grounded comprehension: “I can see it and understand it very clearly; I can grasp the information visually” (P-28). These evaluations help explain the high endorsement of Deaf-friendly design and the expressed desire for similar resources.

Taken together, these five categories converge in the core category Inclusive Autonomy, which captures the idea that learners reported greater independence and motivation when Technological Access, sign-mediated scaffolding, and clear pedagogical organisation worked in harmony. This is expressed directly in excerpts such as: “I’m also learning to use the VLO itself and to become more autonomous in learning English” (P-17). In this sense, the VLO did not simply deliver content; it created conditions in which Deaf learners could regulate their pace, rely on LSC as a bridge, and gradually build confidence in written English.

In addition to the five main code families, the analysis used a set of cross-cutting tags to mark transversal dimensions that appeared across multiple categories rather than functioning as hierarchical subcodes. These tags captured: (a) UDL dimensions (Representation, Action–Expression, Engagement), (b) language components (Reading, Writing, Grammar), (c) modality of mediation (LSC, SEE-based manual coding, Text–Captions, Video–Interface, with SEE-based lexical pairing where relevant), and (d) perceived impact (Access, Comprehension, Motivation–Autonomy, Transfer). Tags were applied with a 3-point ordinal weight (1–3) to indicate relative salience, supporting finer-grained interpretation of how participants framed their experience across channels and impacts.

Figure 8

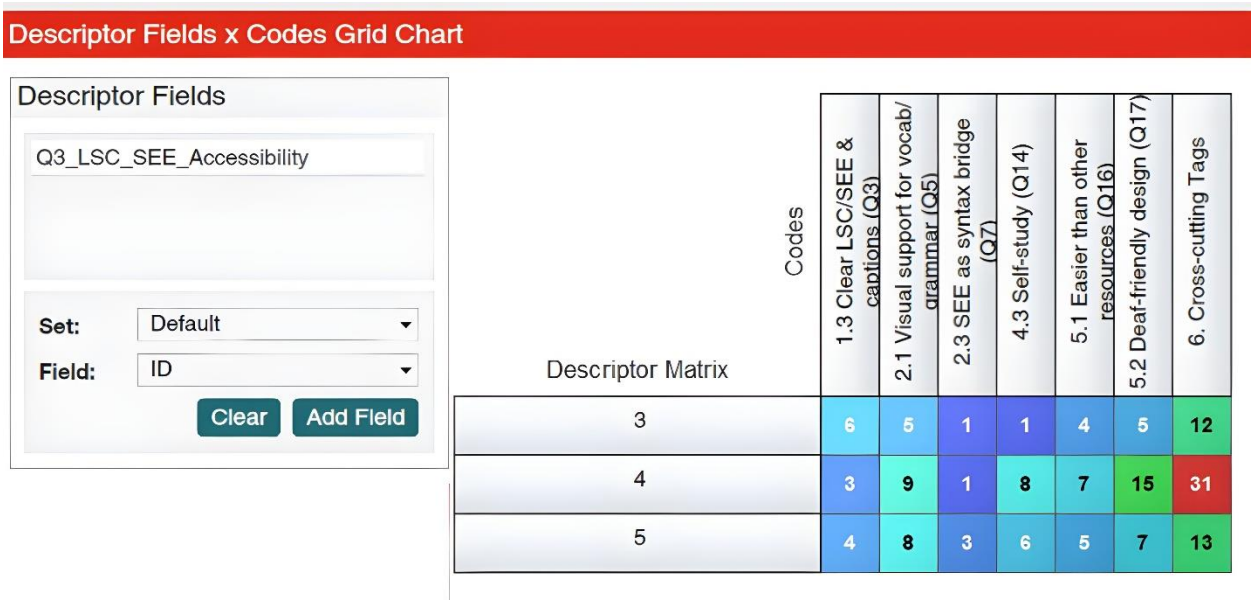
Concept Map: Emerging Categories in Deaf Language Learning Autonomy



To examine how thematic categories relate to a key accessibility indicator, a descriptor × codes matrix was used to display the distribution of coded excerpt applications across levels of the accessibility descriptor Q3_LSC_SEE_Accessibility and key subcodes (e.g., caption clarity, visual support, self-study, and Deaf-friendly design). Here, “descriptor” refers to the Likert rating selected by participants for Q3, used as a grouping variable to explore how coded meanings cluster around different levels of perceived accessibility.

Figure 9

Descriptor × Codes Matrix: Q3_LSC_SEE_Accessibility by Thematic Codes.



Note. The matrix reports coded excerpt application counts (i.e., the frequency with which codes/tags were applied to excerpts associated with each Q3 rating level). Here, descriptor is used in the software sense (a grouping field), not as a psychometric construct. A single excerpt may receive multiple codes/tags, and counts are not normalized by participant; therefore, values reflect coding density rather than prevalence. This method should be interpreted carefully and is suitable for exploratory pattern identification in a pilot DBR cycle. With significant concentrations in Cross-cutting Tags (31) and Deaf-friendly design (15), coding density is highest at rating 4. Visual support for vocabulary/grammar (9), self-study (8), and Easier than other resources (7) come next. By contrast, SEE as a syntax bridge appears infrequently across rating levels.

Taken together, this pattern suggests that participants' accessibility perceptions are most consistently associated with design-related features and multimodal supports, alongside

transversal themes captured through cross-cutting tags. **Source:** Author's analysis using Dedoose (SocioCultural Research Consultants, 2025).

Integrated View of the Findings

Taken together, the quantitative and qualitative strands indicate that learners experienced the VLO as broadly accessible, visually coherent, and responsive to Deaf learners' preferences for sign-supported, multimodal study. Strong levels of agreement in items related to self-study, Deaf-friendly design, and the desire for further resources of this type are consistently echoed in open-ended comments that emphasise expansion rather than replacement. Participants explicitly called for additional units, more short videos, more examples, and continued practice supported through LSC-led mediation and written English (e.g., "include more short videos, more examples, and more practice in both LSC and English," P-18). This convergence supports the interpretation that the VLO's design features—visual scaffolds, sign-first explanations, captions/subtitles, and structured progression—were not only positively perceived but experienced as practically usable for independent learning.

To reduce interpretive bias and avoid selective quotation, integration followed an explicit set of procedures aligned with the study's mixed-methods design logic. First, integration was triggered by (a) items with comparatively lower agreement and/or larger neutral bands (particularly Q3 and Q8, and secondarily Q11 and Q15), and (b) recurring themes identified in open-ended responses and LSC video comments. Second, excerpts were selected following a maximum-variation principle (positive, neutral, and critical) within each analytic dimension, prioritising comments that referred to a specific design feature and included an actionable implication. Third, a refinement priority was recorded when a barrier or theme appeared across at least two data sources (e.g., multiple open-ended responses or convergence between written and

video comments) and could be translated into a concrete design action. Patterns of convergence and divergence were systematically documented through triangulation matrices and the joint display (Appendix G).

The more moderate evaluations found in items related to sign-mediated accessibility accuracy and consistency (Q3) and self-reported confidence in English production (Q8) gain interpretive depth within this rule-governed integration logic when examined in conjunction with participants' qualitative accounts. Specific barriers that could plausibly contribute to neutral responses include technical problems that affect access ("Something should be fixed — the video doesn't play or show completely," P-01) and problems with accuracy in the sign layer ("The signs for 'she' and 'he' are the same and incorrect," P-15). These results suggest that, even in the absence of sign support, consistency and accuracy in sign/caption alignment are critical for perceived accessibility.

Excerpts pertaining to language production show that comprehension support does not always equate to confident written expression in a related but different way. One participant explicitly described English production as cognitively demanding and dependent on repetition (“Expressing myself in English is difficult for me… they require you to repeat a lot,” Est-02). From an interpretive standpoint, these accounts do not contradict the overall positive survey pattern; rather, they specify where further pedagogical strengthening is required—particularly in supporting the transition from comprehension to production through structured, confidence-building practice.

Overall, the integrated evidence indicates that the VLO is already functioning as a promising Deaf-centred resource that advances the core construct of Inclusive Autonomy. At the same time, the joint interpretation of both strands identifies clearly bounded priorities for a

subsequent design iteration. These include improving video delivery and technical reliability across devices, strengthening the consistency of LSC-led mediation and SEE-supported visual alignment, and expanding scaffolding for output-oriented tasks in written English.

Table 6

Joint Display Linking Quantitative Patterns and Illustrative Comments

Quantitative pattern	Related item(s)	Illustrative learner comment (translated; anonymised)	Integrated interpretation
Consistently high agreement across all items (≥ 75% in 18/18).	Q1, Q2, Q4, Q12, Q14, Q17, Q18	"The VLO makes learning easier for people who use LSC by helping them better understand English concepts." (P-02)	Learners value the VLO's accessibility as a practical aid for comprehension. The multimodal design (visual layout, sign-led explanation, and structured content) appears to sustain engagement and independent work and should remain central in future iterations.
Sign-mediated accessibility precision/consistency agreement is comparatively lower (Q3 = 75.9%).	Q3	"The signs for 'she' and 'he' are the same and incorrect." (P-15)	Slightly lower agreement plausibly reflects moments of perceived linguistic imprecision or inconsistency in the signed layer. This supports prioritising accuracy checks in high-frequency items, caption–subtitle alignment, and systematic review of recurrent language targets.
Neutral responses linked to technical interruptions.	Q3 and related access experience	"Something should be fixed — the video doesn't play or show completely." (P-01)	Neutral responses can be interpreted in light of access disruptions that reduce continuity of learning. Refinement should include video encoding and testing across devices, loading performance, and reliability of embedded media.
Confidence in written production remains more cautious (Q8 = 82.8%).	Q8	"Expressing myself in English is difficult for me… they require you to repeat a lot." (P-02)	To bridge comprehension into more assured production, learners might need extra output scaffolds (model texts, guided writing frames, incremental practice). Supports for

Quantitative pattern	Related item(s)	Illustrative learner comment (translated; anonymised)	Integrated interpretation
			accessibility should go beyond comprehension to performance tasks.
Strong appreciation for Deaf-friendly design and comparison with regular courses.	Q16, Q17, Q18	"The virtual English course is difficult because there is no interpreter. This VLO is better." (P-05)	The VLO reduces barriers typically experienced in interpreter-limited contexts by providing sign-mediated access. This reinforces its social-impact value while also pointing to the importance of institutional alignment (interpreters, teachers, and materials working coherently).
Requests for cultural and bilingual expansion.	Q12–Q15; Q17–Q18	"…explore how to adapt everything to Deaf culture so that the course is fully prepared." (P-19)	Learners are not only requesting accessibility but also culturally grounded development. Strengthening Deaf cultural integration and explicit bilingual connections may support motivation, identity affirmation, and sustained engagement with English as an additional language.

Note. Quantitative patterns are derived from item-level descriptive statistics (medians and percentage of agreement; scores 4–5), consistent with the study's descriptive and exploratory scope and its focus on prioritising redesign. Illustrative comments were translated into English and anonymised for reporting.

From a design-based perspective, this integrated picture supports a pragmatic conclusion: the VLO operates as a coherent and functional prototype within a bounded pilot cycle, while the combined evidence base provides a transparent and traceable foundation for iterative refinement in future cycles.

Operationalisation of Analytical Dimensions

The study did not test formal statistical hypotheses, nor did it seek to establish causal relationships. Instead, it followed an exploratory and descriptive logic consistent with a design-based, mixed-methods evaluation of an educational artefact (Cohen et al., 2018; Johnson & Onwuegbuzie, 2004). Consequently, the term *analytic dimension* is used throughout to refer to measured aspects of user experience captured through Likert-type indicators and interpreted through complementary qualitative evidence. These analytic dimensions function as organising constructs for reporting and integration, rather than as inferential constructs.

Across the dataset, questionnaire items and qualitative codes operationalised five dimensions of the VLO experience:

Educational Technology and Accessibility. Technical reliability, navigation, and visual layout, as well as the perceived accessibility of content through the VLO interface. In the qualitative strand, participants also referred to the role of written supports (e.g., subtitles/captions, where present) as part of their broader access experience.

Visual and Bilingual Mediation. Integration of LSC as the primary language of explanation (sign-first mediation), alongside SEE-based grammatical scaffolding; SEE-based lexical pairing as a mnemonic layer for vocabulary visualisation and recall; and the coordinated use of written text, images, and supporting written cues (including subtitles/captions, where present) to support vocabulary learning and comprehension of basic written English grammar.

Pedagogical Principles and Learning Organisation. Clarity of sequence, variety of activities, and the role of quizzes as mechanisms for self-check, consolidation, and guided progression through the learning pathway.

Knowledge Management and Self-Regulation. Perceived relevance of topics, encouragement for self-study, reflection on learning, and reported transfer of learning to practical or everyday communication purposes.

Comparative Experience and Cultural Relevance. Comparisons with other English learning resources, perceptions of Deaf-friendly design and sign-first positioning, and expressed demand for similar materials designed with Deaf learners in mind.

For each dimension, Likert-scale items provided structured indicators of participants' evaluations, while qualitative codes captured the meanings, explanations, and improvement-oriented suggestions that contextualised those ratings. The core category *Inclusive Autonomy* is therefore treated as an integrative interpretive construct emerging from convergent patterned meanings in the qualitative dataset, rather than as a variable to be statistically tested (Maxwell & Chmiel, 2014; Salmona et al., 2020). These operational dimensions also informed the organisation of the joint display and the integrated interpretation presented in the Integrated View of the Findings.

Integrative Interpretive Summary

Taken as a whole, the evidence gathered in this study shows how Deaf users of Colombian Sign Language (LSC) engaged with the multimodal VLO under authentic, asynchronous study conditions, reflecting both their available linguistic resources and the structural constraints that shape their experience in virtual education. The quantitative indicators offer an initial descriptive profile: most items received very high levels of agreement, while a

smaller group displayed comparatively more neutral or mixed distributions. These tendencies gain interpretive value when considered alongside participants' qualitative contributions, including open-ended responses and the supplementary post-use LSC video dataset (n = 6), which were used to contextualise patterns and support the identification of design-relevant refinement priorities.

Across the dataset, learners repeatedly clarified why particular features of the VLO supported their learning. They referred to the clarity of the signing, the visual rhythm and sequencing of activities, the availability of supporting written cues (including captions/subtitles where present), and the possibility of revisiting examples at their own pace. From an interpretive standpoint, one of the most consistent patterns concerns the central role of bilingual–visual mediation. Higher levels of agreement tended to coincide with moments where LSC-led explanations, SEE-based scaffolding, and written English operated in coordinated alignment. When this alignment weakened—whether due to perceived imprecision in the sign layer, reduced clarity in written supports, or insufficient modelling for production-oriented tasks—participants' evaluations shifted towards more moderate positions, particularly in relation to accessibility and confidence.

Autonomy and self-control in open and remote learning environments constitute a second interpretive strand. Participants appreciated the freedom to explore the VLO at their own pace and to revisit content without external pressure. Several comments characterised their learning experiences as "step by step" or "visually," indicating that visual organisation and structured sequencing facilitated their learning. These perspectives align with the high levels of agreement observed in the self-study, reflection, and perceived utility items. However, it seems that autonomy is most effectively experienced when accompanied by adequate scaffolding—

particularly for tasks involving the production of brief written texts and the transition from controlled practice to independent written expression. This is evident from requests for additional examples, extended practice, and more precise guidance in specific areas.

A third point relates to the cultural and affective dimension of the resource. Deaf-friendly design was not treated as a minor feature; rather, it shaped how learners understood and valued the VLO in relation to their previous educational experiences. Some participants specifically stated that it was "for Deaf people," citing the use of sign language and visually based explanations as essential components.

These remarks point to the importance of linguistic and cultural recognition in digital learning environments. They also reflect participants' positive views of Deaf-friendly design and their interest in using similar materials in the future.

In summary, the integrated interpretation indicates that the VLO created an accessible, motivating, and culturally responsive environment for foundational written English learning. At the same time, the findings make visible which components require refinement in a subsequent design cycle. The evidence therefore clarifies not only which elements were effective, but also why they mattered for learners and where targeted adjustments are needed to support sustained development in written English. In this sense, the results provide formative guidance for the next DBR iteration, in line with the study's refinement-oriented research focus.

Trustworthiness and Rigor of the Analysis

Because the study combined quantitative and qualitative strands with a linguistically diverse population, particular care was taken to ensure that the analysis met standards of rigour expected in graduate-level educational research. Rigour is addressed here through credibility,

dependability, confirmability, and transferability, using procedures appropriate for an exploratory, descriptive, mixed-methods evaluation of an educational artefact.

Credibility was strengthened through the use of multiple, convergent sources of evidence and through explicit integration procedures. Likert-type items provided a structured view of participants' perceptions, while open-ended responses (Q19–Q20) and the supplementary post-use LSC video dataset (n = 6)—including three participant-initiated spontaneous opinion clips and three informal interview-style reflections—added explanatory depth that could support or qualify the quantitative tendencies. Integration was treated as a documented analytic step rather than as a purely narrative move: triangulation matrices and a mixed-methods joint display were used to connect item-level patterns (frequencies, medians, and agreement rates) with illustrative excerpts and coded themes. This allowed the analytic pathway to remain visible, showing how interpretations were derived through convergence, divergence, and expansion across sources (see Appendix G and the descriptor × codes exploration reported in the Integrated View of the Findings). In addition, the inclusion of LSC-based video prompts for questionnaire items reduced reliance on written English for comprehension, thereby lowering the risk that misunderstandings in written English might distort responses.

Dependability was supported by maintaining a transparent record of analytic steps and by stabilising the qualitative coding scheme through iterative refinement. Questionnaire responses were exported, screened for completeness and duplicates, and organised using a consistent file structure. Descriptive calculations (frequencies, medians, agreement rates, and item means reported descriptively) were generated from the cleaned dataset and presented through tables and graphs (see Appendix J; see also Appendix D for data-handling records).

For the qualitative strand, the dataset was examined through iterative coding and constant

comparison in Dedoose, guided by a structured codebook with explicit definitions and exemplar anchors (see Appendix F). As new nuances emerged, refinements to code definitions or boundaries were tracked through versioned updates to the codebook and verified through repeated review of coded excerpts to ensure coherence and consistent application. Any category consolidation was justified by re-checking representative excerpts against updated definitions. To strengthen intra-coder consistency, the codebook was finalised after stabilisation, followed by a verification phase conducted in two ways: (1) a targeted spot-check of coded excerpts against the finalised definitions to confirm consistency of application, and (2) a full verification of all verbatim excerpts used in reporting (n = 16) by cross-checking each excerpt against the original Dedoose export. Together, these procedures increase confidence that reported quotations accurately reflect the source data and that coding decisions remained aligned with the finalised codebook (see Appendix E for translated verbatim excerpts).

Confirmability was addressed by anchoring interpretations as closely as possible to visible evidence and by maintaining a clear distinction between description and inference. Quantitative statements are supported by item-level indicators (frequencies, medians, and agreement rates), while qualitative claims are illustrated through anonymised excerpts and clearly signposted coded patterns rather than personal impressions. Interpretations are framed proportionately to the dataset and explicitly linked to the items, categories, and excerpts that informed them, allowing the reader to follow the analytic trail.

To minimise the influence of prior knowledge about specific individuals, identifiers were removed prior to analysis and neutral participant labels (P-XX; Est-XX) were used throughout. Meanings derived from the six post-use LSC videos were checked through repeated replay to confirm accuracy and preserve pragmatic force across the Spanish interpretation and the English

rendering. The resulting excerpts are presented as meaning-preserving analytic renderings for reporting purposes rather than as definitive, time-aligned transcripts. Procedures for codebook development, versioning, and coding verification are detailed under Dependability. In addition, mixed-methods integration followed explicit decision rules (see Appendix G), ensuring that links between comparatively lower-endorsement items, retrieved qualitative excerpts, and recorded refinement priorities remain transparent and open to inspection. In accordance with current guidelines for qualitative research in digital and online contexts, the additional LSC video reflections were handled ethically and reported descriptively (Braun & Clarke, 2025; Thomas et al., 2024).

Transferability was approached not through statistical generalisation, but through sufficiently rich contextual description and design specification. The thesis outlines the institutional context at UNAD, the characteristics of Deaf LSC users in virtual programmes, and the design features of the VLO with enough detail for readers in comparable contexts to judge relevance and applicability. The combined reporting of (a) overall descriptive trends and (b) specific features highlighted by participants (e.g., sign-first mediation, captions/subtitles, structured sequencing, and self-paced navigation) supports a grounded assessment of which insights may plausibly transfer to other settings serving Deaf sign language users or learners who benefit from multimodal, self-paced resources.

Taken together, these procedures aim to ensure that the analysis remains systematic, traceable, and closely aligned with participants' lived experiences. The intention is not to claim definitive or universal effects, but to present conclusions that are proportionate to the evidence, transparent in their derivation, and useful for informing refinement in the next DBR iteration.

Implications for the Next Design-Based Research Cycle

Design-Based Research (DBR) assumes that educational innovations evolve through successive cycles of design, implementation, and evaluation (McKenney & Reeves, 2018; The Design-Based Research Collective, 2003). In line with this logic—and in direct response to the refinement-oriented focus of SRQ4—the findings of this pilot evaluation provide concrete guidance for the next iteration of the VLO and for broader work in inclusive English teaching with Deaf university students in open and distance contexts. Importantly, the implications outlined below are grounded in the integrated evidence: the overall positive descriptive pattern across items, together with more moderate endorsement in selected indicators (e.g., Q3 and Q8, and, to a lesser extent, Q11 and Q15), as well as the explanatory depth provided through open-ended responses and the post-use LSC video dataset (n = 6).

A first implication concerns the refinement of bilingual–visual mediation. Participants' feedback shows that the combination of LSC-led explanation, SEE-based support, and written English was generally useful. At the same time, several comments point to specific areas that need adjustment, particularly in relation to sign choice, caption clarity, and the consistency of written examples. These issues do not undermine the overall value of the resource, but they indicate where small refinements could improve clarity. In a next iteration, this may involve revisiting some video segments, checking the alignment between SEE and written forms, and adding a few more examples where needed—especially in relation to high-frequency pronouns, core vocabulary, and the verb to be. In addition, if future iterations extend the learning pathway into further modules (e.g., Writing Practice, Filling an Application, and Interview Practice), improving coherence between the signed layer and written exemplars is likely to support both comprehension and learners' perceived confidence when engaging in output-oriented tasks.

A second implication relates to the amount and type of practice available. In general, students performed well on the current exercises and tests (e.g., work on pronouns and to be, as well as tasks like matching and word finding). However, several comments emphasise the need for additional practice opportunities and examples. This could be addressed by extending current tasks, such as adding short sentence frames, slightly different examples, or short writing prompts that progressively lead to more independent production, rather than creating completely new sections. In this way, the shift from recognition to use may be less abrupt and learners may find it easier to maintain continuity in their work.

A third implication relates to technical robustness and device compatibility. Some participants reported that videos did not load properly or appeared incomplete. Although these cases were not frequent, they point to the need for more systematic testing in the next iteration of the VLO—especially on mobile devices and under low-bandwidth conditions. This should cover video playback, embedded activities, navigation flow, and caption readability. In a distance education context, where many learners rely on unstable connections or shared devices, ensuring consistent performance is not a minor issue but a basic requirement. These observations also help explain part of the neutral responses linked to interruptions in access.

A fourth implication relates to identity and cultural resonance. In addition to appreciating the Deaf-friendly design, participants indicated a desire for closer ties to Deaf culture and sign language customs. This suggests that future versions could include more explicit references to Deaf lived experience and community contexts. For example, short everyday scenarios, brief notes that position LSC as a full language alongside English, or small optional sections that acknowledge learners' linguistic repertoires (LSC supported by SEE-based visual scaffolding and stable sign–word pairings) may be appropriate. The aim is not to add content

indiscriminately, but to reinforce the idea that these resources are legitimate for learning, rather than auxiliary or remedial. Such adjustments may support motivation, reduce distance from the content, and make English learning feel more meaningful, while preserving the sign-first approach that participants consistently valued.

Finally, the emergence of Inclusive Autonomy as a core category offers a useful direction for the ongoing DBR process. The next iterations can continue to prioritise conditions that allow learners to work independently while remaining supported at both linguistic and pedagogical levels. In practical terms, this means maintaining a balance between flexibility and structure, keeping sign-led and visual mediation at the centre of the design, and using learner feedback as a basis for gradual refinement rather than as isolated corrections.

In this way, the next cycle can extend the VLO's contribution to more equitable and accessible English learning in virtual and hybrid environments. These implications are treated as formative redesign priorities emerging from the integrated dataset. Their significance is interpreted through the theoretical lens of UDL, Deaf bilingual–bicultural perspectives, and design-based research in inclusive digital pedagogy, while keeping claims proportionate to the pilot scope and the formative purpose of the evaluation.

Discussion and Conclusions

Discussion

This study set out to understand how a multimodal Virtual Learning Object (VLO), designed under Universal Design for Learning (UDL) principles, could support Deaf users of Colombian Sign Language (LSC) as they began to develop basic written English at the A1 level. The findings suggest that the resource did more than offer "accessible materials." Rather, it created a learning space in which visual, signed, and written modes worked together in ways that participants repeatedly described as meaningful and manageable. In the quantitative strand (n = 29), responses across the 18 Likert items showed consistently high levels of agreement in most indicators, while the qualitative evidence helped explain why particular features were experienced as supportive—or, in a smaller number of cases, how specific access and mediation constraints qualified the overall pattern. This is consistent with the rationale of transparent mixed-methods integration in language-learning research: patterns matter, but the reasons behind those patterns are often where the pedagogical account becomes more credible and defensible, particularly in formative, refinement-oriented work.

In relation to the main research question, which examined how a sign-first, multimodal VLO could support Deaf LSC users' initial development of A1 written English, the findings indicate that the resource functioned not merely as an accessible tool, but as a coherent learning environment in which visual, signed, and written modes worked together in pedagogically meaningful ways.

The category discussion in the Data Analysis and Results already showed how Technological Access, Multimodal Mediation for English, Pedagogical Organisation, Self-Regulation and Relevance, and Comparison and Cultural Relevance converge in the core

construct of Inclusive Autonomy in Deaf Language Learning. The present section extends that interpretation. In line with Gray's reminder that a discussion chapter should relate findings to the research questions and the literature rather than simply restate results (Gray, 2014), the analysis here focuses on what the convergent categories suggest about inclusive digital pedagogy for Deaf learners and how the findings speak back to prior scholarship.

In response to SRQ2, and consistent with the needs patterns noted for SRQ1, the results indicate that carefully engineered multimodal design can support Deaf learners' access to written English in ways that go beyond accommodation. The coordinated use of LSC video explanations, SEE-based pedagogical coding scaffolds (for grammar), SEE-based lexical pairing for vocabulary visualisation, captions/subtitles, and visual organisers enabled participants to link sign-based mediation with written input through a coherent, step-by-step sequence.

Importantly, this design choice is not grounded in the assumption that Deaf Colombians "should" pair English with any particular external sign language. Rather, it acknowledges two sociolinguistic realities that commonly coexist in Deaf learners' language ecologies: (a) Colombian Deaf signers often engage in lexical pairing between Spanish terms and LSC (and vice versa) as part of everyday bilingual meaning-making; and (b) in practice, widely disseminated resources for representing English vocabulary in a signed form frequently rely on SEE-based manual coding representations that make selected aspects of English morphology visually explicit through systematic markers. In this study, the target language remains written English, while SEE functions as a pedagogical coding scaffold to make English form and vocabulary more visible and memorable within a sign-first logic anchored in LSC. SEE is treated as coding support rather than as a community language.

From a Universal Design for Learning (UDL) perspective, participants' accounts indicate that the VLO did not simply align with the three core principles in abstract terms, but made them visible in practice. Representation was mainly supported through LSC-led explanations, complemented by SEE-based visual cues that made aspects of English grammar more explicit, alongside written models. Engagement was associated with the way the resource was organised—particularly its clear sequencing, the possibility of working at one's own pace, and a learning environment that several participants described as calm and manageable. Through guided writing assignments and comprehension exercises that did not rely on auditory input, students were able to respond in terms of action and expression. In this way, UDL principles became apparent in how participants interacted with and understood the material rather than being viewed as impersonal rules (CAST, 2024a; Seymour, 2024).

Within that sign-first logic, participants did not describe the VLO as merely "translated" or "interpreted;" they described it as structured and intelligible, with visual supports that reduced cognitive load while making English forms feel learnable. For example, one participant emphasised the appeal and clarity of the resource: "I found it interesting and enjoyable… It includes visual explanations, clear subtitles, and sign language, which make it much easier to understand the VLO videos" (P-07). This interpretation resonates with Huertas and Oyola's argument that explicit, visually supported lexical work can strengthen vocabulary command and support self-directed reading (Huertas Torres & Oyola Gamboa, 2017); here, that principle is extended to Deaf learners, who used bilingual and visual cues not only to decode words but also to construct simple A1 sentences.

Addressing SRQ3, the categories connected to Pedagogical Organisation and Self-Regulation highlight the value of structured and revisitable tasks for fostering autonomy.

Learners repeatedly framed the experience as “step by step” and appreciated being able to return to explanations when unsure. One participant, for instance, stated that the resource was “very clear and not confusing” and that it “guides me step by step” (P-28). This is consistent with Acosta, Colina, and Eguis’s emphasis on interactive strategies that support autonomy in virtual higher education (Acosta Calderon et al., 2024), while also pointing to a Deaf-specific nuance: self-regulation appears to be more achievable when the learning environment provides clear sequencing, regular opportunities to check understanding, and explicit connections between English content and practical communication. In other words, autonomy is not treated as a fixed personal trait; it appears to develop through design conditions that reduce uncertainty, support revisiting, and keep the learning pathway navigable. This reading is also consistent with the modest distributional shifts observed in the quantitative strand, where comparatively larger neutral response proportions and/or lower endorsement in Q3 and Q8 signalled specific friction points without contradicting the overall positive pattern.

Additionally, the findings point to a broader issue: designing for inclusion is not only a matter of usability, but also of how learners are positioned culturally and emotionally within the learning environment. Marín et al. (2023) warn that research in educational technology may unintentionally create what they describe as “invisible borders” across contexts, particularly when dominant academic languages obscure or simplify differences in meaning (pp. 1349–1350). This perspective helps interpret what occurred in this study. Rather than treating accessibility as a set of add-on features, the VLO was structured around sign-mediated explanation and visual scaffolding from the outset.

Participants’ accounts reflect this orientation in concrete terms. For example, P-11 described sign mediation as essential for equitable access, noting that it “ensures that Deaf

students have full access to information," and went on to characterise the resource as "very clear" and "excellent" (Open-ended Q19). Similarly, P-28 emphasised not only clarity but also the way the resource was organised and experienced: "this one is very clear and not confusing… It guides me step by step," adding that it "makes me feel good and calm" (Open-ended Q19).

Taken together, these responses suggest that accessibility was experienced less as a technical provision and more as a way of organising the learning experience—one that recognises language, identity, and emotional engagement as integral to meaning-making.

In relation to SRQ4, Inclusive Autonomy synthesises how accessibility, pedagogy, and cultural recognition intersected in this evaluation, helping the study interpret—not merely list—why the operational redesign priorities outlined in Implications for the Next Design-Based Research Cycle matter within Deaf learners' linguistic ecology and UDL-informed design.

In line with Mackey and Gass's emphasis on making learners' strategy use and reasoning visible—not only their outcomes (Mackey & Gass, 2011)—the qualitative evidence shows participants articulating autonomy as something they were actively developing through interaction with the VLO. One learner stated plainly: "I'm also learning to use the VLO itself and to become more autonomous in learning English" (P-17). This matters because it positions autonomy not as a generic ideal, but as something observable within participants' accounts of engagement with the resource. Overall, the discussion suggests that Inclusive Autonomy is indicated in this dataset as an emergent, design-derived construct when multimodal resources are intentionally designed for Deaf learners' linguistic ecology rather than retrofitted from hearing-centred models.

Research Implications for the Field of Study

In addition to its local application at UNAD, this study contributes to current conversations about inclusive educational technology and English language teaching (ELT). From a pedagogical standpoint, the evidence indicates that sign-first, visually mediated learning environments can constitute a viable pathway for Deaf students in higher education to engage with CEFR A1 written English without reliance on auditory channels. This position is grounded in the mixed-methods evidence (n = 29), where all 18 Likert items reached at least 75% agreement (scores 4–5), while participants' accounts clarified why the design was perceived as workable—most notably through recurring references to clarity, structured progression, and emotional reassurance. Following the integration decision rules established in the Data Analysis and Results section, the comparatively moderate distributions in Q3 and Q8 are interpreted as signals for refinement rather than as contradictory evidence. In this context, the design criteria articulated in the conceptual framework—sign-first mediation, multimodal scaffolding, micro-task structuring, and pedagogical coding supports—demonstrate how UDL principles can be translated into operational features that respond to Deaf learners' conditions and sustain what this study conceptualises as Inclusive Autonomy in Deaf Language Learning.

These results raise practical questions about how institutions define English language requirements for Deaf students. In this study, access was not achieved by placing learners into existing virtual courses, but by reconsidering how those resources are designed from the outset. The VLO was structured around LSC-mediated explanation, visual support for written language, and an explicit recognition of Deaf learners' cultural and linguistic positioning as foundational design conditions.

Seen in this way, inclusion appears less as a matter of access to existing provision and more as a matter of design orientation. What matters is not only whether learners can enter a system, but how that system is designed to recognise their linguistic and cultural conditions. This understanding aligns with perspectives that bring together research, educational innovation, and social impact, where innovation is expected to respond to real educational conditions while maintaining conceptual rigour (Waterhouse et al., 2022). From this standpoint, the VLO can be understood as a small but carefully documented intervention that contributes to ongoing institutional discussions on language policy, equity, and curriculum design, particularly by making explicit how specific design decisions shape learner experience.

Looking beyond this specific context, the findings suggest that digital designs informed by UDL may also support other learners who benefit from multimodal input and the possibility of working at their own pace. However, the central implication is not primarily technical, but pedagogical and ethical. Recent work has called for renewed attention to the human dimension of technology-mediated education, questioning approaches that prioritise efficiency over lived experience (Al-Tawil & Hoven, 2024). The findings in this study resonate with that concern. Participants described accessibility not only in terms of features, but also in terms of how those features made it easier to understand content, progress with less uncertainty, and engage without the tension often associated with inaccessible materials. In this sense, accessibility was described less in terms of tools and more in terms of how the resource supported understanding, confidence, and a more comfortable learning experience.

Finally, the study contributes a methodological implication. The combination of Design-Based Research (DBR) and a mixed-methods approach proved particularly appropriate for examining inclusive digital interventions in ELT. The iterative sequence of design,

implementation, and refinement enabled responsive adjustments based on participant feedback—such as clarifying instructions, improving sign–video alignment, and planning additional practice opportunities—while maintaining a structured account of both quantitative tendencies and qualitative explanations. In this way, the study outlines an adaptable pathway for evaluating Virtual Learning Objects (VLOs) and similar resources developed for diverse student populations, including Deaf sign language users (McKenney & Reeves, 2018; The Design-Based Research Collective, 2003).

Research Limitations of the Present Study

As with any exploratory project, certain limitations frame how the findings should be interpreted. Following Gray's emphasis on making explicit the conditions under which results are produced (Gray, 2014), and Mackey and Gass's call for transparency regarding sample and context (Mackey & Gass, 2011), the following considerations help situate the scope of the evidence presented.

First, the sample was relatively small (n = 29) and drawn from a specific population: Deaf LSC users enrolled in UNAD programmes who opted to participate voluntarily. For this reason, the quantitative patterns are not intended to be statistically generalisable to all Deaf learners in Colombia or Latin America. Rather, they should be understood as context-bound indicators whose interpretive strength lies in their convergence with the qualitative accounts.

Second, the evaluation period was relatively short, and some participants reported technical issues, such as incomplete video playback and segments that required adjustment in terms of sign accuracy and consistency. These issues may have shaped responses to certain indicators, particularly those related to learners' confidence when introducing themselves (Q8) and to sign-mediated accessibility (Q3). Extending the implementation period, together with

more systematic testing across devices and bandwidth conditions, would help determine whether such issues are occasional or more persistent.

Third, the evaluation relied primarily on self-reported perception measures (Likert-type items and open-ended responses), complemented by a small post-use video corpus in LSC. This corpus comprised six clips: three spontaneous opinion recordings initiated by participants and three informal, interview-style reflections based on conversational prompts rather than structured protocols. This approach was appropriate for capturing participants' perspectives within authentic self-paced study conditions while piloting a usable support resource. At the same time, the resulting evidence base is more robust for interpreting reported experiences than for tracing the fine-grained processes through which participants interacted with the VLO—such as navigation patterns, points of difficulty, or real-time use of scaffolds. Future iterations could therefore incorporate lightweight, accessibility-sensitive process data (e.g., optional navigation traces, short guided walkthroughs, or brief follow-up prompts in LSC) to enable a more detailed understanding of learner interaction while maintaining feasibility and ethical alignment.

Finally, because participation was voluntary, the possibility of self-selection bias cannot be ruled out. Those who chose to take part may have been more motivated, more comfortable with technology, or more interested in learning English than those who did not participate. Consequently, the dataset represents the experiences of a particular subset of study participants. These factors should be considered when interpreting the findings, as mentioned in discussions of participation and access in educational research (Costello et al., 2023). Therefore, rather than being broad statements about the experiences of all Deaf learners, the results are best interpreted as formative evidence that can guide future refinement.

Recommendations for Further Research

Several avenues for additional research become apparent in light of these constraints and the project's formative nature.

Extending the VLO to a broader and more diverse group of Deaf sign language users—including LSC users—and, where relevant, hard-of-hearing learners would help situate the findings beyond the specific conditions of this study. Incorporating participants from different regions and with varied educational trajectories would allow for more informative comparisons across subgroups—for example, in relation to age, prior exposure to English, literacy histories, or access to stable connectivity—and would strengthen the transferability of the findings beyond the present institutional context.

In response to the reliance on self-reported data and the need for more detailed process evidence, subsequent DBR cycles could incorporate additional accessibility-sensitive qualitative approaches. These may include semi-structured interviews conducted in LSC, small focus groups with clearly defined protocols for turn-taking and consent in signed interaction, or guided screen recordings in which participants explain how they navigate the resource. Such approaches would support a more detailed account of how learners interpret visual cues, negotiate meaning across LSC and written English, and develop self-regulation strategies over time—particularly when encountering ambiguity, technical interruptions, or issues related to sign accuracy and sign–caption alignment.

A related line of inquiry could examine how Deaf learners in Colombia naturally engage in Spanish–LSC lexical pairing and whether similar strategies could be adapted to support English vocabulary development without displacing LSC as the primary language of access.

Further work could extend the VLO beyond self-introduction and basic A1 content by gradually incorporating more complex grammar and language used in everyday situations. Research in related contexts (Chomicz, 2025) suggests that technology-supported writing environments can help learners develop vocabulary, gain better control of grammatical forms, and organise their ideas more clearly. These tools have also been associated with increased confidence in writing among Deaf and hard-of-hearing learners. Future iterations in this direction might incorporate more structured writing assistance and feedback as part of the learning sequence, while making sure that digital tools continue to support pedagogical guidance rather than take its place.

Although this study does not allow for comparisons across different models of inclusion, this would be a valuable direction for future research. It would be useful to examine how Deaf learners progress under different instructional conditions—for example, comparing participation in mainstream English courses supported by interpreters with engagement in visually and bilingually designed environments such as the VLO developed here. Looking at these contrasts could help clarify not only differences in written outcomes, but also how learners experience the process in terms of motivation, identity, and sense of belonging, all of which are closely related to persistence in language learning.

There is also room to explore how the idea of Inclusive Autonomy might extend beyond the design of a single resource. Future research could look at how tutors and interpreters work with sign-first materials, how roles are negotiated in hybrid or virtual settings, and how institutional accessibility policies connect with the linguistic realities and educational priorities of Deaf communities. Exploring these aspects would help situate the concept within everyday educational practice, rather than leaving it only at an analytical level.

Conclusions

Taken together, the evidence gathered in this project portrays a learning environment in which Deaf LSC users engaged with a multimodal VLO in ways that reflect both their existing strengths and the structural barriers they routinely encounter in virtual higher education. Across the mixed-methods dataset (n = 29), descriptive questionnaire patterns converged with open-ended accounts and the six post-use LSC videos (spontaneous opinions and informal interview-style reflections), suggesting that carefully designed visual and bilingual mediation can make A1 written English more accessible, more meaningful, and more aligned with Deaf learners' linguistic and cultural positioning.

A central contribution of the study lies in the operationalisation of Inclusive Autonomy: an approach in which accessibility, multimodality, and learner agency are understood as interdependent dimensions of inclusive pedagogy rather than as separate concerns. In this thesis, Inclusive Autonomy is framed as a context-bound, design-derived construct emerging from convergent evidence, rather than as a universal model or prescriptive framework. The findings indicate that when virtual resources are structured from a sign-first perspective—through the coordination of LSC video mediation, SEE-based pedagogical coding scaffolds for grammar, SEE-based lexical pairing as mnemonic support, SignWriting, images, and written text—learners may be better positioned to regulate their pace, revisit explanations, reflect on progress, and connect basic English forms with practical communicative purposes. While this does not eliminate all learning challenges, it does point to a clear advantage over audio-dependent approaches, which often fail to provide equivalent entry points for Deaf learners in fully virtual contexts.

From a methodological perspective, the project demonstrates how a small-scale, design-based mixed-methods evaluation can generate evidence that is both context-sensitive and theoretically informative. Rather than advancing universal claims or causal assertions, the study presents conclusions that are proportionate to the evidence, transparent in their basis, and oriented toward refinement. In this sense, the findings function as formative evidence: they document what participants valued, where tensions emerged—such as sign–caption alignment and occasional technical interruptions—and which design priorities warrant attention in a subsequent iteration of the VLO. Consistent with the study's integration logic as developed in the Data Analysis and Results section, the comparatively moderate distributions observed in Q3 and Q8 are interpreted as refinement signals rather than as indicators of rejection.

From an institutional perspective, the findings suggest the need to move beyond minimum-compliance approaches to accessibility and to recognise inclusive digital design as a core dimension of educational quality. In contexts where Deaf sign language users engage with English requirements through virtual provision, this implies developing structured sequences of VLOs, strengthening faculty preparation in bilingual–visual pedagogy, and revisiting language requirements in light of Deaf learners' linguistic realities. Such steps would contribute to a more equitable model of language education, while remaining attentive to the study's contextual scope and the need for continued iterative evidence.

Answers to the Research Questions (verifiable alignment)

SRQ1 (Reported Communicative, Technological, and Pedagogical Needs). The findings indicate that participants' reported needs were closely linked to conditions of access and mediation. There was a consistent emphasis on sign-first explanation (LSC), clear visual scaffolding, and stable written supports (e.g., captions/subtitles) to make early written English

accessible and manageable (see category convergence and participant accounts in the Data Analysis and Results and Discussion sections).

SRQ2 (Visual, Bilingual, and Multimodal Resources Integrated into the VLO Design). The coordinated use of LSC explanations, SEE-based pedagogical coding scaffolds, SEE-based lexical pairing, captions/subtitles, and visual organisers was consistently described as supportive. At the same time, isolated issues related to sign–caption alignment and technical interruptions were identified as priorities for refinement, particularly in relation to Q3 and Q8 and their qualitative explanations (see Research Limitations and Recommendations for Further Research).

SRQ3 (Perceived Accessibility, Usability, Pedagogical Organisation, and Usefulness). Participants described autonomy and self-regulation as emerging from structured sequencing, revisitable explanations, and predictable task organisation ("step by step"), suggesting that self-regulation was enabled by design conditions rather than treated as a fixed learner trait (see Discussion section, Pedagogical Organisation and Self-Regulation).

SRQ4 (Refinement Priorities for the Next DBR Cycle). Inclusive Autonomy integrates how accessibility, pedagogy, and cultural recognition intersected in participant-reported experience and category convergence, informing concrete priorities for subsequent DBR iterations (see Discussion, Research Limitations, and Recommendations for Further Research).

In this sense, the study suggests that when technology, pedagogy, and Deaf culture are brought into genuine dialogue, virtual English learning does not need to reproduce existing inequalities. Rather, it can become a space in which Deaf learners' linguistic repertoires are recognised, their autonomy is supported through accessible and meaningful mediation, and their

participation in higher education is approached as a concrete design commitment rather than a rhetorical aspiration.

Bibliography

Abata Checa, F. M., & Proaño León, S. V. (2024). Experiences of Teaching English to a Deaf University Student. *Salud, Ciencia y Tecnología - Serie de Conferencias*, *3*. https://doi.org/10.56294/sctconf2024.658

Acosta Calderon, C. A., Colina Sánchez, D. M., & Eguis Badillo, M. R. (2024). Estrategias de enseñanza y aprendizaje que promueven el pensamiento crítico en los estudiantes de la Escuela de Ciencias de la Educación de la UNAD en Valledupar. *EducAcción Sentipensante*, *3*(2), 15–34. https://doi.org/10.22490/28057597.6763

Adigun, O. T., Mathosa, M., & Anyanwu, C. J. (2025). The implication of translanguaging on the linguistic competencies of deaf students. *Frontiers in Communication*, *10*, 1515836. https://doi.org/10.3389/fcomm.2025.1515836

Al-Tawil, R., & Hoven, D. (2024). Threading Humanity Back into Education and Educational Research. *Open Praxis*, *16*(2), 269–279. https://doi.org/10.55982/openpraxis.16.2.644

Braun, V., & Clarke, V. (2025). Reporting guidelines for qualitative research: A values-based approach. *Qualitative Research in Psychology*, *22*(2), 399–438. https://doi.org/10.1080/14780887.2024.2382244

Brown, A. L. (1992). Design Experiments: Theoretical and Methodological Challenges in Creating Complex Interventions in Classroom Settings. *Journal of the Learning Sciences*, *2*(2), 141–178. https://doi.org/10.1207/s15327809jls0202_2

CAST. (2024a). *CAST Universal Design for Learning Guidelines version 3.0.* Retrieved from https://udlguidelines.cast.org

CAST. (2024b). *Universal Design for Learning Guidelines version 3.0* [Graphic organizer]. Lynnfield, MA: Author. https://udlguidelines.cast.org/

Castañeda Villamizar, M. J., & Palomino Solera, N. del C. (2025). *El servicio de interpretación para sordos en entorno universitario modalidad remota: Una mirada desde la experiencia empírica* [Monografía de pregrado, Universidd del Valle]. https://hdl.handle.net/10893/38923

Cenoz, J., & Gorter, D. (2021). *Pedagogical Translanguaging* (1a ed.). Cambridge University Press. https://doi.org/10.1017/9781009029384

Chomicz, M. (2025). Enhancing EFL writing skills for adult Deaf and hard of hearing individuals. *Frontiers in Education*, *9*, 1504503. https://doi.org/10.3389/feduc.2024.1504503

Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education* (eighth edition). Routledge. www.routledge.com/cw/cohen

Congreso de la República de Colombia. (1996). *Ley 324 de 1996. Por la cual se reconoce oficialmente la Lengua de Señas Colombiana (LSC)*. Diario Oficial Nº 42.836. https://www.funcionpublica.gov.co/eva/gestornormativo/norma_pdf.php?i=349

Congreso de la República de Colombia. (2013a). *Ley 1651 de 2013 – "Por medio de la cual se modifican los artículos 13, 20, 21, 22, 30 y 38 de la Ley 115 de 1994 y se dictan otras disposiciones (ley de bilingüismo)"*. https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=53770

Congreso de la República de Colombia. (2013b). *Ley Estatutaria 1618 de 2013. Por medio de la cual se establecen las disposiciones para garantizar el pleno ejercicio de los derechos de las personas con discapacidad.* https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=52081

Consejo Superior Universitario de la Universidad Nacional Abierta y a Distancia (UNAD). (2025, julio 30). *Acuerdo No. 028 del 30 de julio de 2025: Por el cual se adopta la política diferencial formativa en el marco de la evolución del Modelo Pedagógico Unadista hacia el Modelo Heutagógico Unadista Solidario 5.0*. Secretaría General. https://sgeneral.unad.edu.co/images/documentos/consejoSuperior/acuerdos/2025/ACUE_COSU_028_30072025.pdf

Corte Constitucional. (2002). Sentencia 128 de 2002. *Expediente D-3668.*

Costello, E., Brunton, J., Bolger, R., Soverino, T., & Juillerac, C. (2023). Massive Omission of Consent (MOOC): Ethical Research in Educational Big Data Studies. *Online Learning*, *27*(2). https://doi.org/10.24059/olj.v27i2.3759

Council of Europe. (2020). *Common European Framework of Reference for Languages: Companion Volume*. Council of Europe Publishing. www.coe.int/lang-cefr

Cousins, J. B., Hoang, J., Yilma, L., Zha, Y., Bould, D., Gacii, V. M., Subramanian, B., & Evans, F. (2024). Using Dedoose to "Quantitize" Qualitative Data in Mixed Method Analysis: A Case Analysis. *Canadian Journal of Program Evaluation*, *39*(1), 83–96. https://doi.org/10.3138/cjpe-2023-0040

da Rocha Costa, A. C., & Dimuro, G. P. (2002). SignWriting-Based Sign Language Processing. En I. Wachsmuth & T. Sowa (Eds.), *Gesture and Sign Language in Human-Computer Interaction* (pp. 202–205). Springer Berlin Heidelberg. https://link.springer.com/chapter/10.1007/3-540-47873-6_22

Devia Robayo, H. I. (2017). *Análisis documental para la elaboración de Objetos Virtuales de Aprendizaje en educación inclusiva, para estudiantes Sordos en educación superior*

virtual y a distancia [Monografía (Especialización), Universidad Nacional Abierta y a Distancia UNAD]. https://repository.unad.edu.co/handle/10596/13042

Devia Robayo, H. I. (2024). *Roles y funciones de los consejeros académicos de apoyo tutorial para sordos en la Universidad Nacional Abierta y a Distancia – UNAD* [Tesis de Maestría]. Universidad Nacional Abierta y a Distancia UNAD.

Dostal, H. M., Scott, J. A., Chappell, M. D., & Black, C. (2025). A Scoping Review of Literacy Interventions Using Signed Languages for School-Age Deaf Students. *Behavioral Sciences, 15*(8), 1104. https://doi.org/10.3390/bs15081104

Dostal, H., Scott, J., Gediel, A., Vilhalva, S., & Gasparin, C. (2024). Literacy and signing deaf students: A multi-national scoping review. *Journal of Deaf Studies and Deaf Education, 29*(4), 467–484. https://doi.org/10.1093/jdsade/enae023

Fàbregues, S., Younas, A., Escalante-Barrios, E. L., Molina-Azorin, J. F., & Vázquez-Miraz, P. (2024). Toward a Framework for Appraising the Quality of Integration in Mixed Methods Research. *Journal of Mixed Methods Research*, *18*(3), 270–280. https://doi.org/10.1177/15586898241257555

Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving Integration in Mixed Methods Designs—Principles and Practices. *Health Services Research*, *48*(6pt2), 2134–2156. https://doi.org/10.1111/1475-6773.12117

Feulner, B., Rosendahl, N., & Serwene, P. (2026). Design Principles in Focus: A Scoping Review of their Use in Design-Based Research. *EDeR. Educational Design Research*, *10*(1). https://doi.org/10.15460/eder.10.1.2437

Fraefel, U. (2014). *Professionalization of pre-service teachers through univer- sity-school partnerships*. 1–13.

Galea, M. (2014). *SignWriting (SW) of Maltese Sign Language (LSM) and its development into an orthography: Linguistic considerations* [Doctoral dissertation, University of Malta]. https://www.signwriting.org/malta/malta.html

Gehret, A. U., & Elliot, L. B. (2025). Perceptions of e-learning by deaf and hard of hearing students using asynchronous multimedia tutorials. *Educational Technology Research and Development*, *73*(3), 1921–1949. https://doi.org/10.1007/s11423-025-10476-z

Gray, D. E. (2014). *Doing research in the real world* (3. ed). Sage.

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a Conceptual Framework for Mixed-Method Evaluation Designs. *Educational Evaluation and Policy Analysis*, *11*(3), 255–274. https://doi.org/10.3102/01623737011003255

Gudoniene, D., Staneviciene, E., Huet, I., Dickel, J., Dieng, D., Degroote, J., Rocio, V., Butkiene, R., & Casanova, D. (2025). Hybrid Teaching and Learning in Higher Education: A Systematic Literature Review. *Sustainability*, *17*(2), 756. https://doi.org/10.3390/su17020756

Guetterman, T. C., Fetters, M. D., & Creswell, J. W. (2015). Integrating Quantitative and Qualitative Results in Health Science Mixed Methods Research Through Joint Displays. *The Annals of Family Medicine*, *13*(6), 554–561. https://doi.org/10.1370/afm.1865

Gustason, G., Pfetzing, D., Zawolkow, E., & Lopez, L. (1993). *Signing exact English*. Modern Signs Press.

Guynes, K., & Wood, C. (2024). Professional Issues in the Interpreted Education of Deaf and Hard of Hearing Students. *American Annals of the Deaf*, *169*(3), 262–283. https://doi.org/10.1353/aad.2024.a937173

Hafner, M., Lee, D., Sykes, K., & Yerushalmi, E. (2025). *The value of British Sign Language: An economic analysis* (Nos. RRA4492-1). RAND Europe. https://www.rand.org/t/RRA4492-1

Holcomb, L., Dostal, H., & Wolbers, K. (2025). A comparative study of how teachers communicate in deaf education classrooms. *Journal of Deaf Studies and Deaf Education, 30*(1), 80–93. https://doi.org/10.1093/jdsade/enae043

Hoyos Padilla, J. M., & Ramos Hernandez, P. A. (2025). *Breaking barriers: Teaching English through sign language* [Monografía, Universidad Nacional Abierta y a Distancia UNAD]. https://repository.unad.edu.co/handle/10596/74299.

Huertas Torres, J. A., & Oyola Gamboa, L. K. (2017). *Strengthening vocabulary command within B1 descriptive reading texts at Pruebas Saber 11 and Pruebas Saber Pro tests through SMART goals and a word association memory strategy* [Master's thesis (research report), Universidad de la Sabana]. https://hdl.handle.net/10818/31871

Ineichen, A. (2025). *Spoken and Sign Language Writing Systems: A Comprehensive Typology* [Master's Thesis, University of Zurich]. https://doi.org/https://doi.org/10.5167/uzh-281060

Instituto Nacional para Sordos. (2022). *Orientaciones para la atención educativa de la población sorda en los niveles de educación superior* (J. F. Lesmes & H. A. Márquez, Eds.). INSOR. https://educativo.insor.gov.co/wp-content/uploads/2023/07/Orientaciones-Educacion-Superior.pdf

Instituto Nacional para Sordos & Instituto Caro y Cuervo. (2016). *Diccionario básico de la Lengua de Señas Colombiana*. Instituto Caro y Cuervo.

https://lenguasyliteraturasnativas.caroycuervo.gov.co/pdf-del-diccionario-basico-de-la-lengua-de-senas-colombiana/

International Organization for Standardization. (2018). *Ergonomics of human-system interaction—Part 11: Usability: Definitions and concepts* (ISO 9241-11:2018; 2nd edition). ISO. https://cdn.standards.iteh.ai/samples/63500/33c267a5a7564f298f02bbd65721a181/ISO-9241-11-2018.pdf

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational Researcher*, *33*(7), 14–26. https://doi.org/10.3102/0013189X033007014

Kremmel, B., Eberharter, K., Konrad, E., Guggenbichler, E., Moser-Frötscher, D., Ebner, V., & Spöttl, C. (2023). The CEFR Companion Volume: Opportunities and Challenges for Language Assessment. *Didaktik Slawischer Sprachen*, (Didaktik slawischer Sprachen, 2023: At the Interfaces of Didactics and Philology (Special Issue)), 65–83. https://doi.org/10.48789/2023_SPECIAL_ISSUE3

Li, W. (2017). Translanguaging as a Practical Theory of Language. *Applied Linguistics*, (39), 9–30. https://doi.org/10.1093/applin/amx039

Lironi, E., & Demofonti, S. (2024). *The EU's Digital Transformation 2030: Civil Society Recommendations & Digital Inclusion Guidelines* (p. 44). ECAS – European Citizen Action Service. https://ecas.org/wp-content/uploads/2024/09/ECAS-Digital-Inclusion-Guidelines.pdf

Liu, D. (2024). The effects of segmentation on cognitive load, vocabulary learning and retention, and reading comprehension in a multimedia learning environment. *BMC Psychology*, *12*(1), 4. https://doi.org/10.1186/s40359-023-01489-5

Loaiza-Ramírez, I., & González-Beltrán, B. A. (2026). Digital accessibility guidelines for deaf and hard of hearing persons: A state-of-the-art review article. *Universal Access in the Information Society*, *25*(1), 4. https://doi.org/10.1007/s10209-025-01270-y

Mackey, A., & Gass, S. M. (Eds.). (2011). *Research Methods in Second Language Acquisition: A Practical Guide* (1a ed.). Wiley. https://doi.org/10.1002/9781444347340

Mariana. (2025). Silent Voices, Loud Learning: Exploring English Learning for The Deaf. *Asia Pacific Journal of Educators and Education*, *40*(2), 41–68. https://doi.org/https://doi.org/10.21315/apjee2025.40.2.3

Marín, V. I., Buntins, K., Bedenlier, S., & Bond, M. (2023). Invisible borders in educational technology research? A comparative analysis. *Educational Technology Research and Development*, (71), 1349–1370. https://doi.org/10.1007/s11423-023-10195-3

Martin, J. C. (2007). *Writing and signed languages* [Master of Arts in the Linguistics Program, University of South Carolina]. https://www.signwriting.org/archive/docs6/sw0519-JoeMartin-MAThesis2007.pdf

Maxwell, J. A., & Chmiel, M. (2014). Notes toward a theory of qualitative data analysis. En *The SAGE handbook of qualitative data analysis* (pp. 21–34). SAGE Publications Ltd.

McKenney, S., & Reeves, T. C. (2018). *Conducting Educational Design Research* (2a ed.). Routledge. https://doi.org/10.4324/9781315105642

Ministerio de Educación Nacional. (2013). *Lineamientos política de educación superior inclusiva*. Dirección de Fomento para la Educación Superior. https://www.mineducacion.gov.co/1759/articles-357277_recurso.pdf

Ministerio de Tecnologías de la Información y las Comunicaciones (MinTIC). (2020). *Directrices de accesibilidad web* (Resolución MinTIC 1519 de 2020 – Anexo 1). MinTIC – Viceministerio de Transformación Digital; Dirección de Gobierno Digital. https://gobiernodigital.mintic.gov.co/692/articles-160770_Directrices_Accesibilidad_web.pdf

Obczovsky, M., Bernsteiner, A., Haagen-Schützenhöfer, C., & Schubatzky, T. (2025). Systematizing Decisions in Design-Based Research: From Theory to Design. *Science Education, 109*(2), 523–536. https://doi.org/10.1002/sce.21915

Olszak, I., & Borowicz, A. (2025). Learning styles and strategies of D/deaf and hard of hearing students in foreign language acquisition–a research report. *Frontiers in Education, 10*, 1553031. https://doi.org/10.3389/feduc.2025.1553031

Olujić Tomazin, M. O., Radošević, T., & Hrastinski, I. (2025). Linguistic Skills and Text Reading Comprehension in Prelingually Deaf Readers: A Systematic Review. *Journal of Speech, Language, and Hearing Research, 68*(3), 1277–1310. https://doi.org/10.1044/2024_JSLHR-24-00512

Oviedo, A. (2001). *Apuntes para una gramática de la Lengua de Señas Colombiana*. Universidad del Valle.

Panta, R. (2025). Heutagogy: A Comprehensive Review of Self-Determined Learning in Contemporary Education. *Cureus*. https://doi.org/10.7759/cureus.89731

Percival, K., Ahmed, M., & Khan, N. B. (2025). Adjustment to the Learning Environment Among University Students Who Are Deaf or Hard of Hearing. *South African Journal of Communication Disorders*, *72*(1), 1–13. https://doi.org/https://doi.org/10.4102/sajcd.v72i1.1114

Peters, M., & Fàbregues, S. (2024). Missed opportunities in mixed methods EdTech research? Visual joint display development as an analytical strategy for achieving integration in mixed methods studies. *Educational Technology Research and Development*, *72*(5), 2477–2497. https://doi.org/10.1007/s11423-023-10234-z

Peterson, J. M. (2025). *Theoretical Frameworks Used to Conceptualize the Intersection of Deafness, Emotional/Behavioral Disabilities, and Language in the Literature: A Scoping Review* [Doctoral dissertation, Illinois State University]. ISU ReD: Research and eData (Theses and Dissertations) (2200). https://doi.org/https://doi.org/10.30707/ETD.1763755358.490548

Pires Silva, J. A., Ribeiro Da Silva, C., & Saraiva Pereira, J. (2024). THE ASL: A motivational resource in English classes for deaf students. *Periferia*, *16*(1), e86159. https://doi.org/10.12957/periferia.2024.86159

Presidencia de la República de Colombia. (1997, septiembre 22). *Decreto 2369 de 1997 Por el cual se reglamenta parcialmente la Ley 324 de 1996*. Diario Oficial No. 43137 del 26 de septiembre de 1997.

Putra, H. S., Sugiharto, S., Silva, A. M. D., & Syahrizal, T. (2025). Pedagogical Translanguaging in Language Education: Constructing Translanguaging Space to Reduce Cognitive Load in Support of Sustainable Development Goals (SDGs). *International Journal of Language Education*, *9*(3), 656. https://doi.org/10.26858/ijole.v1i1.77403

Ramadhani, R. S., & Hufad, A. (2024). Unravelling Receptive Language Acquisition: A Comprehensive Study of Deaf Students' English Language Acquisition. *Proceeding of International Conference on Special Education in South East Asia Region*, *3*(1), 176–188. https://doi.org/10.57142/picsar.v3i1.608

Reinoso Caisa, J. E., Reinoso Caisa, R. E., Crespo Castillo, O. S., & Vera Mosquera., J. F. (2025). Lumi H5P una herramienta digital de apoyo para el refuerzo académico del aprendizaje. *Revista Científica Multidisciplinar G-ner@ndo*, *6*(2), 1423–1446.

Rendel, K., Bargones, J., Blake, B., Luetke, B., & Stryker, D. S. (2018). Signing Exact English: A Simultaneously Spoken and Signed Communication Option in Deaf Education. *Journal of Early Hearing Detection and Intervention (JEHDI)*, *3*(2), 18–29. https://doi.org/https://doi.org/10.26077/gzdh-rp64

Rezvani, R., Ghanbar, H., & Pourhemat Khanshir, Y. (2025). Exploring ableism in English language education in DHH university students' lived experiences: *A critical disability studies perspective*. *Studies in Second Language Acquisition*, 1–27. https://doi.org/10.1017/S0272263125100983

Salmona, M., Kaczynski, D., & Lieber, E. (2020). *Qualitative and mixed methods data analysis using Dedoose: A practical approach for research across the social sciences*. SAGE.

Schmalenbach, C., & Ashouri, C. (2025). Design-Based Research—A Framework for Participation and Action in Educational Research. *International Review of Qualitative Research*, 19408447251387997. https://doi.org/10.1177/19408447251387997

Sevilla, A. F. G., Lahoz-Bengoechea, J. M., Conde González, S., Diaz Esteban, A., Folgueira Galán, P., & De La Calle Pérez, J. (2025). Combining the user friendliness of SignWriting with the precision of linguistic parameters. *Adjunct Proceedings of the 25th*

ACM International Conference on Intelligent Virtual Agents, 1–6. https://doi.org/10.1145/3742886.3756740

Seymour, M. (2024). Enhancing the online student experience through the application of Universal Design for Learning (UDL) to research methods learning and teaching. *Education and Information Technologies*, *29*(3), 2767–2785. https://doi.org/10.1007/s10639-023-11948-6

Sindoni, M. G., Ho, W. Y. J., & Wei, L. (2025). Conceptual framework of translanguaging in mediated action: The case of #Bilingualparenting on social media. *Discourse, Context & Media*, *68*, 100959. https://doi.org/10.1016/j.dcm.2025.100959

Skliar, C. (1998). Bilingüismo e buculturalismo. Uma análise sobre as narrativas tradicionais na educação dos surdos. *Revista Brasileira de Educação*, (8), 44–57.

SocioCultural Research Consultants. (2025). *Dedoose* (Versión 10.0.59) [Cloud application for managing, analyzing, and presenting qualitative and mixed method research data]. https://www.dedoose.com/

Stryker, D., Nielsen, D., & Luetke, B. (2015). Signing Exact English: Providing a Complete Model of English for Literacy Growth. *NERA 2015 Conference Proceedings*, *2*, 12. https://digitalcommons.lib.uconn.edu/nera-2015/2/

Sutton, V. (2014). *Lessons in sign writing: Textbook* (4th ed). Deaf Action Committee for Sign Writing. https://www.signwriting.org/lessons/books/

Sutton, V. (2025). *SignWriting Site*. The SignWriting Press. SignWriting. https://www.signwriting.org/

Swanwick, R. (2017). Translanguaging, learning and teaching in deaf education. *International Journal of Multilingualism, 14*(3), 233–249. https://doi.org/10.1080/14790718.2017.1315808

Tamayo-Cano, L. H., Pineda-Hoyos, J. E., Universidad de Antioquia, Riascos-Gómez, A. F., & Universidad de Antioquia. (2025). Virtual Learning Objects in Online English Programs: Addressing Teacher-Centric Orientation and Student Engagement. *Íkala, Revista de Lenguaje y Cultura, 30*(2). https://doi.org/10.17533/udea.ikala.358271

Tannenbaum-Baruchi, C., Ahad Ha'am, B., & Harari, R. (2025). Accessibility and support in higher education: A case study of deaf and hard of hearing students' perceptions. *Higher Education*. https://doi.org/10.1007/s10734-025-01586-x

The Design-Based Research Collective. (2003). Design-Based Research: An Emerging Paradigm for Educational Inquiry. *Educational Researcher*, *32*(1), 5–8. https://doi.org/10.3102/0013189X032001005

Thiessen, S. M. (2011). *A grammar of SignWriting* [ThesesandDissertations. 4458., University of North Dakota]. https://commons.und.edu/theses/4458/

Thomas, S. L., Pitt, H., McCarthy, S., Arnot, G., & Hennessy, M. (2024). Methodological and practical guidance for designing and conducting online qualitative surveys in public health. *Health Promotion International*, *39*(3), daae061. https://doi.org/10.1093/heapro/daae061

Tinoca, L., Piedade, J., Santos, S., Pedro, A., & Gomes, S. (2022). Design-Based Research in the Educational Field: A Systematic Literature Review. *Education Sciences, 12*(6), 410. https://doi.org/10.3390/educsci12060410

United Nations. (2006, diciembre 12). *Convention on the Rights of Persons with Disabilities*. https://www.ohchr.org/en/instruments-mechanisms/instruments/convention-rights-persons-disabilities

Universidad Nacional Abierta y a Distancia (UNAD). (2025). *Modelo Heutagógico Unadista Solidario 5.0*. Sello Editorial UNAD.

Ure-de-Oliveira, R., & Bonilla-Algovia, E. (2025). Digital Divides and Educational Inclusion: Perceptions from the Educational Community in Spain. *Education Sciences*, *15*(8), 939. https://doi.org/10.3390/educsci15080939

Utami, I. S., Ghufron, A., & Ishartiwi, I. (2025). Universal Design for Learning in Online Education: A Systematic Review of Evidence-Based Practice for Supporting Students with Disabilities. *International Journal of Learning, Teaching and Educational Research*, *24*(3), 94–116. https://doi.org/10.26803/ijlter.24.3.5

Velásquez Hoyos, A. P., Jaramillo, S., & Montoya, J. D. (2025). Bilingual Literacy Among Deaf and Hard-of-Hearing Students: A Literature Review in the USA, Canada, and Colombia. *Colombian Applied Linguistics Journal*, *27*(1), 141–154. https://doi.org/10.14483/22487085.20988

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development*, *53*(4), 5–23. https://doi.org/10.1007/BF02504682

Waterhouse, P., Samra, R., & Lucassen, M. (2022). Distance education students' satisfaction: Do work and family roles matter? *Distance Education*, *43*(1), 56–77. https://doi.org/10.1080/01587919.2021.2020622

Weber, J., Hayward, D., Skyer, M., & Snively, S. (2024). Applied deaf aesthetics toward transforming deaf higher education. *Journal of Deaf Studies and Deaf Education*, *30*(1), 108–125. https://doi.org/10.1093/jdsade/enae050

Wolbers, K., Holcomb, L., & Hamman-Ortiz, L. (2023). Translanguaging Framework for Deaf Education. *Languages*, *8*(1), 59. https://doi.org/10.3390/languages8010059

World Wide Web Consortium (W3C). (2024, septiembre 17). *Making Audio and Video Media Accessible*. World Wide Web Consortium (W3C). Web Accessibility Initiative (WAI) | W3C. https://www.w3.org/WAI/media/av/

World Wide Web Consortium (W3C). (2025, septiembre 16). *Understanding Success Criterion 1.2.2: Captions (Prerecorded)* [Standards/Guidelines (WAI – WCAG Understanding)]. World Wide Web Consortium (W3C). Web Accessibility Initiative (WAI) | W3C. https://www.w3.org/WAI/WCAG22/Understanding/captions-prerecorded.html?utm_source=chatgpt.com

Yessengaliyev, A., Karelkhan, N., Goris, T., & Schmidt, P. (2025). Adapting Online Education for Deaf and Hard-of-Hearing Adults: Preferences, Perceptions, and Learning Characteristics. *International Journal of Online and Biomedical Engineering (iJOE)*, *21*(10), 22–36. https://doi.org/10.3991/ijoe.v21i10.54821

Younas, A., Fàbregues, S., Munce, S., & Creswell, J. W. (2025). Framework for types of metainferences in mixed methods research. *BMC Medical Research Methodology*, *25*(1), 18. https://doi.org/10.1186/s12874-025-02475-8

Zhou, J., Lee, S. S., & Kew, S. N. (2025). Developing and evaluating a translanguaging-multiliteracies learning design (LDTMP) for student agency in a college English course

in China. *Frontiers in Education*, *9*, 1504871.

https://doi.org/10.3389/feduc.2024.1504871

Appendices

Appendix A

Audit of UNAD English A1 Course Materials and Accessibility Features

Purpose and claim supported

This appendix documents a focused audit of the instructional and assessment materials embedded in UNAD English A1 (course code reported in the syllabus as 900001, and commonly displayed in campus records as 900001). The audit supports the literature review positioning that Deaf students—particularly Deaf signers who rely on Colombian Sign Language (LSC)—are expected to meet English requirements through largely standardised course resources that were developed primarily to foster the four skills (listening, speaking, reading, and writing) in typical A1 progression. Importantly, this audit is not intended to evaluate the overall academic quality of the English A1 course. On the contrary, the course design and materials are broadly consistent with mainstream EFL instruction for hearing learners and are aligned with four-skill development and grammar progression at A1.

The purpose of the audit is therefore descriptive and accessibility-focused: it clarifies what the course officially requires (including listening and speaking components) and what accessibility supports are structurally built into the course materials for Deaf signers, as opposed to being provided externally through informal or human mediation.

Audit scope and procedure

The audit was conducted through direct review of the course environment and materials made available to students in English A1, a 3-credit methodological course delivered in a virtual environment and designed to develop the four language skills (listening, speaking, reading, and writing) progressively toward A1. The review focused on the materials students must use to

complete activities (e-books/modules, task instructions, and quizzes) and on practical accessibility indicators relevant for Deaf signers.

English A1 (900001) is structured around three course learning outcomes (RAC 1–3) and develops content through twelve INVIL e-book modules (Modules 1–12), covering basic communicative functions (greetings, family/friends, locations, commands, routines, descriptions, comparisons, food preferences, and past activities) and selected A1 grammatical foci (present/continuous forms, comparatives/superlatives, past of be, and modal/functional patterns such as ability and would).

Course audited: UNAD English A1 (syllabus code: 90001)
Unit/Program context: Instituto Virtual de Lenguas (INVIL), Programa Nacional de Inglés
Academic period accessed (researcher): 2025-02-03 to 2025-12-22
Platform/environment (researcher): ACCESIT Plataforma UNAD.
Dates of audit (researcher): 2025-02-03 to 2025-12-22
Units and modules reviewed:

Unit 1 (Modules 1–4)

1. *Greet people*
2. *Talk about friends and family*
3. *Describe where people and places are*
4. *Give and understand simple commands*

Unit 2 (Modules 5–8)

5. *Describe activities in progress*
6. *Talk about daily routines*
7. *Describe and compare people physically*
8. *Simple past of "be"*

Unit 3 (Modules 9–12)

9. *Comparative and superlative adjectives*
10. *Talk about food preferences (continuous form)*

11. *Talk about past activities (vacations)*
12. *Express ability; ordering food (would)*

Evidence Captured. Screenshot-based documentation of representative learning objects and course pages, with a focus on (1) text-heavy instruction segments, (2) audio controls and listening prompts, and (3) the lack of sign language mediation integrated into the official course design.

Audit criteria: indicators of Deaf-accessible design

To maintain analytic clarity, the audit used the following indicators as practical markers of Deaf-accessible design for Deaf signers in early English literacy learning contexts:

Sign-First Mediation Present. Whether instructions or explanations are provided through LSC videos or other signed resources as a primary entry point to tasks.

Audio Dependence. Whether a task or explanation requires listening or relies on audio cues (e.g., audio buttons, listening activities, or audio-only content).

Text Density and Visual Organisation. Whether instruction and explanation are delivered primarily through extended written paragraphs, complex multi-step text, or visually dense screens.

Visual Scaffolds for Form–Meaning Mapping. Whether the materials contain explicit visual aids that assist students in making the connection between written forms and meaning (e.g., guided visual grammar prompts, examples with visual cueing).

Accessibility Supports for Independent Use. Whether features like transcripts, captions, or easily visible navigation are regularly available.

These indicators are aligned with the broader rationale in this thesis that Deaf signers' access to language learning in virtual environments is fundamentally shaped by the availability

of visual mediation and by the reduction of unnecessary barriers created by audio-centred or text-heavy delivery.

Summary finding

Across the reviewed materials in English A1 (900001), the course content and activity prompts were presented as standard resources intended for the general student population and structured around a four-skill methodological approach. Within the scope of this audit, no built-in sign-first learning object, embedded LSC explanation layer, or institutional VLO explicitly tailored to Deaf LSC users was identified as a default component of the audited course materials. While learners may draw on different strategies and supports depending on their profiles and circumstances, the audited learning objects and prompts did not provide systematic LSC-led mediation integrated into the instructional flow.

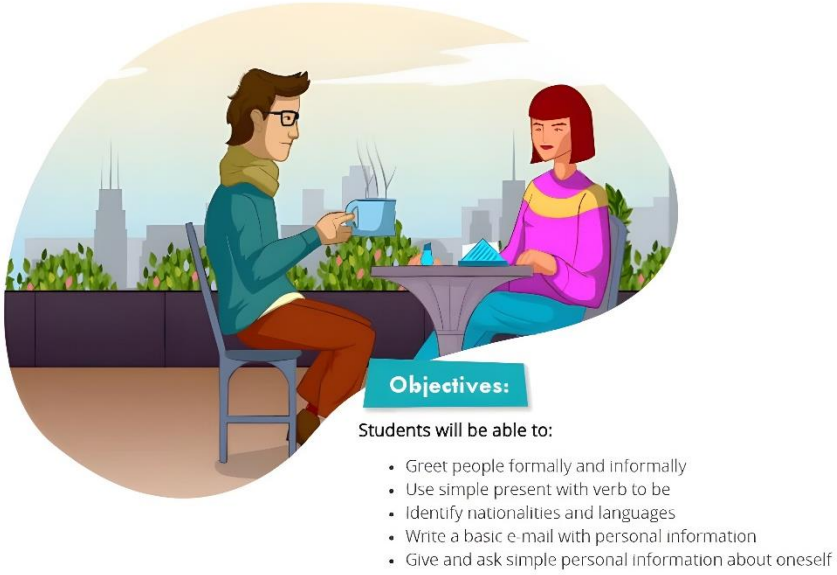
In practical terms, Deaf signers are expected to engage with the same core materials as hearing students, including screens characterized by substantial written instructions and resources containing audio controls, listening prompts, or speaking-orientated requirements. This configuration is not presented here as a deficit in course quality; rather, it documents the access conditions under which Deaf signers attempt to meet the same academic requirements. These documented conditions contextualise the design rationale of the present study, which develops and pilot-evaluates a complementary sign-first, multimodal VLO aligned with Pre-A1/A1 written English learning goals.

Screenshot evidence

The figures below present representative screenshots from the audited course environment. They illustrate typical combinations of written instruction density, the presence of

audio buttons or listening-orientated interface elements, and the absence of embedded sign-first mediation.

English A1 course objectives and targeted skills (introductory course screen).

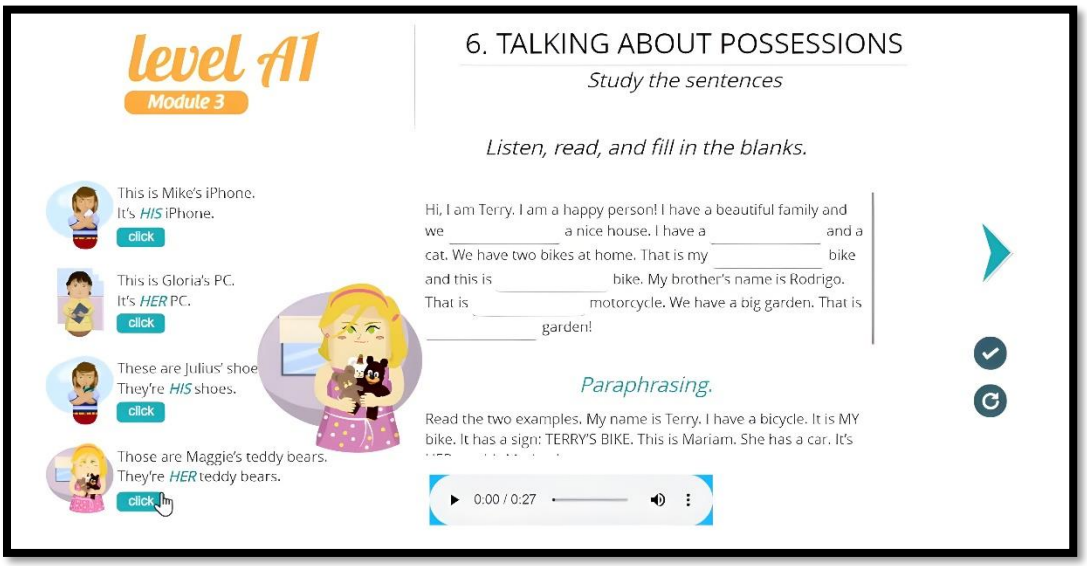


Note. The introductory screen presents the official learning objectives of the English A1 course, including greeting people, using the simple present with to be, identifying nationalities and languages, writing basic emails, and exchanging simple personal information. While these objectives are aligned with CEFR A1 descriptors, the screen does not indicate modality-specific adaptations or sign-first access pathways for Deaf signers, providing a baseline for contrasting intended outcomes with the accessibility characteristics of subsequent learning objects and tasks.

Module-based writing prompt with oral recording requirement (English A1, Module 4.

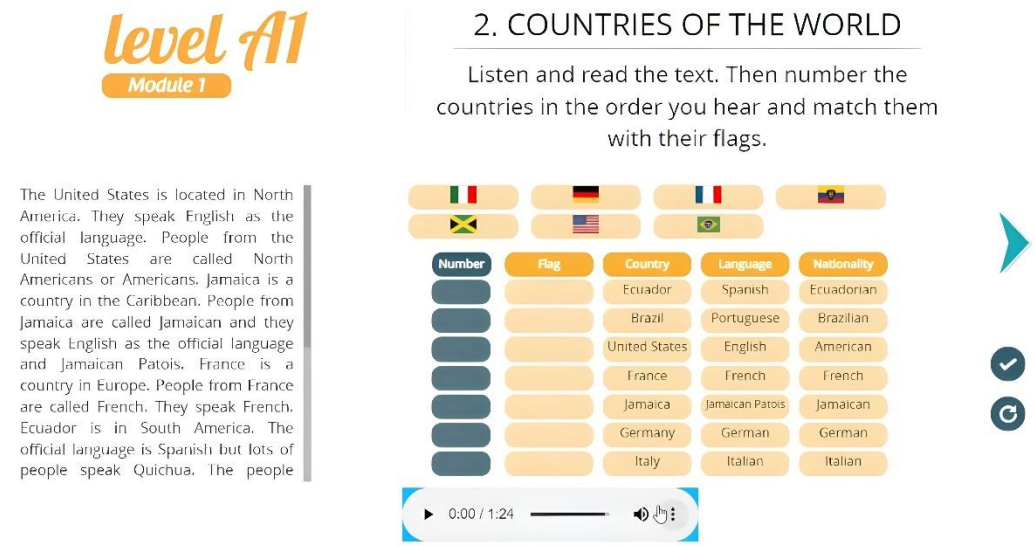
Note. The activity "Talking about your favourite town in your country" provides instructions primarily through written text and requires learners to write sentences and then record an oral description to submit to the tutor ("When you finish writing, record your description…"). The screen shows no embedded sign-first (LSC) explanation or alternative signed mediation, illustrating how standard course materials may assume written-text autonomy and spoken/oral output as default modalities.

Audio controls embedded in learning object: example of audio-dependent interface element.



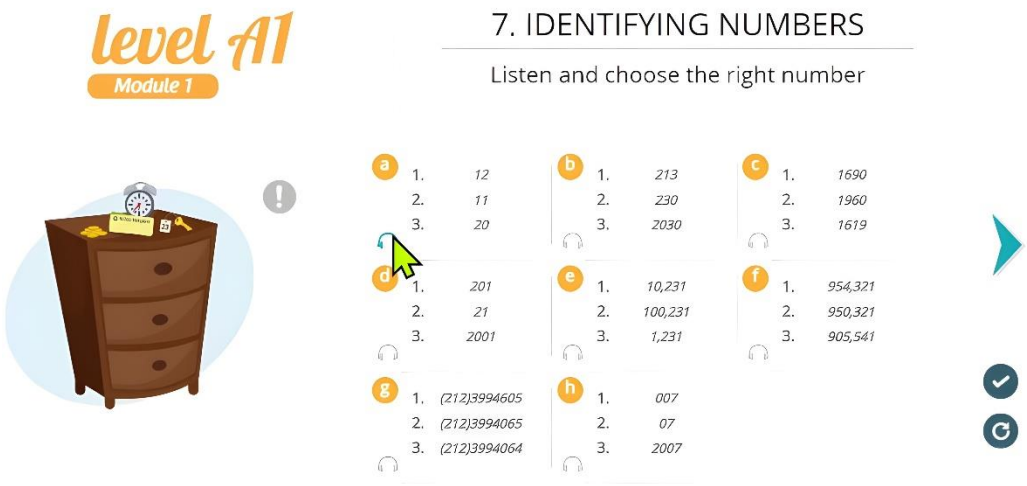
Note. The screen explicitly instructs learners to "Listen, read, and fill in the blanks" and includes an embedded audio player (0:27), indicating that comprehension and task completion may rely on auditory input. Although the activity also contains written text and visual illustrations, it does not provide embedded sign-first (LSC) explanation or signed alternatives within the learning object, illustrating how standard course materials may incorporate audio as a default support channel.

Listening-based sequencing task with extended reading text (English A1, Module 1).



Note. The activity instructs learners to "Listen and read the text. Then number the countries in the order you hear and match them with their flags," and it includes an embedded audio player (1:24). This design integrates an explicitly auditory sequencing requirement ("in the order you hear") alongside a relatively dense written passage, while providing no embedded sign-first (LSC) explanation or signed alternative pathway. As such, the screen exemplifies how standard course learning objects may operationalize comprehension and task completion through hearing-orientated cues rather than visually mediated access.

Audio-only discrimination task: "Listen and choose the right number" (English A1, Module 1).



Note. The task specifically asks students to "listen and choose the right number," and it offers multiple-choice options without written prompts that would enable task completion without the need for audio input. The interface confirms that auditory perception is the main access channel by using headphone icons to indicate listening segments for each item. No embedded sign-first (LSC) explanation or visual alternative is provided, illustrating a fully hearing-dependent task design within the standard course materials.

Screenshots are presented for documentation and audit transparency only. They are included to substantiate the contextual claim that Deaf signers in English A1 (900001) are not provided with institutional sign-first instructional mediation as a default course feature, thereby justifying the design rationale of the VLO developed in this study.

Appendix B

Questionnaire of the Virtual Learning Object (VLO)

The questionnaire screenshots shown in this appendix display the written items in English. However, the same instructions and each questionnaire item were also delivered through accompanying videos in Colombian Sign Language (LSC), which was treated as the primary language of access for participants. The LSC video layer ensured that Deaf respondents could understand the content and complete the survey autonomously, without relying on English reading proficiency.

EVALUATION QUESTIONNAIRE FOR THE VIRTUAL LEARNING OBJECT (VLO)

VLO

Title: *Start the Conversation LSC-EN*

Purpose of the questionnaire:

The purpose of this questionnaire is to collect feedback from Deaf learners about the quality, accessibility, and effectiveness of the Virtual Learning Object (VLO) titled “Start the Conversation LSC-EN.” Your responses will help improve future educational resources and ensure they meet the needs of Deaf users learning English.

Participant information and consent (embedded in the questionnaire)

Your participation is voluntary, and you may stop at any time.

Your answers are anonymous and confidential. The information will be used only for academic and educational research purposes within UNAD.

By continuing and submitting your responses, you confirm that you have understood the instructions and voluntarily agree to participate in this study.

Goal of the Instrument, Participant Information, and Consent (Video in LSC)

https://youtu.be/u7nu50BoQJk?si=zYsj_qkk2mJG3gHe

Instructions for Use

Please take a moment to watch and read carefully. There is no rush. Just follow along step by step.

Please watch the introductory video in Colombian Sign Language (LSC) before answering the questionnaire.

Please watch the introductory video in Colombian Sign Language (**LSC**) before answering the questionnaire.

Read each question carefully.

Indicate your level of agreement using the response scale shown on the screen.

All questions refer specifically to your experience using the Virtual Learning Object (VLO).

Your participation is voluntary, and you may stop at any time.

Your answers are anonymous and confidential. The information will be used only for academic and educational research purposes within UNAD.

By continuing and submitting your responses, you confirm that you have understood the instructions and voluntarily agree to participate in this study.

Scale (for all statements)

Please watch carefully. You will see a series of statements. After each one indicates how much you agree or disagree using the following scale:

😖 | ★ = **Strongly Disagree**

☹️ | ★ ★ = **Disagree**

😳 | ★ ★ ★ = **Neither agree nor disagree**

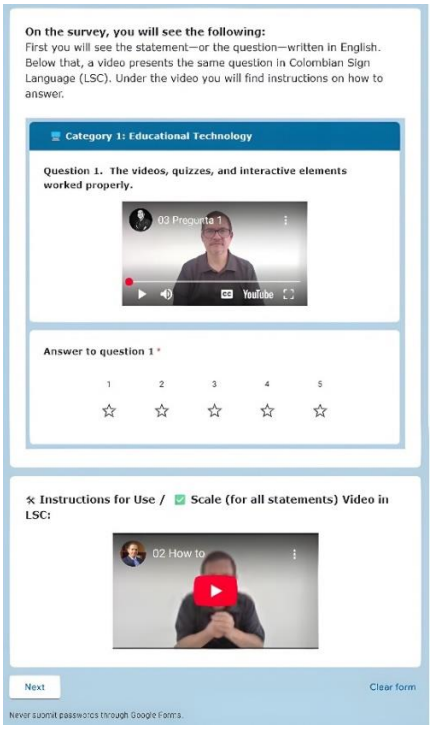
😃 | ★ ★ ★ ★ = **Agree**

😍 | ★ ★ ★ ★ ★ = **Strongly Agree**

On the survey, you will see the following:

First you will see the statement—or the question—written in English. Below that, a video presents the same question in Colombian Sign Language (LSC). Under the video you will find instructions on how to answer.

Screenshot from the questionnaire



Category 1—Educational Technology (Q1–Q4)

Q1. The videos, quizzes, and interactive elements worked properly.

http://youtube.com/watch?v=R5zT7OczYTw

Q2. The VLO was easy to navigate, with clear signs and instructions.

http://youtube.com/watch?v=D_wONmzEc0M

Q3. The content was accessible with Colombian Sign Language and SEE.

http://youtube.com/watch?v=hR0WOVr4nis

Q4. The layout and design helped me stay focused and engaged.

http://youtube.com/watch?v=qbT6k7uNAX0

Category 2—Language Learning (Q5–Q8)

Q5. I learned new English words and grammar through visual support.

http://youtube.com/watch?v=jmFQBrrKLto

Q6. The activities helped me practice reading and writing in English.

http://youtube.com/watch?v=Grol9f4qWg0

Q7. SEE and signed videos helped me understand English sentence structure.

http://youtube.com/watch?v=61MkfuVUnVE

Q8. I feel more confident introducing myself in English.

http://youtube.com/watch?v=DpC4JVsHsxk

Category 3—Pedagogical Principles (Q9–Q11)

Q9. The lessons followed a clear structure and logical order.

http://youtube.com/watch?v=nwOGfxpMJ64

Q10. The VLO included different types of activities (quizzes, videos, etc.).

http://youtube.com/watch?v=uf-duTojp2Q

Q11. The quizzes helped me check my understanding.

http://youtube.com/watch?v=owcMdEj9BCg

Category 4—Knowledge Management/Self-Regulation (Q12–Q15)

Q12. The topics were useful and clearly explained.

http://youtube.com/watch?v=Eka6xq8ackw

Q13. The resource helped me reflect on how I learn English.

http://youtube.com/watch?v=qSRQ3ihCGDLc

Q14. The VLO encouraged me to study and learn on my own.

http://youtube.com/watch?v=Cx95T9CceKM

Q15. I could connect what I learned with my daily life.

http://youtube.com/watch?v=D8Bu00l6jGo

Category 5—Comparative Experience (Q16–Q18)

Q16. Compared to other English resources I have used before, this VLO was easier to understand.

http://youtube.com/watch?v=HhiwfBQGQTs

Q17. I feel more comfortable using this VLO because it is specially designed for Deaf learners.

http://youtube.com/watch?v=lnNvrSgXwwM

Q18. I wish more English learning materials were designed like this one.

http://youtube.com/watch?v=elE0h63Cp7w

Final Questions (Optional—Open-ended):

Q19. How is this VLO different from other English resources you've used? What did you like the most?

http://youtube.com/watch?v=qkjXBoEbi-8

Answer to question 19: Please either paste the link to your video response or write your answer directly in the space provided.

Q20. *Do you have any suggestions to improve this VLO?*

http://youtube.com/watch?v=xXa8pfu5zIY

Answer to question 20: Please either paste the link to your video response or write your answer directly in the space provided.

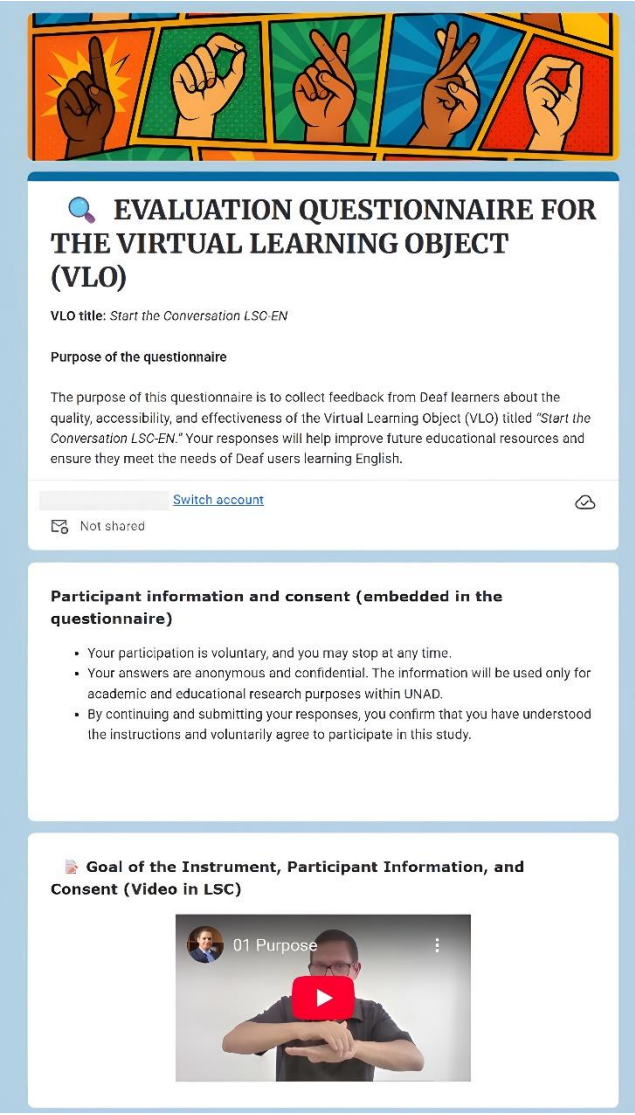
Thank you for your participation. Your responses will be anonymised and used only for research and improvement of the VLO.

Appendix C

Informed Consent Form (Embedded in the Questionnaire)

This study followed UNAD ethical principles for research with human participants and implemented an informed-consent procedure adapted for Deaf users of Colombian Sign Language (LSC). Because the evaluation was administered remotely and asynchronously, and because accessibility and learner autonomy were central to the project, informed consent was integrated into the questionnaire rather than collected through a separate signed document.

Embedded informed-consent statement and participant information (as displayed in the online questionnaire).

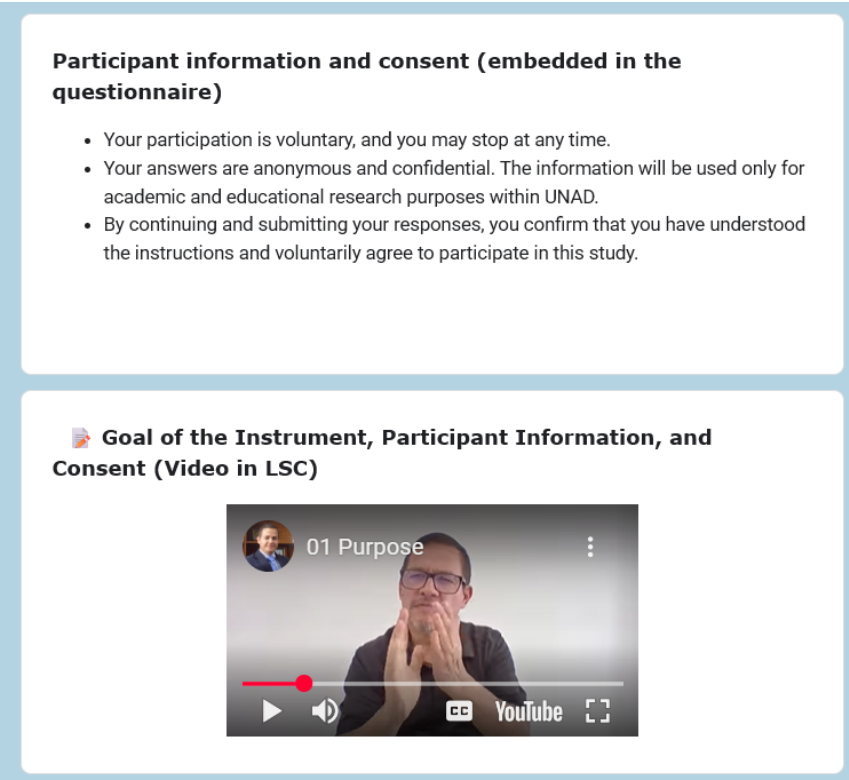


Before answering the Likert-scale items, participants were presented with the consent information embedded in the form: (a) participation was voluntary and participants could stop at any time; (b) responses were anonymous and confidential and would be used only for academic and educational research purposes within UNAD; and (c) by continuing and submitting responses, participants confirmed that they understood the information and voluntarily agreed to participate. The form also stated the purpose of the questionnaire: to collect feedback from Deaf

learners regarding the quality, accessibility, and effectiveness of the Virtual Learning Object (VLO) titled *Start the Conversation LSC-EN*, with the aim of improving future educational resources.

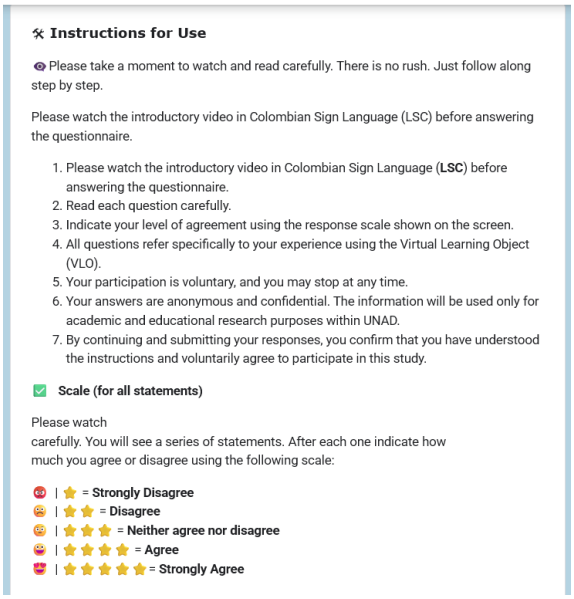
To ensure sign-first accessibility, the questionnaire included LSC video support accompanying the introductory sections and instructions.

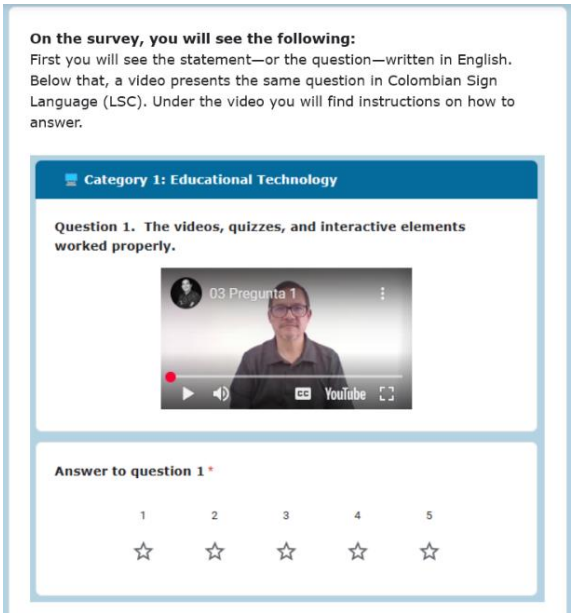
LSC-accessible introduction video embedded in the questionnaire (Goal of the instrument, participant information, and consent).

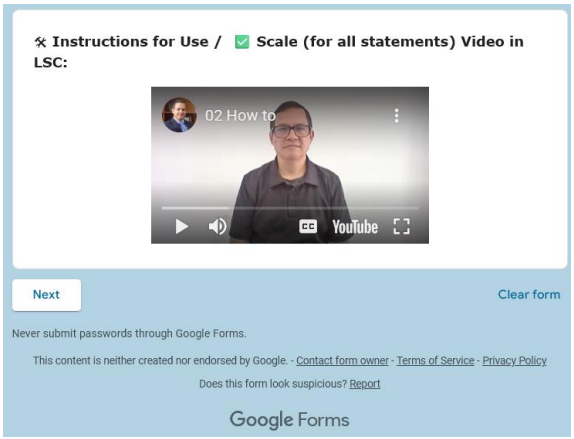


This embedded video explained the goal of the instrument and the nature of participation in LSC, supporting comprehension for Deaf signers before they proceeded to the questionnaire items.

Instructions video embedded in the questionnaire (How to respond).



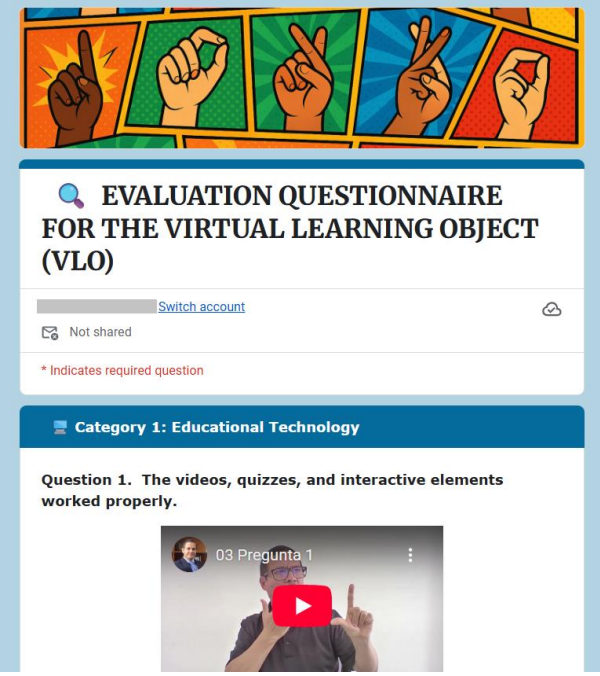




A second LSC video explained how to complete the questionnaire (i.e., reading each statement, selecting agreement levels on a 1–5 scale, and understanding the structure of items: written English statement, LSC video explanation, and a star-based response scale).

The questionnaire implemented implied consent: continuing with the form and submitting responses constituted voluntary agreement to participate. No monetary or academic incentives were offered. The survey did not request names, institutional IDs, or other direct identifiers. For reporting purposes, participant contributions were anonymized using neutral codes.

Screenshot illustrating anonymous data collection (no direct identifiers requested).



This screenshot documents that the form collected only item responses and optional comments, without personally identifying fields.

In sum, the informed-consent process was implemented as an accessible, sign-first, questionnaire-embedded procedure appropriate for an online formative evaluation with Deaf LSC users.

Archiving note (for auditability). At the time of data collection, the consent text and LSC videos were accessible within the questionnaire. For traceability, the researcher archived a PDF export of the questionnaire interface and recorded the video titles/links used during the data-collection period.

Appendix D

Data Cleaning and Coding Tables

Data Cleaning and Coding Tables

This appendix documents the procedures and technical decisions applied to prepare, clean, code, and preliminarily categorize the dataset used in this study. Reporting these steps supports transparency, methodological rigor, and auditability of the mixed-methods analysis.

Participant Coding Table (Survey Dataset)

To protect anonymity, each valid survey record was assigned a unique alphanumeric identifier at the moment of data extraction. The questionnaire was designed **not** to collect personal identifiers (e.g., names, email addresses, phone numbers, institutional IDs). Accordingly, no direct identifiers were retained in the exported dataset. Participant codes were generated following the format **P–01 to P–29**, corresponding to the final number of valid records included in the dataset (**n = 29**).

Important note on traceability. The participant codes (**P–xx**) correspond exclusively to **survey records**. Additional qualitative materials (six LSC-based videos used as supplementary qualitative evidence) were treated as a **separate auxiliary corpus** and were **not** linked to a specific P-code unless the correspondence was unequivocal (see Section D.1.1).

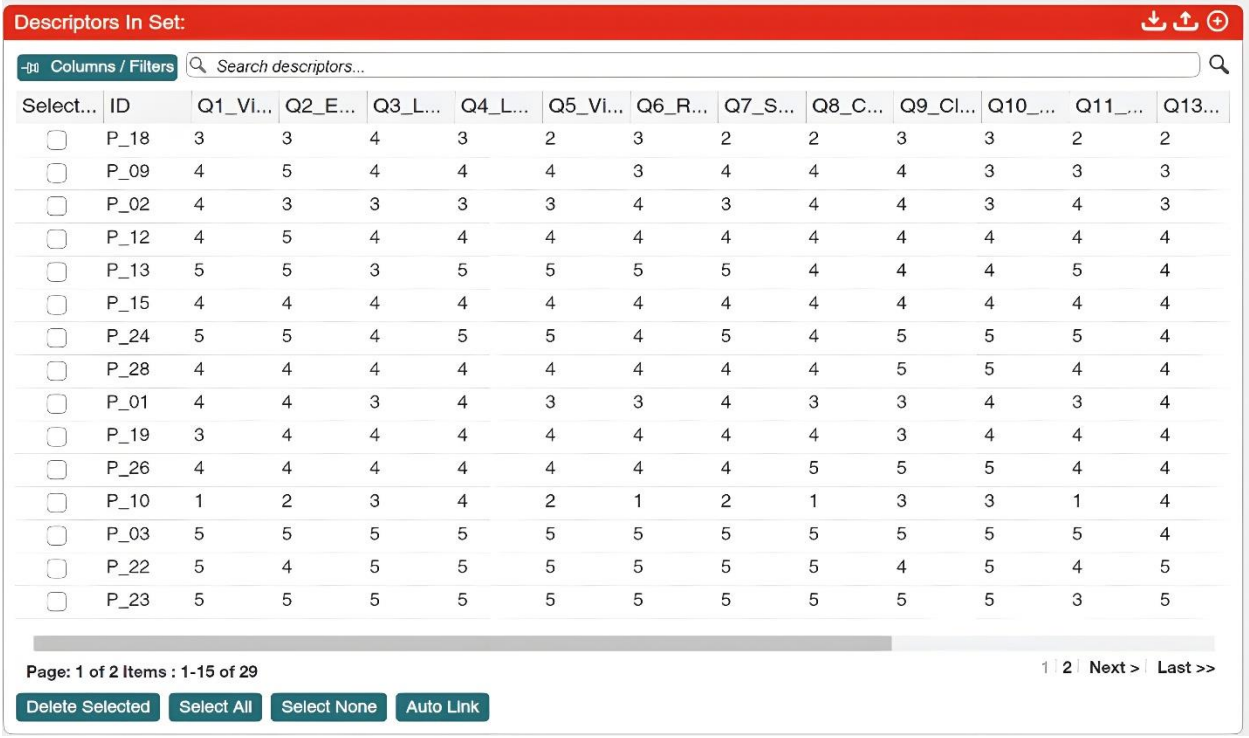
Survey Participant Codes (Anonymized Cases; n = 29)

Participant Code	Description	Notes
P–01	Deaf participant – valid survey record	Included in quantitative analysis; qualitative inclusion depends on Q19–Q20
P–02	Deaf participant – valid survey record	Included
P–03	Deaf participant – valid survey record	Included
P–04	Deaf participant – valid survey record	Included
P–05	Deaf participant – valid survey record	Included
P–06	Deaf participant – valid survey record	Included
P–07	Deaf participant – valid survey record	Included
P–08	Deaf participant – valid survey record	Included
P–09	Deaf participant – valid survey record	Included
P–10	Deaf participant – valid survey record	Included; no open-ended text (Q19–Q20)
P–11	Deaf participant – valid survey record	Included
P–12	Deaf participant – valid survey record	Included
P–13	Deaf participant – valid survey record	Included; no open-ended text (Q19–Q20)

Participant Code	Description	Notes
P–14	Deaf participant – valid survey record	Included; no open-ended text (Q19–Q20)
P–15	Deaf participant – valid survey record	Included
P–16	Deaf participant – valid survey record	Included
P–17	Deaf participant – valid survey record	Included
P–18	Deaf participant – valid survey record	Included
P–19	Deaf participant – valid survey record	Included
P–20	Deaf participant – valid survey record	Included; no open-ended text (Q19–Q20)
P–21	Deaf participant – valid survey record	Included
P–22	Deaf participant – valid survey record	Included
P–23	Deaf participant – valid survey record	Included
P–24	Deaf participant – valid survey record	Included
P–25	Deaf participant – valid survey record	Included
P–26	Deaf participant – valid survey record	Included
P–27	Deaf participant – valid survey record	Included

Participant Code	Description	Notes
P–28	Deaf participant – valid survey record	Included
P–29	Deaf participant – valid survey record	Included; no open-ended text (Q19–Q20)

Imported survey cases in Dedoose showing anonymized participant identifiers (P–01 to P–29).



Select...	ID	Q1_Vi...	Q2_E...	Q3_L...	Q4_L...	Q5_Vi...	Q6_R...	Q7_S...	Q8_C...	Q9_Cl...	Q10_...	Q11_...	Q13...
☐	P_18	3	3	4	3	2	3	2	2	3	3	2	2
☐	P_09	4	5	4	4	4	3	4	4	4	3	3	3
☐	P_02	4	3	3	3	3	4	3	4	4	3	4	3
☐	P_12	4	5	4	4	4	4	4	4	4	4	4	4
☐	P_13	5	5	3	5	5	5	5	4	4	4	5	4
☐	P_15	4	4	4	4	4	4	4	4	4	4	4	4
☐	P_24	5	5	4	5	5	4	5	4	5	5	5	4
☐	P_28	4	4	4	4	4	4	4	4	5	5	4	4
☐	P_01	4	4	3	4	3	3	4	3	3	4	3	4
☐	P_19	3	4	4	4	4	4	4	4	3	4	4	4
☐	P_26	4	4	4	4	4	4	4	5	5	5	4	4
☐	P_10	1	2	3	4	2	1	2	1	3	3	1	4
☐	P_03	5	5	5	5	5	5	5	5	5	5	5	4
☐	P_22	5	4	5	5	5	5	5	5	4	5	4	5
☐	P_23	5	5	5	5	5	5	5	5	5	5	3	5

Note. The case IDs function as analytic labels and contain no identifying information. The screenshot should display the **Cases** (or equivalent) panel/list in Dedoose where P–01 to P–29 appear as imported cases.

Coding of Auxiliary Qualitative Materials (Six LSC Videos)

In addition to the survey dataset, the study incorporated six short LSC-based videos as supplementary qualitative evidence. These videos comprised:

Three spontaneous opinion videos (participants independently shared their views about the VLO).

Three informal interview-style reflections (participant-initiated signed exchanges used as reflective, conversational input; not semi-structured interviews).

Because the Research Design intentionally avoided collecting identifiers (e.g., names, emails, gender markers), these materials could not be consistently matched to a specific survey respondent.

To maintain transparency, the auxiliary corpus was coded using separate identifiers:

Est–01 to Est–03 = Spontaneous opinion videos (LSC video comments)

Est–04 to Est–06 = Informal interview-style reflections (participant-initiated signed exchanges)

Linkage rule (critical). Auxiliary items were linked to a P-code only when the correspondence was unequivocal (e.g., an internal cue that clearly establishes linkage without introducing personal names in transcription). In those instances, the auxiliary item was linked to the corresponding case in Dedoose:

Est–03 (linked in Dedoose to **P–19**)

Est–05 (linked in Dedoose to **P–28**)

All other auxiliary items remain unlinked and are cited as: Est–01 (unlinked), Est–02 (unlinked), Est–04 (unlinked), Est–06 (unlinked).

This decision avoids over-claiming case-level triangulation while still allowing the auxiliary corpus to contribute to thematic elaboration, explanatory insight, and design implications.

Data Cleaning Procedures (Survey Dataset)

The dataset exported from Google Forms was processed through a structured cleaning protocol applied in four steps:

Step 1 – Verification of anonymisation / removal of identifiers

Confirmation that the questionnaire did not request names, email addresses, or other direct identifiers.

Review of open-ended responses (Q19–Q20) to ensure no participants included self-identifying information in free text; any incidental identifiers would have been removed prior to analysis.

Step 2 – Standardization of response values

Likert-type responses were normalized into numerical values (**1–5**) aligned with the instrument scale.

Text variants in brief responses (e.g., “si / sí / Sí / yes”) were standardized for analytic consistency (lowercase categories).

Empty open-ended answers were coded as NA (see Section C.3).

Step 3 – Duplicate and incomplete response control

No duplicate records were detected in the final dataset.

Five cases (**P–10, P–13, P–14, P–20, P–29**) contained no open-ended responses (Q19–Q20). These cases were included in quantitative descriptive emphasises but contributed no analyzable text for qualitative coding.

Step 4 – Verification of dataset integrity

Cross-check of column naming consistency and item alignment (Q1–Q18; Q19–Q20).

Manual review of response completeness and internal coherence prior to analysis.

Rules for Handling Missing Data

To maintain methodological consistency and avoid artificially inflating patterns, the following rules were applied across quantitative and qualitative strands.

Quantitative data (Likert responses: Q1–Q18)

If missing Likert values had occurred, missing entries ≤10% within a case would have been coded as NA and handled through pairwise exclusion for descriptive emphasises. No imputation procedures were used.

In the final dataset, all 29 participants provided complete Likert responses, so missing-value handling was not required for Q1–Q18.

Qualitative data (open-ended responses: Q19–Q20)

Blank open-ended responses were coded as NA–Blank (participant did not provide a comment).

Extremely short responses (e.g., “ok”, “bien”) were retained but coded as Low-Information Units to ensure transparency while avoiding over-interpretation.

Because five participants (**P–10, P–13, P–14, P–20, P–29**) did not answer Q19–Q20, they were included in quantitative emphasises but provided no analyzable text for qualitative coding.

Video-based responses submitted through the survey (links pasted into Q19/Q20 boxes)

When a participant responded via an LSC video link pasted into the open-ended response box, the message was first interpreted into Spanish and then translated into English for reporting consistency (as the thesis is written in English).

All submitted video links contained usable content; therefore, no entries required coding as unintelligible or unusable visual input.

Initial Coding Categories (Preliminary Codebook)

The first cycle of qualitative coding used a hybrid approach (descriptive + values coding), resulting in the preliminary categories below. These categories reflect the early organisation

observed in participants' comments and preceded later thematic refinement. Example meaning units are presented as verbatim excerpts in English and attributed to anonymized sources.

Preliminary Coding Categories (Cycle 1)

Category Code	Category Name	Description	Example Meaning Unit
T-ACC	Technological Access	Comments on technical access and usability (e.g., video clarity, navigation, interface reliability)	"It is visual, clear, and easy to understand." (P–18)
M-VIS	Multimodal Mediation	Perceptions of sign language + written English mediation (LSC/SEE supports; captions; visual scaffolding)	"I believe it's important to strengthen both languages—Sign Language and English." (P–03)
P-ORG	Pedagogical Organisation	Clarity of sequence, steps, and instructional structure	"This VLO helps me learn English step by step." (P–17)
S-REG	Self-Regulation & Relevance	Motivation, usefulness, and transfer to life goals	"Learning English may have an impact on my life in the future, maybe for work." (Est–04)
INT-F	Interface Feedback	Readability, text density, layout comfort, and navigation load	"However, there shouldn't be so many long texts." (P–17)
L-DIFF	Learning Difficulties	Barriers that hinder learning (e.g., lack of interpreting support in other courses; access constraints)	"The virtual English course is difficult because there is no interpreter." (P–05)

Note. These categories informed the second analytical cycle and the subsequent triangulation matrix/joint display procedures.

Notes on Reliability and Researcher Reflexivity

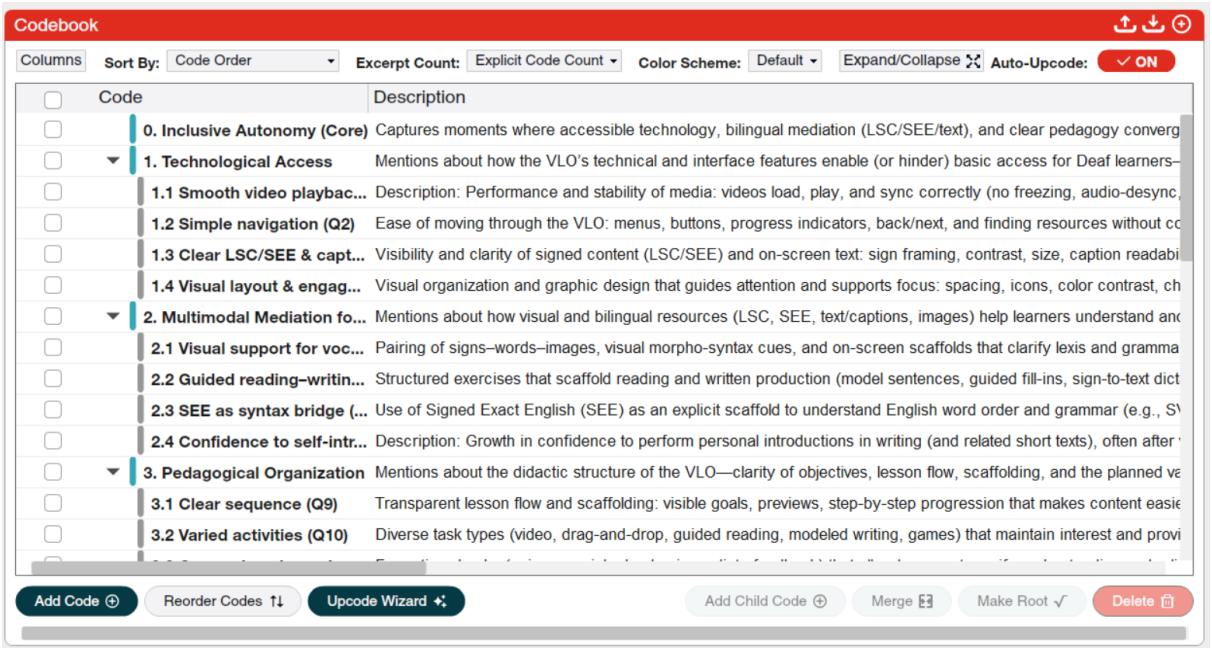
Although not a formal interrater reliability study, the following procedures were used to strengthen transparency and analytic stability:

Coding consistency was checked in two rounds, one week apart, to verify stability in category application across the dataset.

Analytic memo writing accompanied difficult interpretation decisions, especially when responses were brief, implicit, or conceptually dense.

Particular attention was paid to preserving Deaf participants' intended meaning, including short written responses and sign language contributions requiring interpretation and translation. Ambiguous segments were coded conservatively rather than over-interpreted.

Codebook in Dedoose (example view).



Note. The screenshot should show the Codebook/Codes workspace in Dedoose with the main families and/or preliminary category labels visible, supporting auditability of the coding scheme.

Appendix E

Qualitative Evidence (Translated Verbatim Excerpts)

This appendix compiles anonymized verbatim excerpts from Deaf participants' qualitative feedback on the Virtual Learning Object (VLO). The primary qualitative source consisted of the questionnaire open-ended responses (Q19–Q20), originally provided in written Spanish. In addition, six short Colombian Sign Language (LSC) video recordings were shared voluntarily by participants outside the questionnaire after using the VLO.

For analytic consistency in an English-language thesis, LSC contributions were first interpreted into Spanish and then translated into English using AI-assisted support (ChatGPT), followed by researcher review to preserve meaning, tone, and pragmatic force. All excerpts reproduced here are drawn from the cleaned analytic corpus and are presented in English translation. Participant codes (e.g., P-19, Est-02) do not reveal personal identities.

Clarification on the six LSC videos (supplementary qualitative corpus). The supplementary corpus includes six short LSC videos: (a) Est-01 to Est-03: participant-initiated spontaneous opinion clips; and (b) Est-04 to Est-06: informal interview-style reflections (conversational, participant-facing exchanges not designed as semi-structured interviews). These materials were used as contextualising evidence to elaborate themes and explain questionnaire patterns; they were not treated as a separate standalone instrument:

Est-01 to Est-03 = spontaneous participant opinions (participant-initiated signed comments).

Est-04 to Est-06 = informal interview-style reflections (signed, interview-like exchanges conducted informally).

These materials were used as contextualising evidence to elaborate themes and explain patterns; they were not treated as a separate standalone instrument.

Technological Access

These excerpts illustrate how participants experienced access conditions, usability, and technical affordances that shaped independent engagement with the VLO.

	Participant Excerpt
P-26	"I have to go to the UNAD university library to access the internet and study."
P-17	"However, there shouldn't be so many long texts."
Est-03	"I really like its design. I liked the section where it has icons and signs that guide you to answer according to what you are learning or what is being asked."
Est-01	"The VLO was very clear, easy to understand, and very in-depth… I really hope there can be more resources like that for the next English levels."
P-01	"Something should be fixed — the video doesn't play or show completely."

Multimodal Mediation for English

These excerpts refer to the use of LSC-based mediation, captions, and multimodal scaffolds (images, videos, and bilingual supports) to make written English more accessible.

	Participant Excerpt
P-07	"Clear subtitles, and sign language, which make it much easier to understand the VLO videos."
Est-01	"It has been better with signs; that helped my learning a lot."

Participant	Excerpt
P-02	“The VLO makes learning easier for people who use LSC by helping them better understand English concepts.”
P-18	“Include more short videos, more examples, and more practice in both LSC and English.”
P-15	“The signs for ‘she’ and ‘he’ are the same and incorrect.”

Pedagogical Organisation

Here, participants comment on structure, sequencing, clarity of instructions, and the step-by-step nature of the learning path.

Participant	Excerpt
P-28	“I feel it orients and guides me effectively. It is organized and not disordered.”
P-09	“It helps me learn basic English step by step.”
Est-03	“I liked the section where it has interactive videos… I think that has helped me build knowledge.”
P-04	“I don’t have any suggestions; everything is fine.”

Self-Regulation and Perceived Relevance

These excerpts capture learners’ motivation, perceived usefulness, confidence, and the personal meaning attributed to learning English through the VLO.

Participant	Excerpt
P-07	“I found it interesting and enjoyable.”
P-12	“I understand them a little, but I can follow quite well.”

Participant	Excerpt
P-21	"The VLO is an excellent idea."
P-28	"The information is clear; I think I learn well, and it makes me feel good and calm."
Est-02	"Expressing myself in English is difficult for me… they require you to repeat a lot."

Comparison and Cultural Relevance

These excerpts compare the VLO with other learning resources and highlight Deaf-accessibility expectations, including the role of sign language and support structures.

Participant	Excerpt
P-05	"The virtual English course is difficult because there is no interpreter. This VLO is better."
Est-03	"Before, I studied DUO (the 'little bird' one)… it was difficult to understand and to keep an appropriate learning pace."
P-08	"I know that this virtual platform is different — it feels like… campus because it teaches English directly in the space provided."
P-19	"…explore how to adapt everything to Deaf culture so that the course is fully prepared."
Est-06	"In the United States, Deaf children learn American Sign Language (ASL) from an early age… Deaf culture is an essential part of their education."

Inclusive Autonomy and Overall Evaluation

These excerpts express overall evaluation and the sense of autonomy supported by accessible design, sign-first mediation, and learner agency.

Participant	Excerpt
P-11	"Using their mother language… while learning English makes all the difference. Excellent work."
P-08	"It is important that reading in the VLO works correctly because sometimes it shows both wrong and right translations."
P-28	"The development is excellent—truly outstanding."
Est-01	"I really hope there can be more resources like that for the next English level"

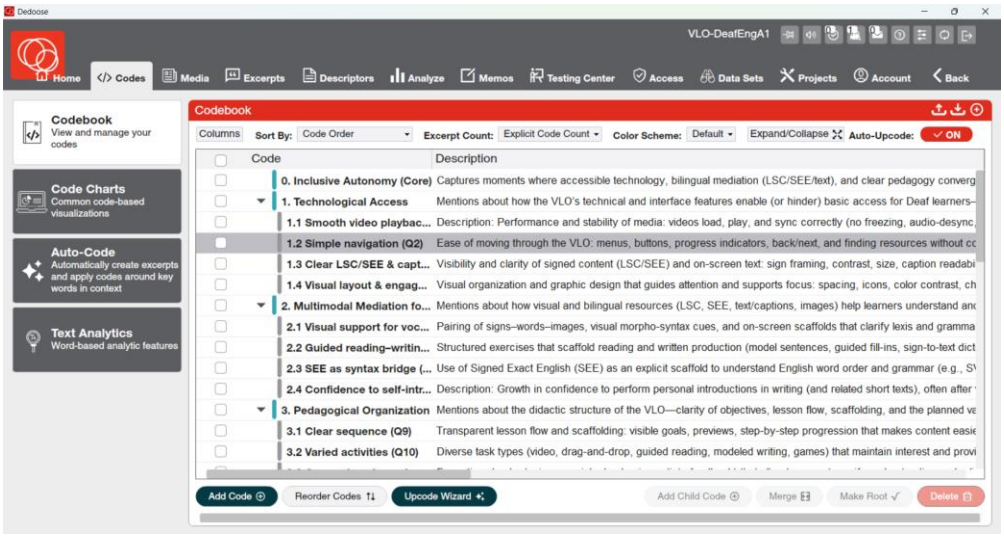
Appendix F

Code Tree and Category System

This appendix presents the final analytical code tree used in the qualitative strand of the mixed-methods study. The coding system was developed primarily deductively, guided by the study's research questions, objectives, and questionnaire dimensions, and then refined through close engagement with Deaf participants' qualitative contributions. These contributions included: (a) open-ended survey responses (written text and LSC-based video responses provided through links), and (b) an auxiliary corpus of six short LSC videos, consisting of three spontaneous participant opinions and three informal interview-style reflections (participant-initiated signed exchanges, not semi-structured interviews).

Across iterative cycles, the codebook was adjusted using a combination of descriptive, values, and structural coding to ensure that the categories captured both what participants reported and how those experiences aligned with the analytic focus of the project. The structure presented below corresponds to the final code tree implemented in Dedoose.

Final deductive code tree uploaded into Dedoose (implementation view).



Note. Dedoose automated features (e.g., Auto-Code and Text Analytics) were not used in this project. The qualitative analysis relied on a manual, theory-informed coding process supported by iterative refinement, constant comparison, and analytic memo writing.

Final Code Tree (Dedoose Implementation)

0. Inclusive Autonomy (Core Node)

The central category integrating accessibility, sign-first multimodal mediation, and pedagogical clarity as conditions that enable Deaf university students to engage in independent learning of A1 written English.

1. Technological Access

1.1 Smooth video playback

1.2 Simple navigation

1.3 Clear LSC/SEE and captions

1.4 Visual layout and engagement

2. Multimodal Mediation for English

2.1 Visual support for vocabulary and grammar

2.2 Guided reading–writing practice

2.3 SEE as a syntax bridge

2.4 Confidence to self-introduce

3. Pedagogical Organisation

3.1 Clear sequence

3.2 Varied activities

3.3 Comprehension quizzes

4. Self-Regulation and Relevance

4.1 Useful topics

4.2 Learning reflection

4.3 Self-study

4.4 Real-life transfer

5. Comparison and Cultural Relevance

5.1 Easier than other resources

5.2 Deaf-friendly design

5.3 Desire for more resources like this

6. Cross-cutting Tags (Auxiliary Analytic Labels)

6.1 UDL (Representation / Action & Expression / Engagement)

6.2 Language components (Reading / Writing / Grammar)

6.3 Modality (LSC / SEE / Text-Captions / Video-Interface)

6.4 Perceived impact (Access / Comprehension / Motivation–Autonomy / Transfer)

Note. Cross-cutting tags were applied as analytic lenses over excerpts; they do not function as hierarchical subcategories of the main code families. Where relevant to fine-grained interpretation, tags were assigned a **3-point ordinal weight (1–3)** to indicate relative salience within an excerpt.

Description of Each Major Category

0. Inclusive Autonomy (Core Category)

Inclusive Autonomy represents the convergence of accessible technology, sign-first multimodal mediation, and clear pedagogical sequencing as enabling conditions for Deaf learners' agency. Excerpts coded here typically show learners describing: (a) independent navigation and completion of lessons, (b) confidence to study without constant interpreter support, (c) persistence through repetition and self-paced practice, and (d) motivation rooted in Deaf-centred design. The category functions as the core node because it captures the intended outcome state of the innovation: autonomous, visually mediated engagement with A1 written English.

1. Technological Access

This category captures the technical and usability conditions that shape access to the VLO as a learning environment. It includes references to functional reliability (especially video playback), intuitive navigation, readable captions/subtitles, and visually organized layout. Analytically, the category answers a foundational question: What technical conditions must be in place before Deaf learners can fully engage with the pedagogical content?

2. Multimodal Mediation for English

Multimodal Mediation for English captures how bilingual and visual resources—LSC video explanations, SEE cues, images, captions, color-coding, and modelled examples—support

comprehension of vocabulary, grammar, and beginner writing tasks. Recurrent subthemes include sign–text alignment, SEE as an explicit bridge to English syntax, and structured scaffolds that guide learners from recognition to production. In practice, this category represents the linguistic–pedagogical heart of the VLO and is consistent with the project's approach of using LSC as the primary language of explanation while employing SEE as a pedagogical scaffold for written-English form.

3. Pedagogical Organisation

This category focuses on instructional design elements that help learners follow the learning path: clear objectives, sequencing, varied activities, and formative quizzes with feedback. Participants coded here typically comment on whether the VLO feels structured, predictable, and manageable—features that become especially important in self-paced online learning environments.

4. Self-Regulation and Relevance

Self-Regulation and Relevance captures metacognitive awareness and learner agency, including planning study time, monitoring comprehension, identifying difficulties, applying strategies, and connecting content to everyday communication needs. This category highlights the motivational and reflective dimension of learning: learners are not only consuming content but also evaluating their progress and positioning English as meaningful for future goals.

5. Comparison and Cultural Relevance

This category includes comparative judgments (e.g., the VLO being easier than other platforms) and cultural validation (e.g., feeling recognised as Deaf learners). It captures appreciation of Deaf-friendly design features, the perceived value of sign-based mediation, and explicit requests for more resources built with similar principles. Conceptually, this dimension

foregrounds identity, belonging, and cultural fit as conditions that can strengthen persistence and autonomy.

6. Cross-cutting Tags (Auxiliary Analytic Labels)

Cross-cutting tags were used to classify excerpts according to: (a) UDL principles, (b) language domains (reading, writing, grammar), (c) modality (LSC/SEE/captions/interface), and (d) perceived impact (access, comprehension, motivation–autonomy, transfer). These tags do not operate as stand-alone categories; rather, they provide an additional analytic layer that supports pattern detection across the main code families and strengthens integration across qualitative and quantitative evidence.

Relationship Between Categories and Research Questions

To preserve consistency with the research-question structure presented in the Data Analysis and Results chapter (SRQ1–SRQ4), Table E1 summarises how each category contributes to answering the study's research questions.

Category contribution to research questions (SRQ1–SRQ4).

Category	**SRQ1 Expressed needs and contextual constraints—post-use evaluation**	**SRQ2 Design decisions / resources integrated**	**SRQ3 Perceived accessibility/usability & mediation**	**SRQ4 Refinement priorities / next DBR cycle**
0. Inclusive Autonomy	—	✓ (design intention/outcome target)	✓ (integrated experience)	✓✓ (guiding principle for redesign)
1. Technological Access	✓✓ (access constraints & enabling conditions)	✓ (technical design features)	✓✓ (usability + access)	✓✓ (device compatibility, playback, navigation fixes)
2. Multimodal Mediation for English	✓ (mediation needs and barriers)	✓✓ (LSC/SEE/captions/scaffolds integrated)	✓✓ (mediation quality & alignment)	✓✓ (precision, consistency, expanded scaffolding)
3. Pedagogical Organisation	✓ (study conditions shaping engagement)	✓✓ (sequencing + task types)	✓✓ (clarity, pacing, checks for understanding)	✓✓ (task redesign, clearer instructions, more practice)
4. Self-Regulation and Relevance	✓✓ (autonomy constraints in real context)	✓ (features supporting self-study)	✓ (perceived usefulness/transfer)	✓✓ (confidence-building, sustained practice, relevance)
5. Comparison and Cultural Relevance	✓✓ (barriers in other resources)	✓ (Deaf-centred positioning decisions)	✓ (perceived fit and comfort)	✓✓ (cultural grounding priorities,

Category	SRQ1 Expressed needs and contextual constraints—post-use evaluation	SRQ2 Design decisions / resources integrated	SRQ3 Perceived accessibility/usability & mediation	SRQ4 Refinement priorities / next DBR cycle
				expansion requests)
6. Cross-cutting Tags	✓ (modality/impact patterns)	✓ (UDL mapping of design features)	✓✓ (channels and mechanisms of mediation)	✓✓ (prioritises redesign targets by impact + modality)

Interpretive Synthesis. SRQ1 (expressed needs and contextual constraints—post-use reflections) is captured most clearly through Technological Access, Self-Regulation and Relevance, and Comparison and Cultural Relevance (Categories 1, 4, and 5), which surface access constraints, self-study realities, and recurrent barriers in mainstream English provision as reported by participants after using the VLO. SRQ2 (design decisions/resources integrated) is represented in how the code tree mirrors the questionnaire dimensions and in how Multimodal Mediation for English and Pedagogical Organisation map to concrete design features (Categories 2 and 3), with supporting evidence from cross-cutting tags (Category 6). SRQ3 (perceived accessibility/usability and pedagogical usefulness) is addressed most directly through Categories 1–3. SRQ4 (refinement priorities for the next DBR cycle) is strengthened through convergent evidence across categories—especially where excerpts report inconsistency, technical interruption, or the need for expanded practice—consistent with the DBR logic of iterative improvement.

Appendix G

Joint Display (Mixed-Methods Integration)

This appendix presents a mixed-methods joint display integrating quantitative tendencies from Likert-type items (Q1–Q18) with qualitative insights from open-ended comments (Q19–Q20) and LSC-mediated qualitative submissions. The qualitative corpus includes: (a) written open-ended responses within the survey, (b) survey-based LSC video responses provided through links, and (c) an auxiliary set of six short LSC videos, consisting of three spontaneous participant opinions and three informal interview-style reflections (participant-initiated signed exchanges, not semi-structured interviews). The purpose is to show how both strands converge, diverge, or expand understanding regarding the accessibility, usability, and pedagogical value of the VLO for Deaf learners at UNAD.

The table below aligns each major construct assessed quantitatively with representative qualitative evidence and an integrated interpretation that supports the Discussion section.

Joint display linking quantitative trends (Likert items) and qualitative evidence.

Quantitative trends (Likert-type items)	**Qualitative evidence (verbatim excerpts)**	**Integrated interpretation**
High endorsement: The VLO is clear, visually accessible, and easy to navigate.	"It is visual, clear, and easy to understand." (P-18) / "I feel it orients and guides me effectively. It is organized and not disordered." (P-28)	**Strong convergence.** Participants repeatedly describe the VLO as visually intuitive and cognitively manageable, reinforcing the quantitative pattern of high perceived clarity and usability.
High endorsement: LSC-based mediation supports comprehension of instructions and content.	"Clear subtitles, and sign language, which make it much easier to understand the VLO videos." (P-07) / "It has been better with signs; that helped my learning a lot." (Est-01)	**Convergence with expansion.** LSC mediation is framed as a key condition for comprehension rather than a peripheral add-on. The auxiliary LSC corpus strengthens interpretation by clarifying how sign-first scaffolding supports self-paced learning.
Moderate endorsement in specific indicators: Text length/density is generally acceptable, but improvement is desirable.	"However, there shouldn't be so many long texts." (P-17) / "It would be better to include the key words in short, simple paragraphs." (P-17)	**Partial divergence within overall acceptability.** While ratings suggest text, load is manageable for most participants, qualitative comments specify a clear design preference: shorter chunks, keyword-focused presentation, and stronger visual scaffolds—actionable targets for DBR refinement.
High endorsement: Sequencing supports progressive and organized learning.	"This VLO helps me learn English step by step." (P-17) / "I understand them a little, but I can follow quite well." (P-12)	**Convergence.** Step-by-step sequencing appears to reduce uncertainty and support progression, aligning with quantitative trends

Quantitative trends (Likert-type items)	Qualitative evidence (verbatim excerpts)	Integrated interpretation
		related to organisation, structure, and guided practice.
High endorsement: The VLO supports autonomy and sustained engagement.	"The information is clear; I think I learn well… it makes me feel good and calm." (P-28) / "I really hope there can be more resources like that for the next English levels." (Est-01)	**Strong convergence.** Learners link clarity and accessible mediation to confidence and persistence, consistent with the project's core construct of Inclusive Autonomy in Deaf Language Learning.
Moderate–high endorsement: Deaf-centred design and cultural/linguistic fit are valued.	"Using their mother language… while learning English makes all the difference. Excellent work." (P-11) / "The combination of images, videos, and signs supports a more dynamic and inclusive form of learning." (P-02)	**Complementary expansion.** Quantitative agreement is clarified qualitatively: cultural relevance is associated with sign-first legitimacy, visual accessibility, and the sense that Deaf learners are explicitly recognised in design choices.
Less uniform endorsement (context-sensitive): Items related to access conditions show more variation.	"I have to go to the UNAD university library to access the internet and study." (P-26) / "The internet affects participation." (P-19)	**Expansion beyond the artefact.** Variation plausibly reflects constraints partially external to the VLO (connectivity and access conditions). Qualitative excerpts contextualise these barriers as implementation realities that shape participation even when the resource is perceived as well designed.

Note. Quantitative trends are summarised from item-level descriptive patterns in Q1–Q18. Qualitative excerpts derive from open-ended survey responses (Q19–Q20), survey-based LSC video submissions, and an auxiliary set of six short LSC videos (three spontaneous opinions and three informal interview-style reflections). All excerpts are translated and anonymized following the procedures described in Appendix C and Appendix D.

Narrative Integration

Taken together, the joint display indicates strong convergence between strands in three domains: (1) multimodal accessibility through sign-first mediation and visual design, (2) pedagogical organisation and clarity (step-by-step progression), and (3) perceived support for autonomous English learning in a distance-education context.

Areas of partial divergence—especially related to text density—provide concrete direction for iterative improvement in the next Design-Based Research cycle. Importantly, participants' comments indicate that evaluation is not limited to interface usability; it also includes judgments about linguistic legitimacy and cultural fit, which operate as motivational and inclusion-related conditions for sustained engagement.

Appendix H

VLO Prototype Screenshots (Lumi/H5P)

This appendix provides visual documentation of the multimodal Virtual Learning Object (VLO) developed in Lumi/H5P to support Deaf learners' A1-level written English (reading and writing). The screenshots illustrate the prototype's overall structure, key accessibility and multimodal mediation features, linguistic scaffolds, and interactive learning activities implemented across the learning path.

All images correspond to the pilot version implemented during the study. For privacy and ethical compliance, no student data, names, usernames, profile images, chat traces, or other personal identifiers appear in the captured screens.

Technical Specifications of the VLO (Pilot Version)

Authoring environment: Lumi Desktop (H5P authoring)

Core format: H5P interactive package (**.h5p**) archived for reproducibility

Primary delivery logic: sign-first navigation support + multimodal scaffolding for A1 written English

Examples of H5P modules used:

Interactive Video

Course Presentation

Mark the Words

Fill in the Blanks

Dialog Cards

Drag the Words

Find the Words

External Integrations and Embedded Resources (Pilot)

Genially objects (visual stories and image-based sequences embedded inside the VLO)

YouTube-hosted LSC videos embedded via the H5P player

SEE (Signed Exact English) cues used selectively as visual scaffolding for basic grammar patterns

SignWriting symbols used selectively for vocabulary anchoring (where applicable)

Accessibility and Multimodal Mediation Features (Design Intent). Systematic use of **LSC videos** to scaffold instructions, transitions, and task completion

SEE-based cues to make English grammar patterns visually explicit

Color-coded text to highlight basic grammatical roles (e.g., subject/verb cues)

Icons and pictograms to support navigation and meaning-making

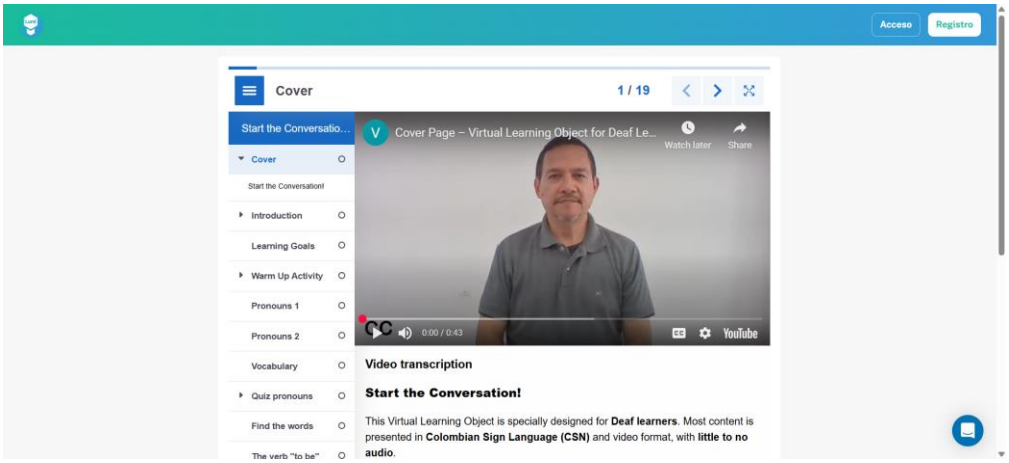
Reduced text density per screen (chunking) to support visual processing and minimize overload

High-contrast layout choices to improve readability and visual salience

Screenshot List (Pilot Prototype)

Home Screen of the VLO

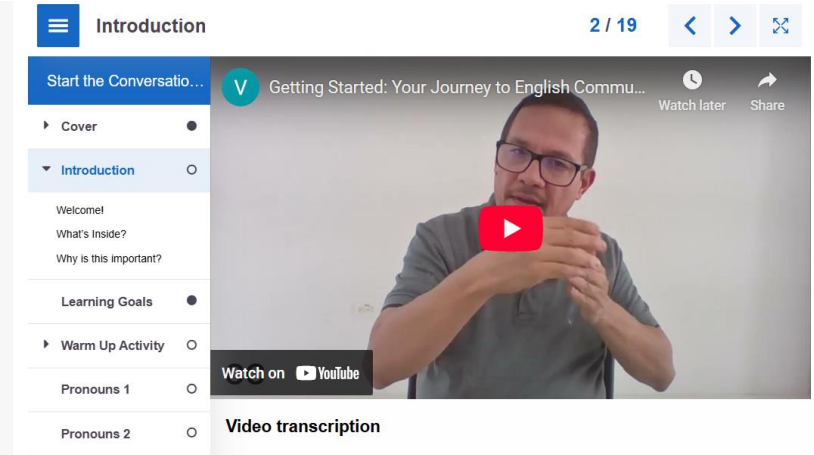
Home screen of the Lumi/H5P prototype (pilot version).



Note. The opening interface displays the module title, navigation elements, overall layout, and the entry point to the introductory LSC video. No personal identifiers are visible.

Introductory LSC Video: Purpose and Participant Orientation

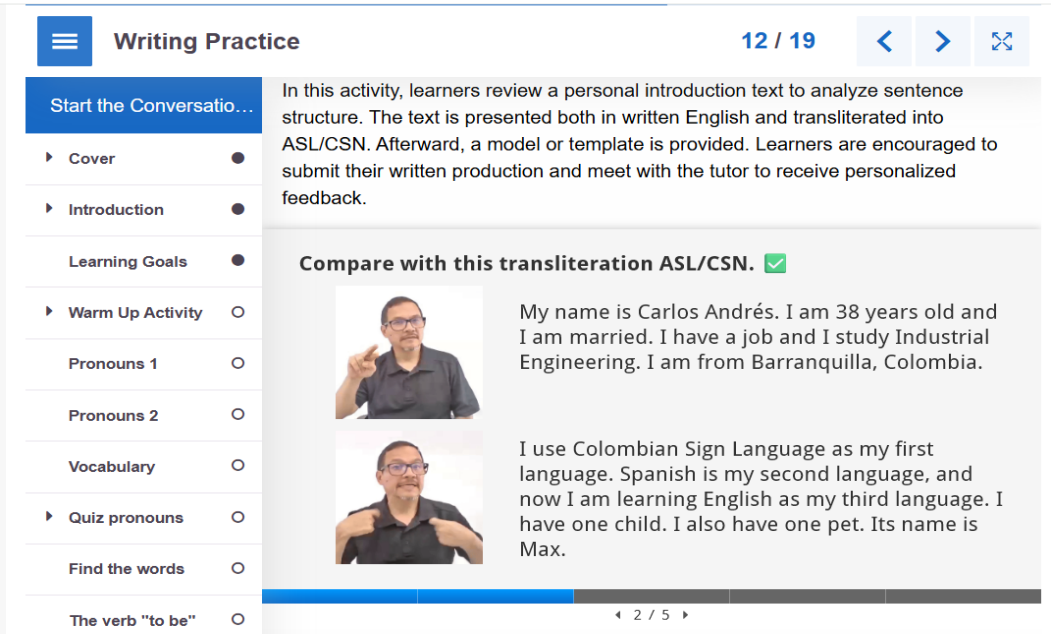
Introductory LSC video screen (orientation to the learning object and study context).

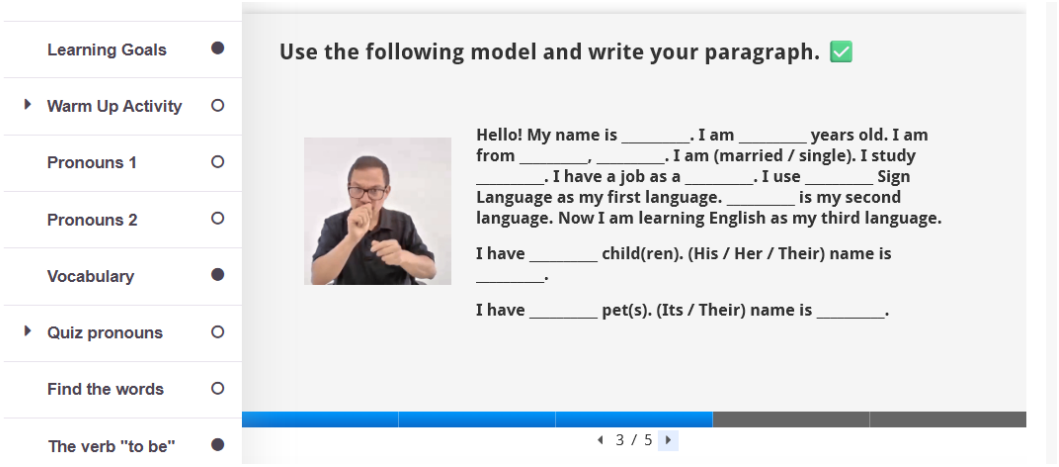


Note. This screen presents the LSC video used to orient learners to the VLO and explain the general purpose and participation conditions in accessible form. Captions and a “Continue” button are visible as part of user control and navigation support.

Course Presentation: Guided Reading Module

Course Presentation screen illustrating guided reading supports.

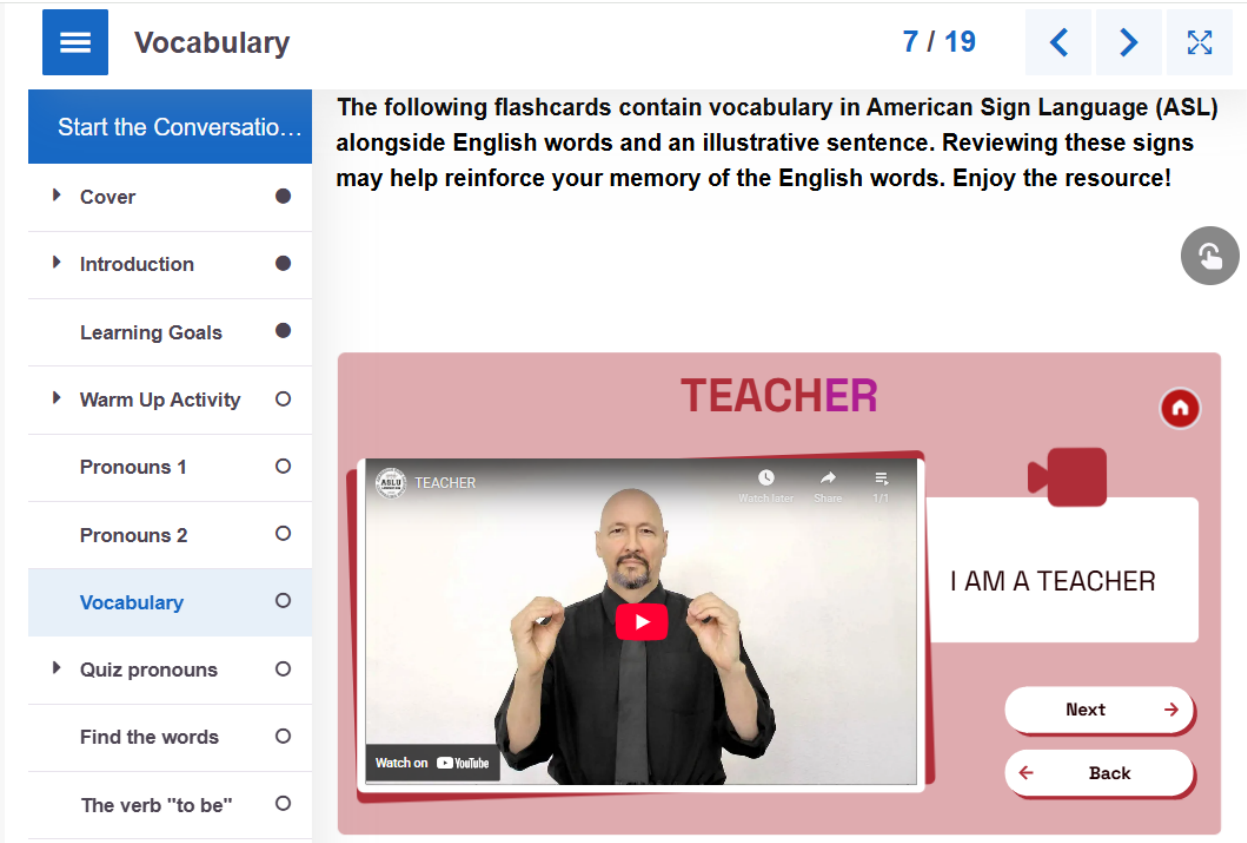


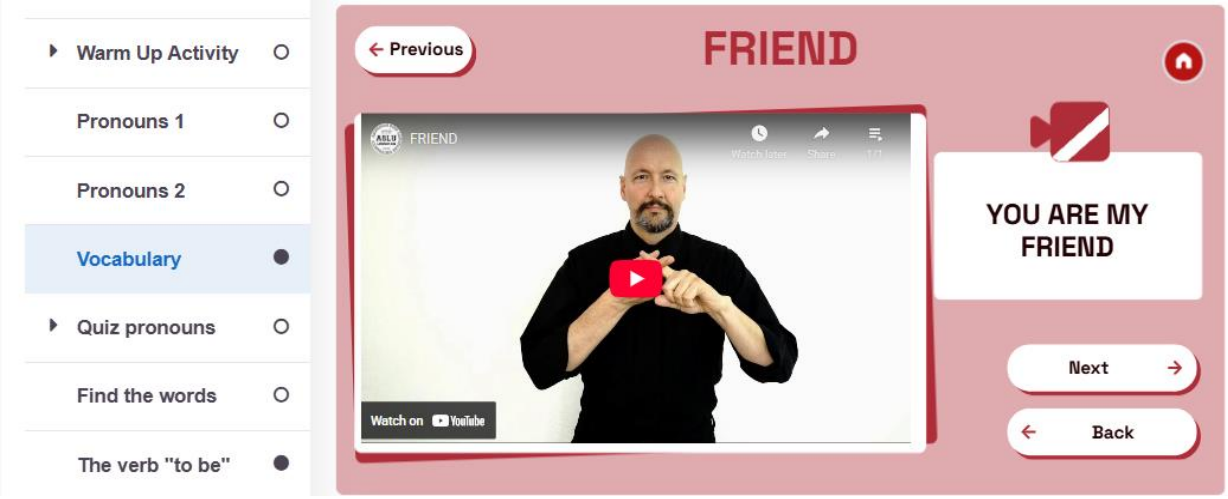


Note. The screen illustrates guided reading elements (e.g., simplified text, labelled images, and visual cues). Where applicable, SEE-based supports are shown as part of grammar-focused mediation.

Vocabulary Presentation: Genially Integration

Embedded Genially vocabulary panel within the H5P learning path.

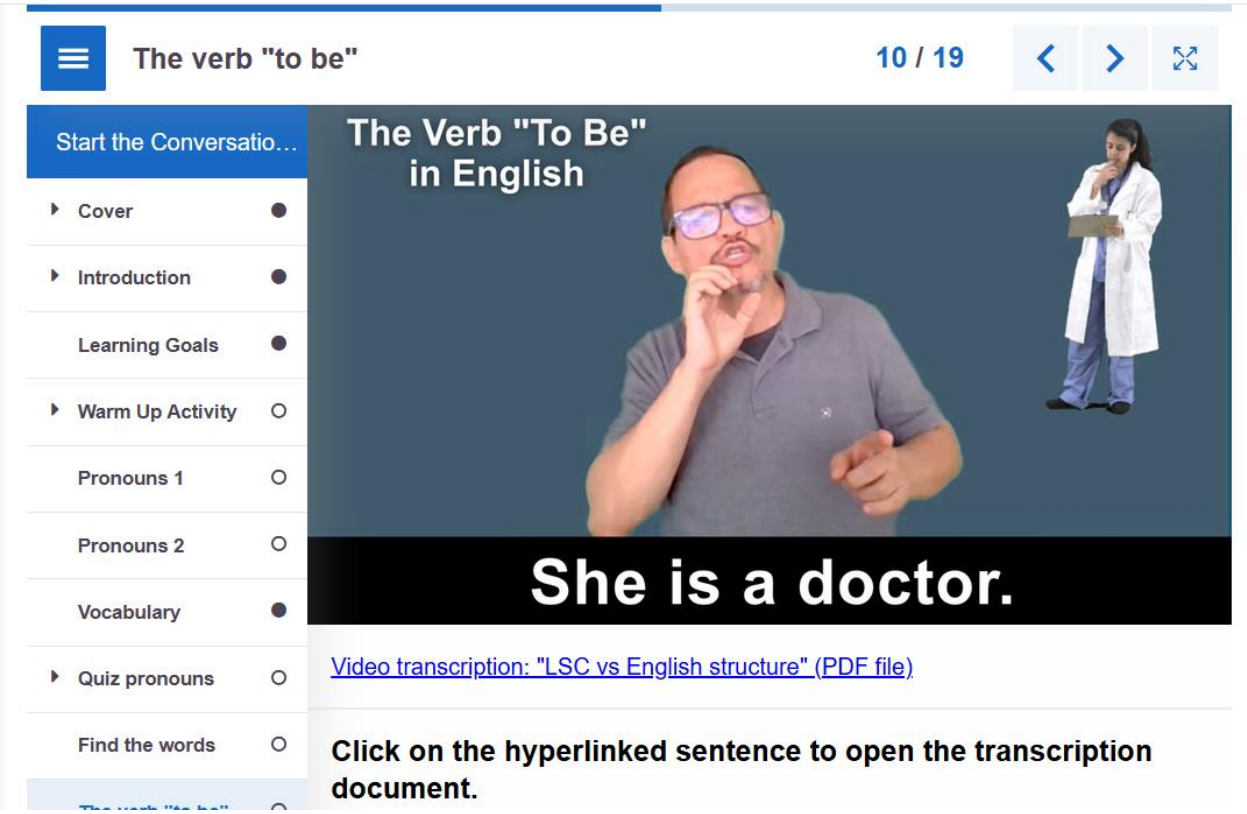




Note. This screenshot shows a Genially object embedded via iframe inside the VLO. The panel uses images, icons, and interactive elements to support vocabulary recognition and engagement.

Grammar Visualisation with SEE Cues

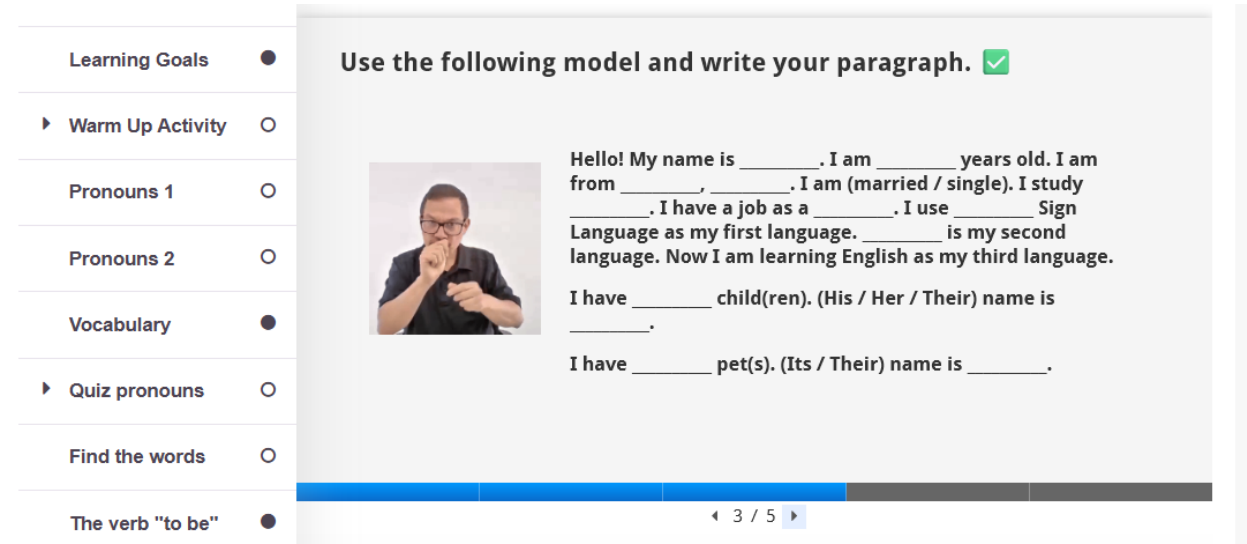
Grammar visualisation screen with SEE-based scaffolding (example sentence model).



Note. The screen illustrates a model sentence (e.g., *I am writing a message*) supported through multi-layered visual cues, including SEE-based representations and pictographic support, to make English sentence structure more explicit.

Interactive Activity: Fill in the Blanks

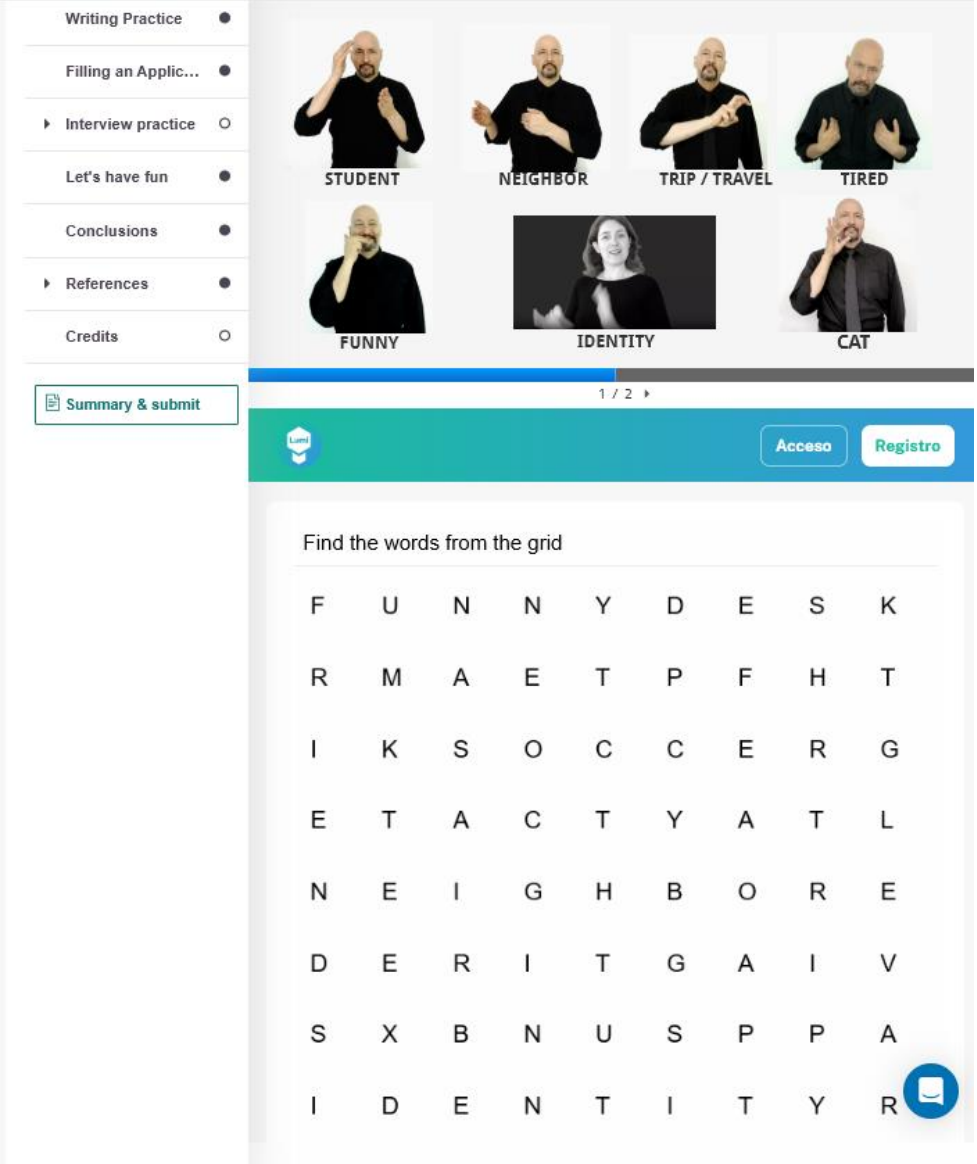
H5P "Fill in the Blanks" activity aligned with A1 reading–writing objectives.



Note. The activity targets-controlled sentence patterns and supports recognition-to-production practice at A1 level through structured prompts and immediate interaction.

Interactive Activity: Find the Words (Word Grid)

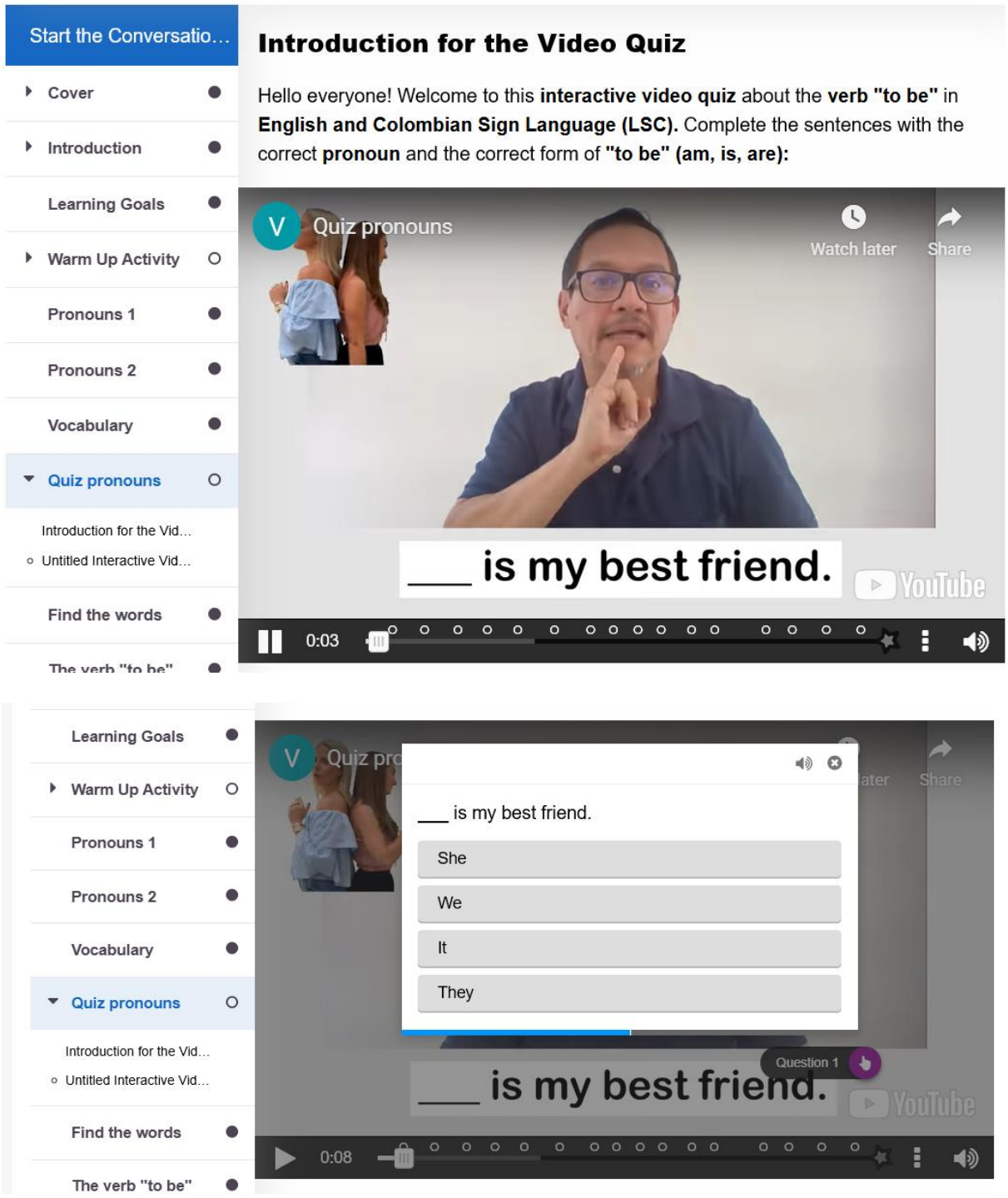
H5P "Find the Words" activity for vocabulary consolidation.



Note. The activity reinforces vocabulary learning through an engaging search format. Where included in the pilot, lexical supports may reference sign-based cues used for vocabulary anchoring.

Comprehension Check: Multiple Choice with LSC Support

Comprehension check item integrating images and LSC-mediated explanation.



Note. This screen combines visual options with an LSC video explanation to support comprehension checks. Where applicable, SEE-based cues are used to scaffold English form recognition and reduce ambiguity in basic structures.

Visual Accessibility and Multimodal Mediation Features (Cross-Screenshot Summary)

Across the screens presented above, the VLO demonstrates recurring accessibility and mediation decisions such as: (a) systematic LSC video scaffolding for navigation and task understanding; (b) selective SEE cues to support explicit grammar awareness; (c) visual cues (icons, pictograms, and color-coding) to support sentence-structure attention; (d) chunked presentation to reduce text density; (e) consistent iconography to strengthen usability; (f) high-contrast layout choices to enhance readability; and (g) optional SignWriting symbols used selectively for vocabulary anchoring. These features are broadly consistent with UDL-orientated design principles emphasising multiple means of representation and engagement.

Notes for Reproducibility (Pilot Prototype)

To replicate or extend the prototype:

The **.h5p package** was authored in Lumi Desktop and can be deployed in compatible environments (e.g., Moodle with H5P support) or adapted for web-based delivery depending on institutional infrastructure.

LSC videos were recorded and edited for online delivery to balance visual clarity with file size and loading time.

Genially objects were embedded to preserve visual continuity across the learning sequence and to support image-based learning segments.

YouTube-hosted LSC videos were embedded with **autoplay disabled** to maintain user control and reduce unwanted cognitive load during navigation.

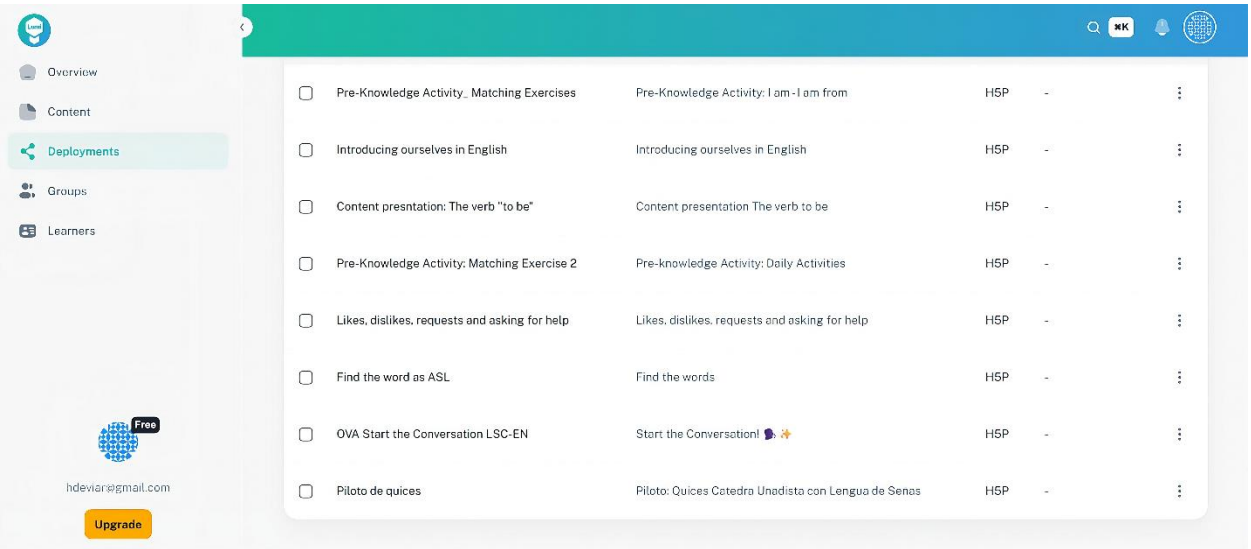
Appendix I

Design-Based Research Iterations and Revisions

This appendix documents the iterative development of the Virtual Learning Object (VLO), *Start the Conversation LSC-EN*, following the core logic of Design-Based Research (DBR): design → feedback → revision → pilot evaluation → redesign implications. Although the prototype originated as a course deliverable for 523008—Resources Development for English Language Learning, the successive refinements completed during and after that course informed the conceptualization and methodological design of the present thesis.

In practice, the VLO was not developed as a single linear activity but as a bundle of multiple H5P resources authored within Lumi, each corresponding to a specific learning segment (e.g., pre-knowledge tasks, guided content presentation, practice activities, and quizzes). The internal structure of these Lumi-authored resources is illustrated in Figure I1.

Lumi workspace view showing multiple H5P resources integrated into the VLO prototype.



Note. The screenshot illustrates the internal list of H5P resources authored and managed within Lumi as part of the VLO prototype (e.g., pre-knowledge activities, content presentations,

practice tasks, and quizzes). No student data are shown. Source: Author's screenshot (2024/2025).

The evolution of the VLO is synthesized across three stages: (1) the Initial Version, (2) Course-Based Revisions guided by tutor feedback, and (3) Pilot-Based Adjustments informed by Deaf learners' responses. Evidence sources include course artefacts, feedback meeting notes, field notes, and participant feedback.

First Iteration – Initial VLO Design (Course Phase 1–2)

Purpose and Context

The first version of the VLO was developed as an initial prototype to support Deaf A1 learners in producing basic self-introductions in **written English**. At this stage, the design priority was to create a **sign-first**, visually orientated learning path that made foundational structures explicit and learnable in a self-paced format.

Initial Design Focus

The initial version targeted:

Basic personal information (identity, origin, and simple descriptors),
the verb to be.
Personal pronouns.
Nationalities and simple questions.
Contrastive visibility between LSC discourse patterns and English sentence order, and SEE as a bridge to make grammar visually explicit.

Characteristics of the first prototype

LSC-based explanations to orient learners and scaffold key concepts.
Early SEE representations to highlight English syntax.
H5P/Lumi interactive video as the core learning sequence.
Limited module set (intro, vocabulary, pronouns, and a basic quiz).
Self-review as the main quality-control mechanism at this stage.

Self-detected limitations

Some instructions were not sufficiently explicit for fully independent navigation.

Visual design elements (e.g., colour variation and font inconsistency) increased cognitive load.

Visual reinforcement was limited (few icons, pictorial supports, or repeated models).

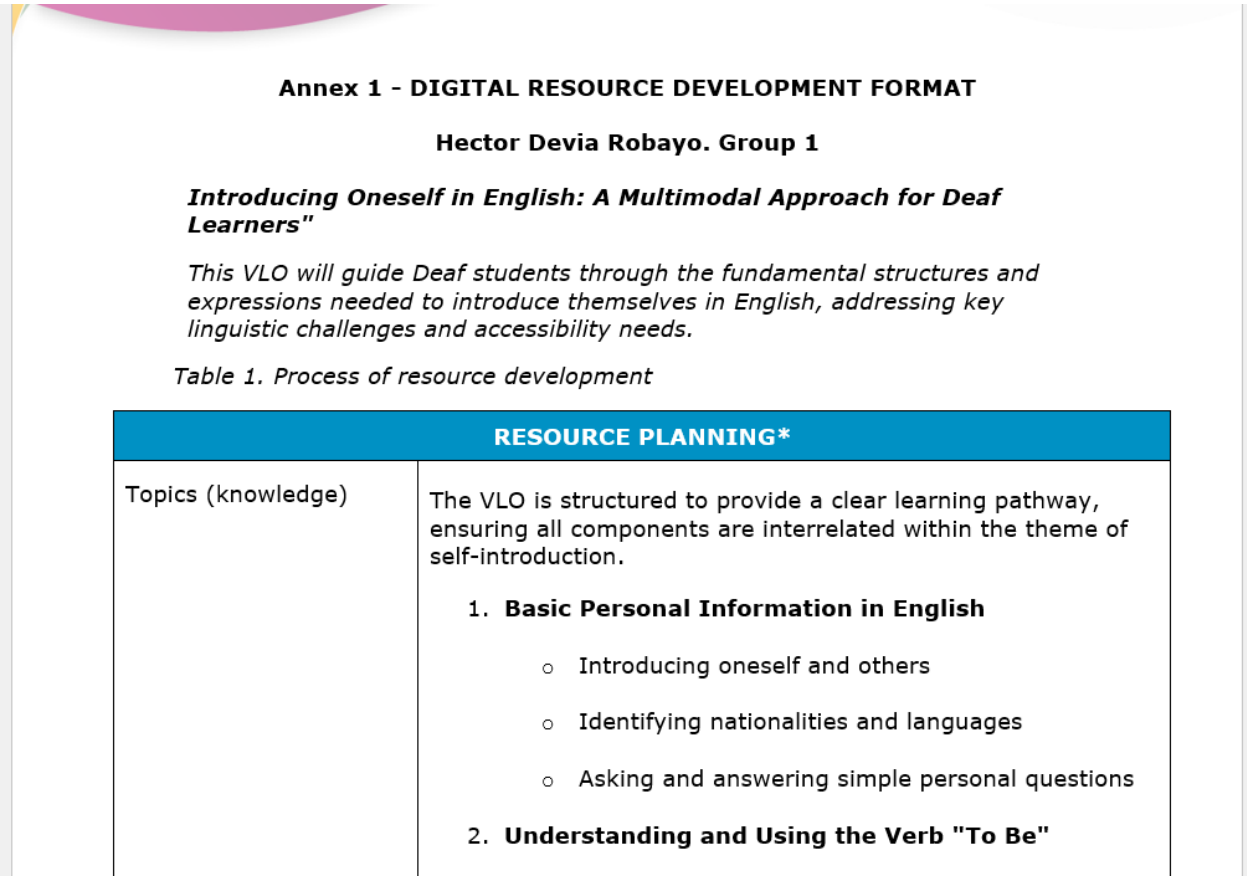
Differentiation among LSC, SEE, and written English was not always consistently signposted.

This initial iteration functioned as the initial prototype for subsequent DBR refinement.

Second Iteration – Course Tutor Feedback and Course-Based Revisions (Meetings 1 and 2)

The second iteration emerged from formative feedback provided by Professor Edwin Londono, who reviewed the prototype's structure, clarity, and accessibility during the course development process.

Screenshot of "Annex 1 – Digital Resource Development Format" (resource planning section).



Annex 1 - DIGITAL RESOURCE DEVELOPMENT FORMAT

Hector Devia Robayo. Group 1

Introducing Oneself in English: A Multimodal Approach for Deaf Learners"

This VLO will guide Deaf students through the fundamental structures and expressions needed to introduce themselves in English, addressing key linguistic challenges and accessibility needs.

Table 1. Process of resource development

RESOURCE PLANNING*	
Topics (knowledge)	The VLO is structured to provide a clear learning pathway, ensuring all components are interrelated within the theme of self-introduction. 1. **Basic Personal Information in English** ○ Introducing oneself and others ○ Identifying nationalities and languages ○ Asking and answering simple personal questions 2. **Understanding and Using the Verb "To Be"**

Note. Excerpt from Annex 1: Digital Resource Development Format (resource planning section for the VLO prototype). This artefact documents how the early learning pathway and topic scope were structured during the course phase, prior to the pilot evaluation.

Key adjustments recommended by the tutor

Clarify activity instructions to reduce ambiguity and support self-paced learning.

Reduce unnecessary colour saturation and normalize typography for readability.

Strengthen **LSC–SEE–(international sign references where relevant)–written English** alignment to increase pedagogical transparency.

Simplify the interactive video structure and reduce non-essential animations.

Reorganize the learning path to improve progression and coherence.

Implemented revisions (course-based)

Instructions were streamlined and standardized across sections.

Visual design was revised (cleaner palette, consistent font use, improved contrast).

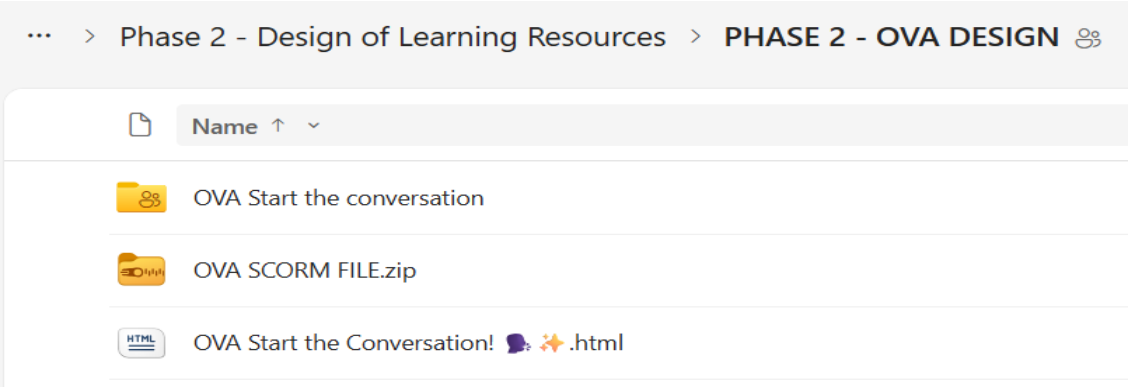
Selected LSC explanations were re-recorded or re-sequenced for pacing and clarity.

SEE scaffolds were adjusted to better reflect English word order where relevant.

Sections were reorganized to produce a more predictable and guided learning sequence.

Outcomes of this iteration (course deliverables)

Exported VLO deliverables produced during Phase 2 (SCORM package and HTML version).



Note. Screenshot showing the Phase 2 “OVA DESIGN” outputs, including SCORM and HTML formats. This output evidences that the revised prototype was packaged for deployment in compatible learning environments, supporting readiness for pilot testing.

Third Iteration – Pilot Evaluation With Deaf Students (Current Study Input)

Pilot modality

The VLO and the evaluation instrument were shared asynchronously with Deaf UNAD learners via institutional email. Participants interacted independently with the VLO, supported by LSC-based instructions embedded within the resource and in the evaluation workflow.

Quantitative tendencies (summary)

Descriptive results showed generally high levels of agreement regarding usability, accessibility, and pedagogical clarity across the evaluation dimensions reported in the study (see Appendix I for full statistics and Appendix F for the integration display).

Qualitative insights informing adjustments

Qualitative feedback highlighted:

- the practical value of LSC explanations and captions for comprehension,
- the need for additional visual supports (icons, drawings, more modelled examples),
- occasional confusion in quizzes when visual guidance was limited, and
- appreciation of SEE as a scaffold that makes English grammar more visible.

Some learners referenced prior exposure to international Deaf media and widely disseminated sign language resources. These references were interpreted as part of participants’ broader communicative repertoires and comparative experiences, rather than as evidence of ASL functioning as an instructional language within the VLO. LSC remained the primary language of mediation throughout.

Adjustments completed based on pilot input

Added a short vocabulary expansion sequence aligned with self-introduction topics. Inserted a dedicated vocabulary section after the Pronouns module to strengthen anchoring before practice tasks.

Improved pacing and segmentation in selected explanations to reduce visual overload.

Revised specific SEE-based prompts to improve internal consistency across activities.

Revisions planned for a next DBR cycle (documented, not implemented here)

Provide step-by-step visual guidance for quizzes and transitions.

Expand SEE models to cover additional A1 structures beyond introductions.

Include optional comparative notes acknowledging learners' exposure to international sign resources when pedagogically useful.

Add a guided "introduction builder" activity to scaffold incremental writing production.

Outcome

The pilot evaluation validated the VLO's relevance and accessibility for Deaf learners and generated actionable redesign implications consistent with DBR logic of successive refinement.

DBR Synthesis: From Course Prototype to Thesis Research Project

Although the VLO began as a course prototype, the iterative cycle of design, feedback, and pilot evaluation produced:

evidence of gaps in Deaf-accessible English learning resources in virtual higher education,

documented learner needs (sign-first mediation, grammar visibility, visual organisation),

a functional prototype with measurable usability and perceived pedagogical value, and

a clearly researchable problem aligned with accessibility, multimodality, and inclusive pedagogy.

This process contributed directly to framing the present study as the design and evaluation of a multimodal, sign-first VLO to support Deaf learners in producing A1 written self-introductions in English.

Evidence Sources Used in This Appendix

Course resource development documents (e.g., Annex 1 – Digital Resource Development Format).

Course syllabus and resource development guidelines (Phase 2 / OVA (VLO) design instructions).

Feedback notes from meetings with Professor Edwin Londono.

Student evaluation results (Google Forms dataset) and exported summaries used for analysis.

Qualitative excerpts (survey open-ended responses and LSC-mediated contributions, interpreted/translated).

Records of modifications to the VLO, including Lumi project workspace and deployment screenshots, .h5p exports, and packaging outputs (e.g., SCORM/HTML artefacts) used during the course and pilot phases.

Appendix J

Quantitative Tables and Graphs

Quantitative Tables and Graphs

This appendix presents the quantitative results obtained from the evaluation instrument applied to Deaf participants who interacted with the multimodal Virtual Learning Object (VLO). The analysis includes frequency distributions and percentages for each of the 18 Likert-type items (Q1–Q18). All responses were anonymized and coded as P-01 to P-29. The tables and graphs in this appendix were generated from the dataset exported from Google Forms and processed using Excel.

Anonymized Database

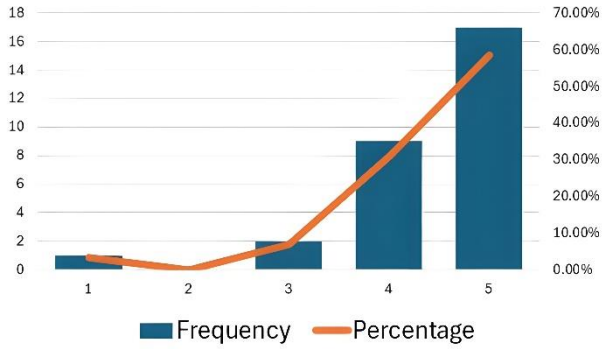
The raw data file included timestamped responses and open-ended comments. To protect participants' identities, no personal information was retained in the analytic dataset. Only numerical responses for the 18 Likert-scale items (Q1–Q18) were used to produce the frequency tables and distributions reported in this appendix. The anonymized dataset is archived separately and can be consulted upon request.

Frequency Tables, Percentages, and Descriptive Graphs

For each item, the table reports the frequency (n = 29) and percentage of responses across the 1–5 scale. A corresponding bar-chart distribution should be included after each table (or grouped after all tables, depending on the formatting of the thesis).

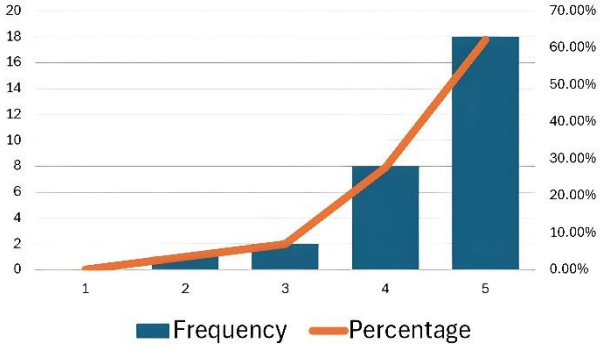
Question 1. *"The videos, quizzes, and interactive elements worked properly."*

Response	Frequency	Percentage
1	1	3.40%
2	0	0.00%
3	2	6.90%
4	9	31.00%
5	17	58.60%



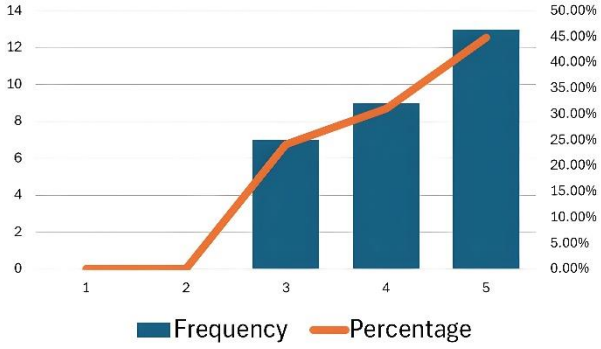
Question 2. *"The VLO was easy to navigate, with clear signs and instructions."*

Response	Frequency	Percentage
1	0	0.00%
2	1	3.40%
3	2	6.90%
4	8	27.60%
5	18	62.10%



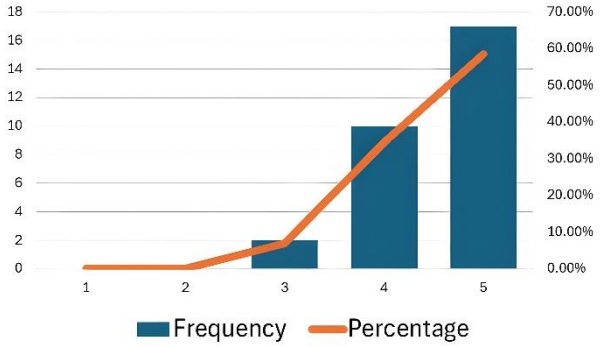
Question 3. *"The content was accessible with Colombian Sign Language (LSC) and SEE."*

Response	Frequency	Percentage
1	0	0.00%
2	0	0.00%
3	7	24.10%
4	9	31.00%
5	13	44.80%



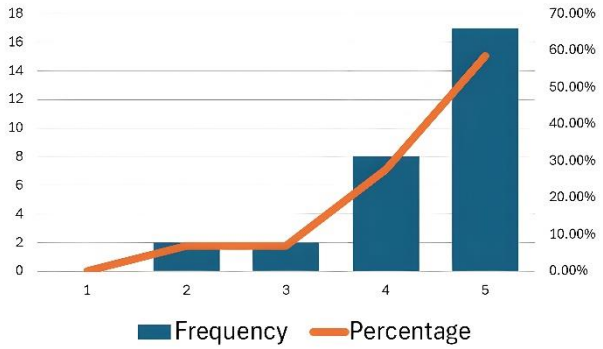
Question 4. *"The layout and design helped me stay focused and engaged."*

Response	Frequency	Percentage
1	0	0.00%
2	0	0.00%
3	2	6.90%
4	10	34.50%
5	17	58.60%



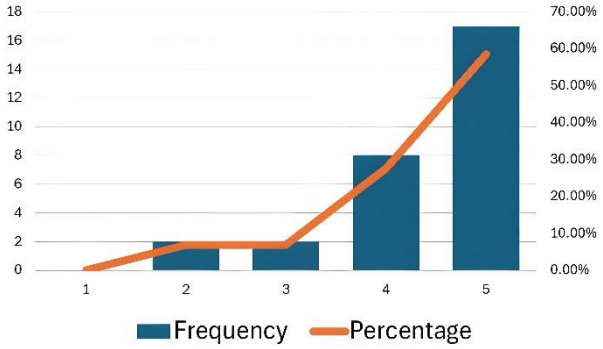
Question 5. *"I learned new English words and grammar through visual support."*

Response	Frequency	Percentage
1	0	0.00%
2	2	6.90%
3	2	6.90%
4	8	27.60%
5	17	58.60%



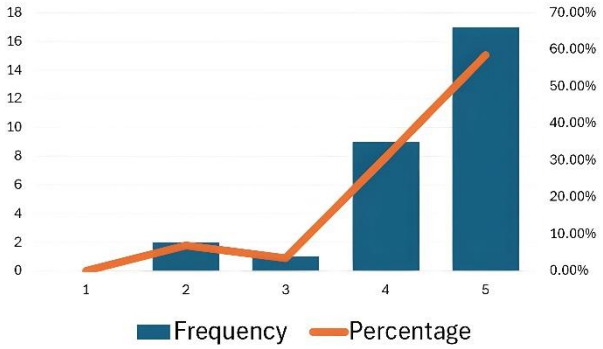
Question 6. *""The activities helped me practice reading and writing in English."*

Response	Frequency	Percentage
1	0	0.00%
2	2	6.90%
3	2	6.90%
4	8	27.60%
5	17	58.60%



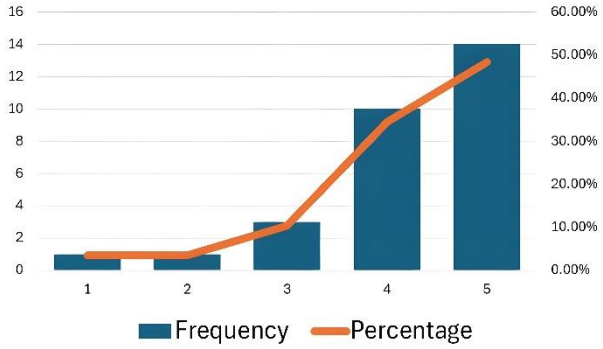
Question 7. *"SEE and signed videos helped me understand English sentence structure."*

Response	Frequency	Percentage
1	0	0.00%
2	2	6.90%
3	1	3.40%
4	9	31.00%
5	17	58.60%



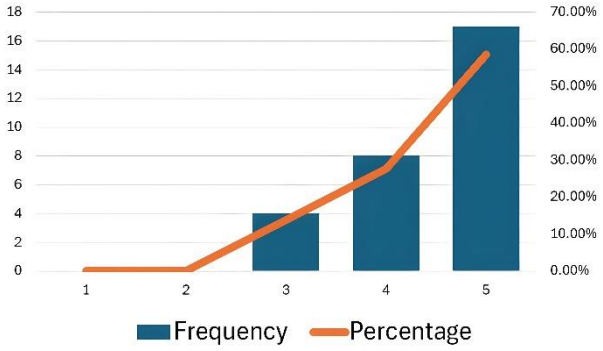
Question 8. *"I feel more confident introducing myself in English."*

Response	Frequency	Percentage
1	1	3.40%
2	1	3.40%
3	3	10.30%
4	10	34.50%
5	14	48.30%



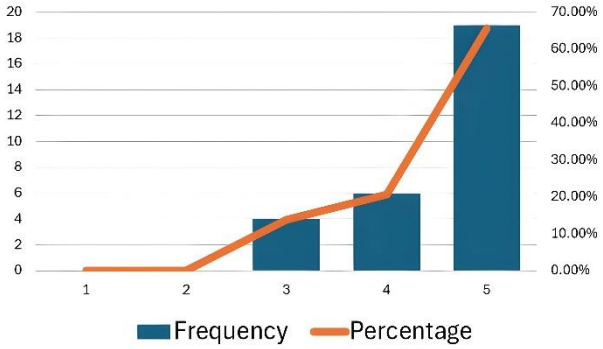
Question 9. *"The lessons followed a clear structure and logical order."*

Response	Frequency	Percentage
1	0	0.00%
2	0	0.00%
3	4	13.80%
4	8	27.60%
5	17	58.60%



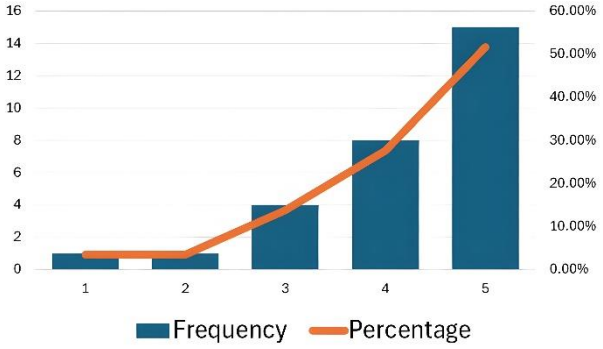
Question 10. *"The VLO included different types of activities (quizzes, videos, etc.)."*

Response	Frequency	Percentage
1	0	0.00%
2	0	0.00%
3	4	13.80%
4	6	20.70%
5	19	65.50%



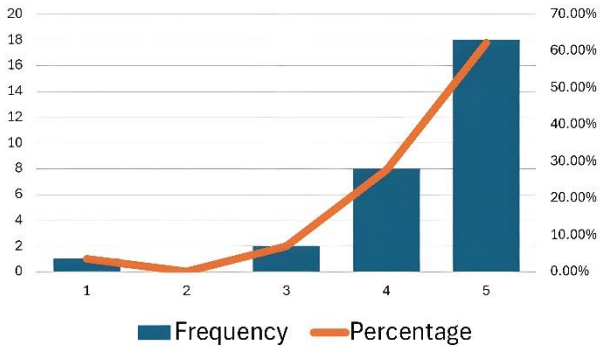
Question 11. *"The quizzes helped me check my understanding."*

Response	Frequency	Percentage
1	1	3.40%
2	1	3.40%
3	4	13.80%
4	8	27.60%
5	15	51.70%



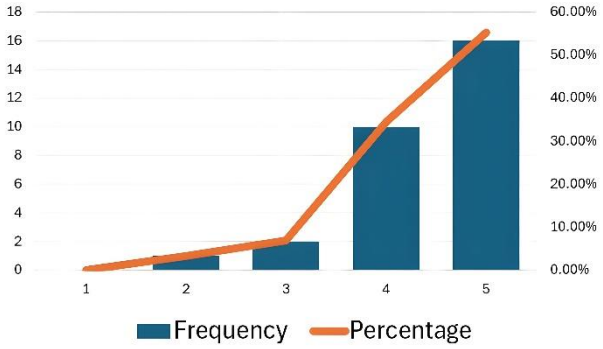
Question 12. *"The topics were useful and clearly explained."*

Response	Frequency	Percentage
1	1	3.40%
2	0	0.00%
3	2	6.90%
4	8	27.60%
5	18	62.10%



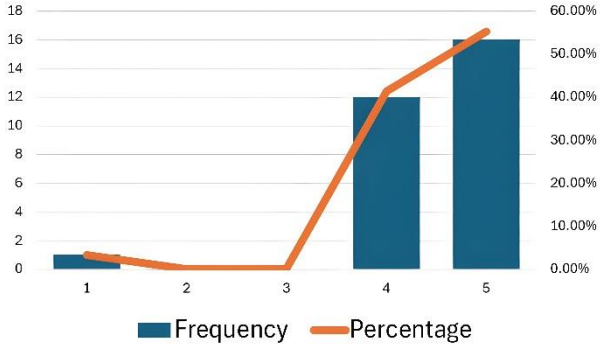
Question 13. *"The resource helped me reflect on how I learn English."*

Response	Frequency	Percentage
1	0	0.00%
2	1	3.40%
3	2	6.90%
4	10	34.50%
5	16	55.20%



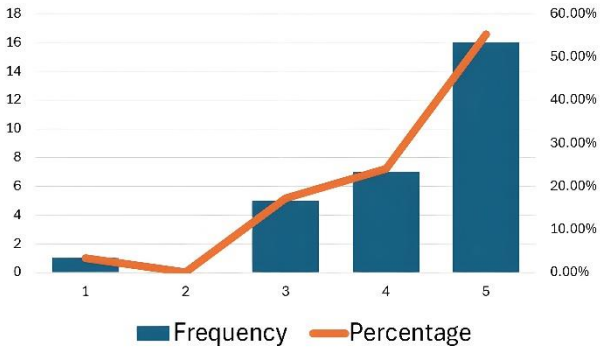
Question 14. *"The VLO encouraged me to study and learn on my own."*

Response	Frequency	Percentage
1	1	3.40%
2	0	0.00%
3	0	0.00%
4	12	41.40%
5	16	55.20%



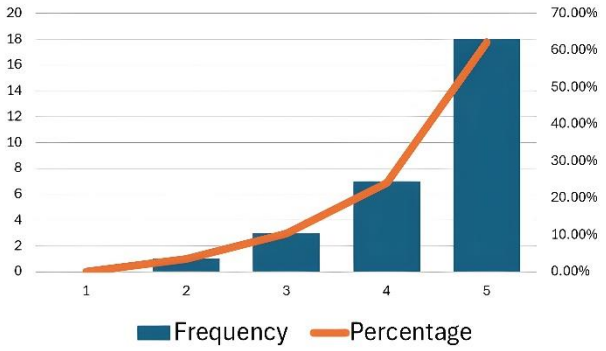
Question 15. *"I could connect what I learned with my daily life."*

Response	Frequency	Percentage
1	1	3.40%
2	0	0.00%
3	5	17.20%
4	7	24.10%
5	16	55.20%



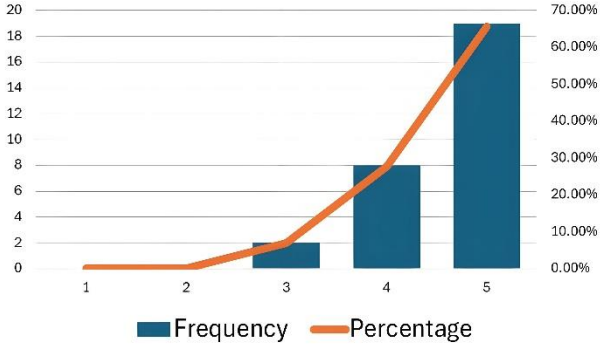
Question 16. *"Compared to other English resources I have used before, this VLO was easier to understand."*

Response	Frequency	Percentage
1	0	0.00%
2	1	3.40%
3	3	10.30%
4	7	24.10%
5	18	62.10%



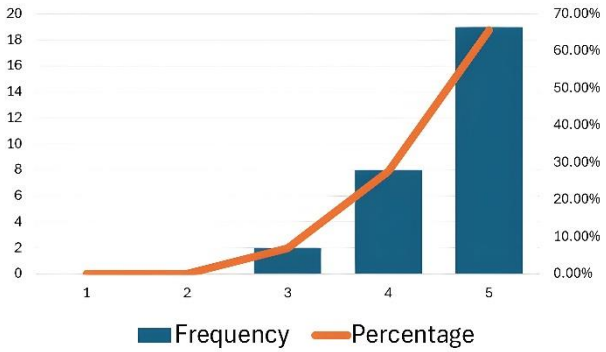
Question 17. *"I feel more comfortable using this VLO because it is specially designed for Deaf learners."*

Response	Frequency	Percentage
1	0	0.00%
2	0	0.00%
3	2	6.90%
4	8	27.60%
5	19	65.50%



Question 18. *"I wish more English learning materials were designed like this one."*

Response	Frequency	Percentage
1	0	0.00%
2	0	0.00%
3	2	6.90%
4	8	27.60%
5	19	65.50%



Appendix K

Additional Materials Used in Data Collection

This appendix compiles the supporting materials used during the data collection process for the evaluation of the multimodal Virtual Learning Object (VLO). These materials supported clear communication with participants, provided accessible instructions in Colombian Sign Language (LSC), and facilitated voluntary, informed participation throughout the study. All items included here were shared ethically and aligned with inclusive and accessible research principles for Deaf learners. Personal names, email addresses, and institutional identifiers have been removed where applicable to protect confidentiality.

Invitation Emails Sent to Participants

Below is the email template used to invite Deaf students to participate in the VLO evaluation. The message was originally sent in Spanish and is presented here alongside an English translation for documentation purposes.

18/4/25, 15:38 Universidad Nacional Abierta y a Distancia - UNAD Mail - Invitación a revisar y evaluar recurso digital para aprender inglés 📘 👍

Hector Istmod Devia Robayo <hector.devia@unad.edu.co>

Invitación a revisar y evaluar recurso digital para aprender inglés 📘 👍
4 messages

[E-mails removed]

👍 **¡Hola, queridos estudiantes!**

18/4/25, 15:38 Universidad Nacional Abierta y a Distancia - UNAD Mail - Invitación a revisar y evaluar recurso digital para aprender inglés 📘 👍

https://youtu.be/cWCKYCGmKCw

Les envío un **cordial saludo** y los invito a revisar un **recurso digital (VLO)** que hemos preparado **especialmente para ustedes**.

Este objeto virtual de aprendizaje está diseñado para apoyar la **enseñanza y el aprendizaje del inglés** en estudiantes **sordos** usuarios de la **Lengua de Señas Colombiana (LSC)**.

🌱 **Su opinión es muy importante.**
Evaluar este recurso nos permitirá **mejorarlo** y hacerlo más **útil y accesible** para todos.

Les agradecería mucho que lo **revisen con calma** y luego **completen la evaluación.**

📌 **Ambos recursos están disponibles en los siguientes enlaces:**

🔗 **Recurso (VLO):** https://app.Lumi.education/run/5zyBpG

📋 **Evaluación (con Lengua de Señas incluida):** https://docs.google.com/forms/d/e/1FAIpQLScAxr0rC6A4IL_m4xjsgP4WW-nrDrwl4nFVjtg3X30IePz_Lw/viewform?usp=sharing

🎯 **Si por algún motivo no desean participar**, por favor **respondan este mensaje o correo** informándolo. Esa respuesta también es **muy valiosa** para nosotros.

🌟 **Gracias por su invaluable contribución a este proyecto.**

Un fuerte abrazo,
Héctor Devia Robayo

Email Template – Initial Invitation

Actual send message in Spanish	**Message translated into English**
🪴 **Su opinión es muy importante.** Evaluar este recurso nos permitirá **mejorarlo** y hacerlo más **útil y accesible** para todos. Les agradecería mucho que lo **revisen con calma** y luego **completen la evaluación**. 📌 **Ambos recursos están disponibles en los siguientes enlaces:** 🔗 **Recurso (VLO):** https://app.Lumi.education/run/5zyBpG 📋 **Evaluación (con Lengua de Señas incluida):** https://docs.google.com/forms/d/e/1FAIpQLScAxr0rC6A4IL_m4xjsgP4WW-	🪴 **Your opinion is very important.** Evaluating this resource will allow us to improve it and make it more useful and accessible for everyone. I would greatly appreciate it if you could review it calmly and then complete the evaluation. 📌 **Both resources are available at the following links:** 🔗 **Resource (VLO):** https://app.Lumi.education/run/5zyBpG 📋 **Evaluation (with Sign Language included):**

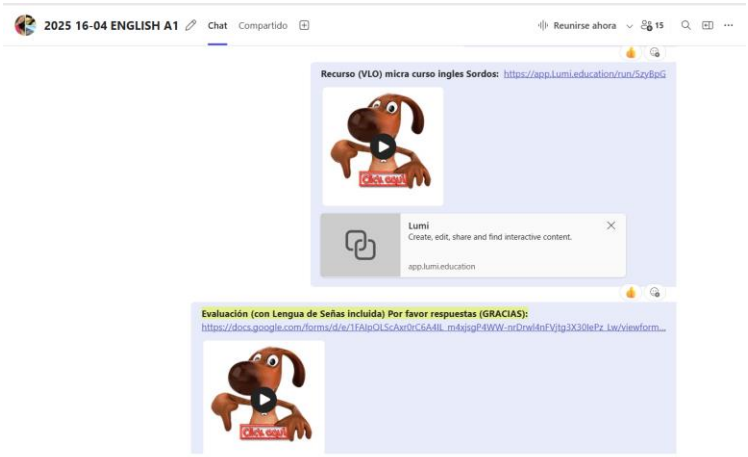
nrDrwI4nFVjtg3X30IePz_Lw/viewform?usp=sharing 🎯 **Si por algún motivo no desean participar**, por favor **respondan este mensaje o correo** informándolo. Esa respuesta también es **muy valiosa** para nosotros. 🌟 **Gracias por su invaluable contribución a este proyecto.** Un fuerte abrazo, **Héctor Devia Robayo**	https://docs.google.com/forms/d/e/1FAIpQLScAxr0rC6A4IL_m4xjsgP4WW-nrDrwI4nFVjtg3X30IePz_Lw/viewform?usp=sharing 🎯 **If for any reason you do not wish to participate,** please reply to this message or email to let us know. That response is also very valuable to us. 🌟 **Thank you for your invaluable contribution to this project.** Warm regards, **Héctor Devia Robayo**

Note. Although the email invitation was written in Spanish, participants also received the evaluation workflow with LSC videos embedded in the questionnaire, ensuring that core instructions and ethical information were accessible in their primary language.

Follow-Up Messages and Reminders through MS TEAMS

In addition to the invitation email, short reminders were sent through institutional channels to ensure that all participants had equal access to the VLO and the evaluation instrument. Reminders were brief, link-based, and were complemented by LSC video reminders when needed.

Reminder messages are sent on LSC Videos



Actual Spanish/LSC message sent.

Recurso (VLO) micro curso ingles Sordos: *https://app.Lumi.education/run/5zyBpG*
Evaluación (con Lengua de Señas incluida) Por favor, respuestas (GRACIAS):
https://docs.google.com/forms/d/e/1FAIpQLScAxr0rC6A4IL_m4xjsgP4WW-nrDrwl4nFVjtg3X30IePz_Lw/viewform?usp=sharing

English translation of the reminder:
Resource (VLO)—English micro-course for Deaf students:
https://app.Lumi.education/run/5zyBpG
Evaluation (with Sign Language included). Please send your responses (THANK YOU):
https://docs.google.com/forms/d/e/1FAIpQLScAxr0rC6A4IL_m4xjsgP4WW-nrDrwl4nFVjtg3X30IePz_Lw/viewform?usp=sharing

LSC Instructional Videos Used in the Questionnaire

To ensure full accessibility, the evaluation instrument included short instructional videos in Colombian Sign Language (LSC). These videos explained: (a) the goal of the instrument, (b) how to respond to the Likert scale, (c) the voluntary nature of participation, and (d) confidentiality and ethical handling of responses. In addition, each item in the questionnaire was accompanied by an LSC video presenting the same content as the written English item, allowing participants to respond based on information provided in their primary language.

LSC Video 1 – Participation Instructions

LSC Video 1 – Goal of the Instrument, Participant Information, and Consent (LSC video):

Video link: https://www.youtube.com/watch?v=u7nu50BoQJk

LSC Video 2 – Instructions for Use / Scale Explanation (LSC video):

Video link: https://youtu.be/wwm30jJig6U

These resources ensured that the key instructions and ethical conditions of participation were communicated in participants' natural language and reduced the risk that written English could limit comprehension of the research procedures.

Appendix L

Specialised Analytical Summary (RAE) in Spanish

Resumen Analítico Especializado (RAE)	
El presente Resumen Analítico Especializado (RAE) sintetiza los componentes principales del trabajo de grado titulado *Design, Pilot Implementation, and Evaluation of a UDL-Guided Multimodal Virtual Learning Object to Support A1 Written English Skills in Deaf LSC Users at UNAD*. Su propósito es ofrecer una visión estructurada del estudio, su orientación metodológica y sus aportes principales dentro de su contexto de investigación específico, en concordancia con los lineamientos de la Escuela de Ciencias de la Educación (ECEDU) de la Universidad Nacional Abierta y a Distancia (UNAD).	
Título	*Design, Pilot Implementation, and Evaluation of a UDL-Guided Multimodal Virtual Learning Object to Support A1 Written English Skills in Deaf LSC Users at UNAD* [Diseño, implementación piloto y evaluación de un Objeto Virtual de Aprendizaje (OVA) multimodal, guiado por el Diseño Universal para el Aprendizaje (DUA), para apoyar el desarrollo del inglés escrito A1 (lectura, escritura y gramática) en estudiantes Sordos usuarios de la Lengua de Señas Colombiana (LSC) en la UNAD].
Modalidad del trabajo de grado	Proyecto de investigación con orientación de Investigación Basada en Diseño (IBD), desarrollado como un pilotaje de un solo ciclo mediante métodos mixtos descriptivos. El estudio tiene un alcance formativo, centrado en documentar la experiencia de uso y las percepciones reportadas por los participantes en términos de accesibilidad, usabilidad y organización pedagógica, en lugar de medir resultados de aprendizaje o establecer relaciones causales.
Línea de investigación	El estudio se inscribe en la línea “Bilingüismo en la educación a distancia mediada por tecnologías” de la ECEDU–UNAD. Su pertinencia se ubica en la intersección entre el apoyo al desarrollo del inglés escrito A1 en

	estudiantes Sordos, la accesibilidad digital y la educación inclusiva. El proyecto se articula conceptualmente con el Modelo Heutagógico Unadista Solidario (MHUS 5.0), en tanto prioriza la autonomía del estudiante, la autorregulación y el uso de recursos multimodales flexibles en contextos de educación a distancia.
Autor	Héctor Istmod Devia Robayo ORCID: https://orcid.org/0000-0002-9285-8674
Institución	Universidad Nacional Abierta y a Distancia (UNAD)
Fecha	Abril de 2026
Palabras clave	educación de personas Sordas; Lengua de Señas Colombiana (LSC); inglés escrito A1 (lectura, escritura y gramática); Diseño Universal para el Aprendizaje (DUA); Investigación Basada en Diseño (IBD); Objeto Virtual de Aprendizaje (OVA); enfoque centrado en la lengua de señas (*Sign-First*); Autonomía Inclusiva en el Aprendizaje del Inglés en Personas Sordas; tecnología educativa inclusiva.
Descripción	El proyecto aborda el diseño, la implementación piloto y la evaluación de un Objeto Virtual de Aprendizaje (OVA)—denominado en inglés Virtual Learning Object (VLO)—orientado a apoyar a estudiantes universitarios Sordos usuarios de la Lengua de Señas Colombiana (LSC) en su acceso inicial al inglés escrito A1 (lectura, escritura y gramática), a través de microtareas estructuradas. El diseño se alinea con el Marco Común Europeo de Referencia para las Lenguas (MCER) y se desarrolla en el contexto de la educación abierta, a distancia, virtual e híbrida de la UNAD. Dado que la enseñanza tradicional del inglés suele priorizar habilidades orales (*listening* y *speaking*) y formatos centrados en el audio, el estudio adopta un enfoque centrado en la lengua de señas *(Sign-First*), en el cual la

	LSC funciona como lengua principal de acceso, explicación y mediación pedagógica. El VLO integra: I. mediación instructiva en LSC; II. Inglés Señado Exacto (*Signed Exact English*, SEE) como andamiaje visual acotado para aspectos gramaticales del inglés escrito; III. apoyos selectivos de Escritura de Señas (*SignWriting*); IV. microtareas visualmente secuenciadas, implementadas principalmente en Lumi/H5P como recurso digital de autoaprendizaje. El estudio no busca medir logros de aprendizaje ni establecer relaciones causales. Su propósito es documentar y analizar las experiencias y percepciones reportadas por los participantes en relación con la accesibilidad, la usabilidad, la mediación visual y bilingüe, la organización pedagógica y la utilidad percibida para el aprendizaje autorregulado, bajo condiciones reales de educación a distancia en la UNAD.
Fuentes	La fundamentación teórica se apoya en marcos complementarios: • El MCER (2020) como referente para los descriptores del nivel A1 y la progresión en tareas iniciales de lectura y escritura. • Orientaciones del INSOR sobre accesibilidad y ajustes razonables en educación superior. • Investigaciones sobre alfabetización, translanguaging y mediaciones multimodales en la educación de personas Sordas. • Los principios del DUA para la generación de múltiples formas de representación, participación y acción/expresión. • En el plano metodológico, la IBD/DBR y los métodos mixtos, que permiten la integración de evidencia cuantitativa y cualitativa para la mejora iterativa del diseño.

Estructura del trabajo	El documento se organiza en: introducción (contexto, problemática, preguntas y objetivos), revisión de literatura y marco conceptual, metodología, análisis de resultados, y discusión y conclusiones. Los anexos incluyen instrumentos de recolección de datos, matrices de integración (*joint displays*), capturas del OVA y materiales complementarios.
Metodología	El estudio siguió una orientación de IBD implementada como un pilotaje de un solo ciclo con métodos mixtos descriptivos. Se evaluó un prototipo del OVA desarrollado en Lumi/H5P mediante un cuestionario accesible en Google Forms, compuesto por 18 ítems tipo Likert (Q1–Q18) y dos preguntas abiertas (Q19–Q20). Para garantizar la accesibilidad, cada ítem y sus instrucciones se acompañaron de videos explicativos en LSC. Adicionalmente, se recopilaron seis aportes voluntarios en video en LSC (tres comentarios espontáneos y tres reflexiones tipo entrevista informal), utilizados como datos cualitativos suplementarios. Los datos cuantitativos se analizaron mediante estadística descriptiva, mientras que los datos cualitativos se codificaron temáticamente con apoyo de Dedoose. La integración de ambos enfoques se realizó mediante matrices de triangulación y un *joint display* de métodos mixtos.
Resultados principales	Los resultados evidencian altos niveles de acuerdo en las percepciones de los participantes sobre la accesibilidad del VLO, la mediación visual y bilingüe, la organización pedagógica y su utilidad para el aprendizaje autorregulado. Los 18 ítems alcanzaron niveles de acuerdo de al menos el 75% (valoraciones 4–5). El análisis cualitativo integrado generó cinco categorías que convergen en el constructo *Autonomía Inclusiva en el Aprendizaje del Inglés en Personas Sordas (Inclusive Autonomy in Deaf Language Learning)*, reflejando una mayor capacidad percibida de autorregulación cuando la usabilidad

	tecnológica, la mediación en lengua de señas y la secuenciación instruccional se articulan de manera coherente. Asimismo, se identificaron áreas de mejora: I. mayor precisión y consistencia en algunos segmentos de mediación LSC–SEE; II. ampliación de tareas de producción para fortalecer la confianza del estudiante; III. ajustes frente a dificultades técnicas ocasionales asociadas a dispositivos (por ejemplo, variabilidad en la carga de videos).
Conclusiones	Los hallazgos del ciclo piloto sugieren que un OVA multimodal, guiado por el DUA y basado en un enfoque *Sign-First*, constituye un recurso pedagógicamente coherente y accesible para apoyar el acceso inicial al inglés escrito A1 en estudiantes Sordos usuarios de LSC en contextos de educación superior virtual e híbrida. El estudio señala la necesidad de desarrollar ciclos posteriores de IBD para ampliar y refinar el recurso, así como fortalecer su articulación con estrategias institucionales de accesibilidad digital. En este sentido, aporta criterios de diseño fundamentados empíricamente y una agenda de mejora que orienta la integración progresiva de recursos educativos inclusivos en la UNAD.
Bibliografía	Abczovsky, M., Bernsteiner, A., Haagen-Schützenhöfer, C., & Schubatzky, T. (2025). Systematizing decisions in design-based research: From theory to design. *Science Education, 109*(2), 523–536. https://doi.org/10.1002/sce.21915 Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences, 2*(2), 141–178. https://doi.org/10.1207/s15327809jls0202_2

CAST. (2024a). *CAST Universal Design for Learning Guidelines version 3.0*. https://udlguidelines.cast.org

Chomicz, M. (2025). Enhancing EFL writing skills for adult Deaf and hard of hearing individuals. *Frontiers in Education, 9*, 1504503. https://doi.org/10.3389/feduc.2024.1504503

Congreso de la República de Colombia. (2013a). *Ley 1651 de 2013: Por medio de la cual se modifican los artículos 13, 20, 21, 22, 30 y 38 de la Ley 115 de 1994 y se dictan otras disposiciones (Ley de bilingüismo).* https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=53770

Congreso de la República de Colombia. (2013b). *Ley Estatutaria 1618 de 2013: Por medio de la cual se establecen las disposiciones para garantizar el pleno ejercicio de los derechos de las personas con discapacidad.* https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=52081

Council of Europe. (2020). *Common European Framework of Reference for Languages: Learning, teaching, assessment—Companion volume*. Council of Europe Publishing.

Dostal, H., Scott, J., Gediel, A., Vilhalva, S., & Gasparin, C. (2024). Literacy and signing deaf students: A multi-national scoping review. *Journal of Deaf Studies and Deaf Education, 29*(4), 467–484. https://doi.org/10.1093/jdsade/enae023

Fàbregues, S., Younas, A., Escalante-Barrios, E. L., Molina-Azorin, J. F., & Vázquez-Miraz, P. (2024). Toward a framework for appraising the quality of integration in mixed methods research. *Journal of Mixed Methods Research, 18*(3), 270–280. https://doi.org/10.1177/15586898241257555

Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs—Principles and practices. *Health Services Research*, *48*(6pt2), 2134–2156. https://doi.org/10.1111/1475-6773.12117

Gehret, A. U., & Elliot, L. B. (2025). Perceptions of e-learning by deaf and hard of hearing students using asynchronous multimedia tutorials. *Educational Technology Research and Development*, *73*(3), 1921–1949. https://doi.org/10.1007/s11423-025-10476-z

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis*, *11*(3), 255–274. https://doi.org/10.3102/01623737011003255

Guetterman, T. C., Fetters, M. D., & Creswell, J. W. (2015). Integrating quantitative and qualitative results in health science mixed methods research through joint displays. *The Annals of Family Medicine*, *13*(6), 554–561. https://doi.org/10.1370/afm.1865

Instituto Nacional para Sordos. (2022). *Orientaciones para la atención educativa de la población sorda en los niveles de educación superior* (J. F. Lesmes & H. A. Márquez, Eds.). INSOR. https://educativo.insor.gov.co/wp-content/uploads/2023/07/Orientaciones-Educacion-Superior.pdf

International Organisation for Standardization. (2018). *Ergonomics of human-system interaction—Part 11: Usability: Definitions and concepts (ISO 9241-11:2018)*. ISO. https://cdn.standards.iteh.ai/samples/63500/33c267a5a7564f298f02bbd65721a181/ISO-9241-11-2018.pdf

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, *33*(7), 14–26. https://doi.org/10.3102/0013189X033007014

McKenney, S., & Reeves, T. C. (2018). *Conducting educational design research* (2nd ed.). Routledge. https://doi.org/10.4324/9781315105642

Rendel, K., Bargones, J., Blake, B., Luetke, B., & Stryker, D. S. (2018). Signing Exact English: A simultaneously spoken and signed communication option in Deaf education. *Journal of Early Hearing Detection and Intervention, 3*(2), 18–29. https://doi.org/10.26077/gzdh-rp64

Salmona, M., Kaczynski, D., & Lieber, E. (2020). *Qualitative and mixed methods data analysis using Dedoose: A practical approach for research across the social sciences*. SAGE.

Sutton, V. (2014). *Lessons in sign writing: Textbook* (4th ed.). Deaf Action Committee for Sign Writing. https://www.signwriting.org/lessons/books/

Swanwick, R. (2017). Translanguaging, learning and teaching in deaf education. *International Journal of Multilingualism, 14*(3), 233–249. https://doi.org/10.1080/14790718.2017.1315808

The Design-Based Research Collective. (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher, 32*(1), 5–8. https://doi.org/10.3102/0013189X032001005

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development, 53*(4), 5–23. https://doi.org/10.1007/BF02504682

Wolbers, K., Holcomb, L., & Hamman-Ortiz, L. (2023). Translanguaging framework for Deaf education. *Languages, 8*(1), 59. https://doi.org/10.3390/languages8010059

	World Wide Web Consortium. (2024, September 17). *Making audio and video media accessible*. W3C Web Accessibility Initiative (WAI). https://www.w3.org/WAI/media/av/

Appendix M

Specialised Analytical Summary (RAE) in Portuguese

Resumo Analítico Especializado (RAE)	
O presente Resumo Analítico Especializado (RAE) sintetiza os componentes principais do trabalho de conclusão de curso intitulado *Design, Pilot Implementation, and Evaluation of a UDL-Guided Multimodal Virtual Learning Object to Support A1 Written English Skills in Deaf LSC Users at UNAD*. Seu propósito é apresentar uma visão estruturada do estudo, de sua orientação metodológica e de suas principais contribuições em seu contexto específico de pesquisa, em consonância com as diretrizes da Escuela de Ciencias de la Educación (ECEDU) da Universidad Nacional Abierta y a Distancia (UNAD).	
Título	*Design, Pilot Implementation, and Evaluation of a UDL-Guided Multimodal Virtual Learning Object to Support A1 Written English Skills in Deaf LSC Users at UNAD* [Desenho, implementação piloto e avaliação de um Objeto Virtual de Aprendizagem (OVA) multimodal, orientado pelo Desenho Universal para a Aprendizagem (DUA), para apoiar o desenvolvimento do inglês escrito A1 (leitura, escrita e gramática) em estudantes Surdos usuários da Língua de Sinais Colombiana (LSC) na UNAD].
Modalidade do trabalho de conclusão	Projeto de pesquisa com orientação de Pesquisa Baseada em Design (PBD), desenvolvido como estudo piloto de ciclo único com métodos mistos descritivos. O estudo possui alcance formativo, centrado na documentação da experiência de uso e das percepções relatadas pelos participantes em termos de acessibilidade, usabilidade e organização pedagógica, em vez de mensurar resultados de aprendizagem ou estabelecer relações causais.
Linha de pesquisa	O estudo insere-se na linha “Bilinguismo na educação a distância mediada por tecnologias” da ECEDU–UNAD. Sua pertinência situa-se na interseção entre o apoio ao desenvolvimento do inglês escrito A1 em estudantes Surdos, a acessibilidade digital e a educação inclusiva. O projeto articula-se

	conceitualmente com o Modelo Heutagógico Unadista Solidário (MHUS 5.0), na medida em que prioriza a autonomia do estudante, a autorregulação e o uso de recursos multimodais flexíveis em contextos de educação a distância.
Autor	Héctor Istmod Devia Robayo ORCID: https://orcid.org/0000-0002-9285-8674
Instituição	Universidad Nacional Abierta y a Distancia (UNAD)
Data	Abril de 2026
Palavras-chave	educação de pessoas Surdas; Língua de Sinais Colombiana (LSC); inglês escrito A1 (leitura, escrita e gramática); Desenho Universal para a Aprendizagem (DUA); Pesquisa Baseada em Design (PBD); Objeto Virtual de Aprendizagem (OVA); abordagem centrada na língua de sinais (*Sign-First*); Autonomia Inclusiva na Aprendizagem de Inglês em Pessoas Surdas; tecnologia educacional inclusiva.
Descrição	O projeto aborda o desenho, a implementação piloto e a avaliação de um Objeto Virtual de Aprendizagem (OVA) — denominado em inglês *Virtual Learning Object* (VLO) — destinado a apoiar estudantes universitários Surdos usuários da Língua de Sinais Colombiana (LSC) em seu acesso inicial ao inglês escrito A1 (leitura, escrita e gramática), por meio de microtarefas estruturadas. O desenho alinha-se ao Quadro Europeu Comum de Referência para as Línguas (QECR) e desenvolve-se no contexto da educação aberta, a distância, virtual e híbrida da UNAD. Considerando que o ensino tradicional de inglês tende a privilegiar habilidades orais (listening e speaking) e formatos centrados no áudio, o estudo adota uma abordagem centrada na língua de sinais (*Sign-First*), na

	qual a LSC funciona como língua principal de acesso, explicação e mediação pedagógica. O VLO integra: I. mediação instrucional em LSC; II. Inglês Sinalizado Exato (*Signed Exact English*, SEE) como andaime visual delimitado para aspectos gramaticais selecionados do inglês escrito; III. apoios seletivos de Escrita de Sinais (*SignWriting*); IV. microtarefas visualmente sequenciadas, implementadas principalmente no Lumi/H5P como recurso digital de autoaprendizagem. O estudo não busca medir ganhos de aprendizagem nem estabelecer relações causais. Seu propósito é documentar e analisar as experiências e percepções relatadas pelos participantes em relação à acessibilidade, à usabilidade, à mediação visual e bilíngue, à organização pedagógica e à utilidade percebida para a aprendizagem autorregulada, em condições reais de educação a distância na UNAD.
Fontes	A fundamentação teórica apoia-se em marcos complementares: • O QECR (2020) como referência para os descritores do nível A1 e para a progressão em tarefas iniciais de leitura e escrita. • Orientações do INSOR sobre acessibilidade e ajustes razoáveis no ensino superior. • Pesquisas sobre alfabetização, *translanguaging* e mediações multimodais na educação de pessoas Surdas. • Os princípios do DUA para a criação de múltiplas formas de representação, participação e ação/expressão. • • No plano metodológico, a PBD e os métodos mistos, que permitem integrar evidências quantitativas e qualitativas com vistas à melhoria iterativa do desenho.

Estrutura do trabalho	O documento organiza-se em: introdução (contexto, problemática, perguntas e objetivos), revisão de literatura e quadro conceitual, metodologia, análise de resultados, e discussão e conclusões. Os anexos incluem instrumentos de coleta de dados, matrizes de integração (*joint displays*), capturas do OVA e materiais complementares.
Metodologia	A pesquisa seguiu uma orientação de PBD implementada como um estudo piloto de ciclo único com métodos mistos descritivos. Um protótipo do OVA desenvolvido em Lumi/H5P foi avaliado por meio de um questionário acessível no Google Forms, composto por 18 itens do tipo Likert (Q1–Q18) e duas perguntas abertas (Q19–Q20). Para garantir acessibilidade, cada item e suas instruções foram acompanhados por vídeos explicativos em LSC. Adicionalmente, foram recolhidas seis contribuições voluntárias em vídeo em LSC (três comentários espontâneos e três reflexões em formato de entrevista informal), utilizadas como dados qualitativos suplementares. Os dados quantitativos foram analisados por meio de estatística descritiva, enquanto os qualitativos foram codificados tematicamente com apoio do Dedoose. A integração de ambos os conjuntos de dados foi realizada por meio de matrizes de triangulação e de um *joint display* de métodos mistos.
Resultados principais	Os resultados evidenciam altos níveis de concordância nas percepções dos participantes sobre a acessibilidade do VLO, a mediação visual e bilíngue, a organização pedagógica e sua utilidade para a aprendizagem autorregulada. Os 18 itens alcançaram níveis de concordância de pelo menos 75% (avaliações 4–5). A análise qualitativa integrada gerou cinco categorias convergentes no *construto Autonomia Inclusiva na Aprendizagem de Inglês em Pessoas Surdas (Inclusive Autonomy in Deaf Language Learning)*, refletindo uma maior capacidade percebida de autorregulação quando a usabilidade

	tecnológica, a mediação em língua de sinais e o sequenciamento instrucional se articulam de forma coerente. Também foram identificadas áreas de melhoria: I. maior precisão e consistência em alguns segmentos de mediação LSC–SEE; II. ampliação de tarefas de produção para fortalecer a confiança do estudante; III. III. ajustes frente a dificuldades técnicas ocasionais associadas aos dispositivos (por exemplo, variações no carregamento de vídeos).
Conclusões	Os achados do ciclo piloto sugerem que um OVA multimodal, orientado pelo DUA e baseado em uma abordagem *Sign-First*, constitui um recurso pedagogicamente coerente e acessível para apoiar o acesso inicial ao inglês escrito A1 em estudantes Surdos usuários de LSC em contextos de ensino superior virtual e híbrido. O estudo indica a necessidade de desenvolver ciclos posteriores de PBD para ampliar e refinar o recurso, assim como fortalecer sua articulação com estratégias institucionais de acessibilidade digital. Nesse sentido, oferece critérios de desenho empiricamente fundamentados e uma agenda de aprimoramento que orienta a integração progressiva de recursos educacionais inclusivos na UNAD.
Bibliografía	Abczovsky, M., Bernsteiner, A., Haagen-Schützenhöfer, C., & Schubatzky, T. (2025). Systematizing decisions in design-based research: From theory to design. *Science Education, 109*(2), 523–536. https://doi.org/10.1002/sce.21915

Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences, 2*(2), 141–178. https://doi.org/10.1207/s15327809jls0202_2

CAST. (2024a). *CAST Universal Design for Learning Guidelines version 3.0*. https://udlguidelines.cast.org

Chomicz, M. (2025). Enhancing EFL writing skills for adult Deaf and hard of hearing individuals. *Frontiers in Education, 9*, 1504503. https://doi.org/10.3389/feduc.2024.1504503

Congreso de la República de Colombia. (2013a). *Ley 1651 de 2013: Por medio de la cual se modifican los artículos 13, 20, 21, 22, 30 y 38 de la Ley 115 de 1994 y se dictan otras disposiciones (Ley de bilingüismo).* https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=53770

Congreso de la República de Colombia. (2013b). *Ley Estatutaria 1618 de 2013: Por medio de la cual se establecen las disposiciones para garantizar el pleno ejercicio de los derechos de las personas con discapacidad.* https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=52081

Council of Europe. (2020). *Common European Framework of Reference for Languages: Learning, teaching, assessment—Companion volume*. Council of Europe Publishing.

Dostal, H., Scott, J., Gediel, A., Vilhalva, S., & Gasparin, C. (2024). Literacy and signing deaf students: A multi-national scoping review. *Journal of Deaf Studies and Deaf Education, 29*(4), 467–484. https://doi.org/10.1093/jdsade/enae023

Fàbregues, S., Younas, A., Escalante-Barrios, E. L., Molina-Azorin, J. F., & Vázquez-Miraz, P. (2024). Toward a framework for appraising the

quality of integration in mixed methods research. *Journal of Mixed Methods Research, 18*(3), 270–280. https://doi.org/10.1177/15586898241257555

Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs—Principles and practices. *Health Services Research, 48*(6pt2), 2134–2156. https://doi.org/10.1111/1475-6773.12117

Gehret, A. U., & Elliot, L. B. (2025). Perceptions of e-learning by deaf and hard of hearing students using asynchronous multimedia tutorials. *Educational Technology Research and Development, 73*(3), 1921–1949. https://doi.org/10.1007/s11423-025-10476-z

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis, 11*(3), 255–274. https://doi.org/10.3102/01623737011003255

Guetterman, T. C., Fetters, M. D., & Creswell, J. W. (2015). Integrating quantitative and qualitative results in health science mixed methods research through joint displays. *The Annals of Family Medicine, 13*(6), 554–561. https://doi.org/10.1370/afm.1865

Instituto Nacional para Sordos. (2022). *Orientaciones para la atención educativa de la población sorda en los niveles de educación superior* (J. F. Lesmes & H. A. Márquez, Eds.). INSOR. https://educativo.insor.gov.co/wp-content/uploads/2023/07/Orientaciones-Educacion-Superior.pdf

International Organisation for Standardization. (2018). *Ergonomics of human-system interaction—Part 11: Usability: Definitions and concepts (ISO 9241-11:2018)*. ISO. https://cdn.standards.iteh.ai/samples/63500/33c267a5a7564f298f02bbd65721a181/ISO-9241-11-2018.pdf

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33*(7), 14–26. https://doi.org/10.3102/0013189X033007014

McKenney, S., & Reeves, T. C. (2018). *Conducting educational design research* (2nd ed.). Routledge. https://doi.org/10.4324/9781315105642

Rendel, K., Bargones, J., Blake, B., Luetke, B., & Stryker, D. S. (2018). Signing Exact English: A simultaneously spoken and signed communication option in Deaf education. *Journal of Early Hearing Detection and Intervention, 3*(2), 18–29. https://doi.org/10.26077/gzdh-rp64

Salmona, M., Kaczynski, D., & Lieber, E. (2020). *Qualitative and mixed methods data analysis using Dedoose: A practical approach for research across the social sciences*. SAGE.

Sutton, V. (2014). *Lessons in sign writing: Textbook* (4th ed.). Deaf Action Committee for Sign Writing. https://www.signwriting.org/lessons/books/

Swanwick, R. (2017). Translanguaging, learning and teaching in deaf education. *International Journal of Multilingualism, 14*(3), 233–249. https://doi.org/10.1080/14790718.2017.1315808

The Design-Based Research Collective. (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher, 32*(1), 5–8. https://doi.org/10.3102/0013189X032001005

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development, 53*(4), 5–23. https://doi.org/10.1007/BF02504682

	Wolbers, K., Holcomb, L., & Hamman-Ortiz, L. (2023). Translanguaging framework for Deaf education. *Languages, 8*(1), 59. https://doi.org/10.3390/languages8010059 World Wide Web Consortium. (2024, September 17). *Making audio and video media accessible*. W3C Web Accessibility Initiative (WAI). https://www.w3.org/WAI/media/av/

Appendix N

Specialised Analytical Summary (SAS) in English

Specialised Analytical Summary (SAS)	
The present Specialised Analytical Summary (SAS) synthesises the main components of the thesis entitled *Design, Pilot Implementation, and Evaluation of a UDL-Guided Multimodal Virtual Learning Object to Support A1 Written English Skills in Deaf LSC Users at UNAD*. Its purpose is to present a structured overview of the study, its methodological orientation, and its principal contributions within its specific research context, in accordance with the academic guidelines of the School of Education Sciences (ECEDU) at the Universidad Nacional Abierta y a Distancia (UNAD).	
Title	Design, Pilot Implementation, and Evaluation of a UDL-Guided Multimodal Virtual Learning Object to Support A1 Written English Skills in Deaf LSC Users at UNAD.
Type of Degree Project	Research project conducted under a Design-Based Research (DBR) orientation, implemented as a single-cycle pilot study using a descriptive mixed-methods design. The study has a formative scope, focused on documenting user experience and participant-reported perceptions of accessibility, usability, and pedagogical organisation, rather than measuring learning outcomes or establishing causal relationships.
Research Line	The study is situated within the research line “Bilingualism in Technology-Mediated Distance Education” at ECEDU–UNAD. It is relevant at the intersection of support for the development of A1 written English for Deaf students, digital accessibility, and inclusive education. The project is conceptually aligned with UNAD’s Solidarity-Based Heutagogical Model (MHUS 5.0), which emphasises learner autonomy, self-regulation, and flexible multimodal resources within distance education.

Author	Héctor Istmod Devia Robayo ORCID: https://orcid.org/0000-0002-9285-8674
Institution	Universidad Nacional Abierta y a Distancia (UNAD)
Date	April 2026
Keywords	Deaf education; Colombian Sign Language (LSC); A1 written English (reading, writing, and grammar); Universal Design for Learning (UDL); Design-Based Research (DBR); Virtual Learning Object (VLO); Sign-First approach; Inclusive Autonomy in Deaf Language Learning; inclusive educational technology.
Description	This project addresses the design, pilot implementation, and evaluation of a Virtual Learning Object (VLO)—referred to in Spanish as *Objeto Virtual de Aprendizaje (OVA)*—intended to support Deaf university students who use Colombian Sign Language (LSC) as their primary language in their initial engagement with A1-level written English (reading, writing, and grammar) through structured micro-tasks. The design is aligned with the Common European Framework of Reference for Languages (CEFR) and is grounded in the conditions of open, distance, online, and hybrid higher education at UNAD. Given that traditional English instruction frequently prioritises oral skills (listening and speaking) and audio-centred formats, the project adopts a Sign-First approach, in which LSC functions as the primary language of access, explanation, and instructional mediation. The VLO integrates: I. instructional mediation in LSC; II. Signed Exact English (SEE) as a bounded visual scaffold for selected grammatical features of written English; III. selective SignWriting supports;

	IV. visually sequenced micro-tasks implemented primarily through Lumi/H5P as a self-paced digital learning resource. The study does not aim to measure achievement gains or establish causal effects. Rather, it seeks to document and analyse participants' reported experiences and perceptions of accessibility, usability, visual–bilingual mediation, pedagogical organisation, and perceived usefulness for self-regulated study under authentic distance education conditions at UNAD.
Sources	The theoretical foundation draws upon complementary frameworks: • The CEFR (2020 Companion Volume) as a reference for A1-level descriptors and progression in early reading and writing tasks; • Guidelines from Colombia's National Institute for the Deaf (INSOR) regarding accessibility and reasonable accommodations in higher education; • Research on Deaf literacy, translanguaging, and multimodal mediation in additional language learning; • The principles of Universal Design for Learning (UDL), guiding the creation of multiple means of representation, engagement, and action/expression; • Methodologically, Design-Based Research (DBR) and mixed-methods research, enabling iterative design refinement through the integration of quantitative and qualitative evidence.
Structure of the Thesis	The thesis is organised into the following sections: Introduction (institutional context, problem statement, research questions, and objectives), Literature Review and Conceptual Framework, Methodology, Results Analysis, and Discussion and Conclusions. Appendices include data collection instruments, integration matrices (joint displays), screenshots of the VLO, and supplementary research materials.

Methodology	The study followed a DBR orientation implemented as a single-cycle descriptive mixed-methods pilot. A prototype VLO developed in Lumi/H5P was examined through an accessible post-use questionnaire distributed via Google Forms. The instrument consisted of 18 Likert-type items (Q1–Q18) and two open-ended questions (Q19–Q20). To ensure accessibility, each item and instruction was accompanied by short explanatory videos in LSC. Additionally, six voluntary LSC video contributions (three spontaneous comments and three informal interview-style reflections) were collected as supplementary qualitative data. Quantitative responses were summarised using descriptive statistics. Qualitative data were thematically coded with support from Dedoose. Integration of both strands was conducted through triangulation matrices and a mixed-methods joint display.
Main Findings	Findings show consistently high levels of agreement in participants' reported perceptions of the VLO's accessibility, visual and bilingual mediation, pedagogical organisation, and usefulness for self-regulated learning. All 18 Likert items reached agreement levels of at least 75% (ratings 4–5). Integrated qualitative analysis generated five categories converging in the construct Inclusive Autonomy in Deaf Language Learning, reflecting participants' perceptions of a greater capacity to regulate their learning when technological usability, sign language mediation, and instructional sequencing were coherently aligned. Participants also identified areas for refinement, including: I. improving precision and consistency in certain LSC–SEE mediation segments; II. expanding production-oriented tasks to strengthen learner confidence;

	III. addressing occasional device-specific technical issues (e.g., variability in video loading).
Conclusions	The findings from this pilot cycle suggest that a UDL-guided, Sign-First multimodal VLO can be understood as a pedagogically coherent and accessible resource within this context for supporting initial engagement with A1 written English among Deaf LSC users in virtual and hybrid higher education. The study highlights the need for subsequent DBR cycles to refine and expand the resource, while strengthening its articulation with institutional digital accessibility strategies. In this sense, it provides empirically informed design criteria and a structured refinement agenda to inform the progressive integration of inclusive virtual learning resources within UNAD.
Bibliography	Abczovsky, M., Bernsteiner, A., Haagen-Schützenhöfer, C., & Schubatzky, T. (2025). Systematizing decisions in design-based research: From theory to design. *Science Education, 109*(2), 523–536. https://doi.org/10.1002/sce.21915 Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences, 2*(2), 141–178. https://doi.org/10.1207/s15327809jls0202_2 CAST. (2024a). *CAST Universal Design for Learning Guidelines version 3.0*. https://udlguidelines.cast.org Chomicz, M. (2025). Enhancing EFL writing skills for adult Deaf and hard of hearing individuals. *Frontiers in Education, 9*, 1504503. https://doi.org/10.3389/feduc.2024.1504503 Congreso de la República de Colombia. (2013a). *Ley 1651 de 2013: Por medio de la cual se modifican los artículos 13, 20, 21, 22, 30 y 38 de la Ley 115 de 1994 y se dictan otras disposiciones (Ley de*

bilingüismo). https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=53770

Congreso de la República de Colombia. (2013b). *Ley Estatutaria 1618 de 2013: Por medio de la cual se establecen las disposiciones para garantizar el pleno ejercicio de los derechos de las personas con discapacidad.* https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=52081

Council of Europe. (2020). *Common European Framework of Reference for Languages: Learning, teaching, assessment—Companion volume*. Council of Europe Publishing.

Dostal, H., Scott, J., Gediel, A., Vilhalva, S., & Gasparin, C. (2024). Literacy and signing deaf students: A multi-national scoping review. *Journal of Deaf Studies and Deaf Education, 29*(4), 467–484. https://doi.org/10.1093/jdsade/enae023

Fàbregues, S., Younas, A., Escalante-Barrios, E. L., Molina-Azorin, J. F., & Vázquez-Miraz, P. (2024). Toward a framework for appraising the quality of integration in mixed methods research. *Journal of Mixed Methods Research, 18*(3), 270–280. https://doi.org/10.1177/15586898241257555

Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs—Principles and practices. *Health Services Research, 48*(6pt2), 2134–2156. https://doi.org/10.1111/1475-6773.12117

Gehret, A. U., & Elliot, L. B. (2025). Perceptions of e-learning by deaf and hard of hearing students using asynchronous multimedia tutorials. *Educational Technology Research and Development, 73*(3), 1921–1949. https://doi.org/10.1007/s11423-025-10476-z

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis, 11*(3), 255–274. https://doi.org/10.3102/01623737011003255

Guetterman, T. C., Fetters, M. D., & Creswell, J. W. (2015). Integrating quantitative and qualitative results in health science mixed methods research through joint displays. *The Annals of Family Medicine, 13*(6), 554–561. https://doi.org/10.1370/afm.1865

Instituto Nacional para Sordos. (2022). *Orientaciones para la atención educativa de la población sorda en los niveles de educación superior* (J. F. Lesmes & H. A. Márquez, Eds.). INSOR. https://educativo.insor.gov.co/wp-content/uploads/2023/07/Orientaciones-Educacion-Superior.pdf

International Organisation for Standardization. (2018). *Ergonomics of human-system interaction—Part 11: Usability: Definitions and concepts (ISO 9241-11:2018)*. ISO. https://cdn.standards.iteh.ai/samples/63500/33c267a5a7564f298f02bbd65721a181/ISO-9241-11-2018.pdf

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33*(7), 14–26. https://doi.org/10.3102/0013189X033007014

McKenney, S., & Reeves, T. C. (2018). *Conducting educational design research* (2nd ed.). Routledge. https://doi.org/10.4324/9781315105642

Rendel, K., Bargones, J., Blake, B., Luetke, B., & Stryker, D. S. (2018). Signing Exact English: A simultaneously spoken and signed communication option in Deaf education. *Journal of Early Hearing Detection and Intervention, 3*(2), 18–29. https://doi.org/10.26077/gzdh-rp64

Salmona, M., Kaczynski, D., & Lieber, E. (2020). *Qualitative and mixed methods data analysis using Dedoose: A practical approach for research across the social sciences*. SAGE.

Sutton, V. (2014). *Lessons in sign writing: Textbook* (4th ed.). Deaf Action Committee for Sign Writing. https://www.signwriting.org/lessons/books/

Swanwick, R. (2017). Translanguaging, learning and teaching in deaf education. *International Journal of Multilingualism*, *14*(3), 233–249. https://doi.org/10.1080/14790718.2017.1315808

The Design-Based Research Collective. (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher, 32*(1), 5–8. https://doi.org/10.3102/0013189X032001005

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development, 53*(4), 5–23. https://doi.org/10.1007/BF02504682

Wolbers, K., Holcomb, L., & Hamman-Ortiz, L. (2023). Translanguaging framework for Deaf education. *Languages*, *8*(1), 59. https://doi.org/10.3390/languages8010059

World Wide Web Consortium. (2024, September 17). *Making audio and video media accessible*. W3C Web Accessibility Initiative (WAI). https://www.w3.org/WAI/media/av/