Empowering Deaf Learners: The Promise of Sign Language MOOCs

Paula Escudeiro and Márcia Campos Gouveia
Games, Interaction & Learning Technologies, Porto Superior Institute of Engineering, Porto, Portugal

pmo@isep.ipp.pt
magia@isep.ipp.pt

Abstract: In the realm of education, deaf students face significant communication barriers that limit their integration and success within intellectual communities. Due to the use of distinct mother languages, a communication gap arises between deaf and non-deaf communities. This poses serious difficulties for deaf students, who communicate primarily in sign language and are unable to fluently read materials written in spoken language. As most didactic materials in higher education are available exclusively in spoken languages, this further limits the opportunities and chances for deaf students to succeed. While technological advancements have made it possible to create tools and services that translate between spoken and sign languages, they are often expensive and not widely available in educational settings. The proposal is a pedagogical model that seeks to overcome these obstacles and foster inclusivity by offering deaf students access to educational resources in their mother language – sign language. This is accomplished using Massive Online Open Courses (MOOCs) paired with automatic sign language translation technology. To demonstrate this model's effectiveness, a digital literacy course for schoolteachers was developed and evaluated within a group of users, including deaf students. The paper discusses the state-of-the-art of digital educational content available to the deaf, the process of translating digital learning materials into sign languages, the specifications needed to structure educational content for the deaf, and an example of the development methodology for creating multilingual learning objects for the deaf. The evaluation results indicate that MOOC is inclusive and positively impacts deaf students' learning outcomes. The proposed pedagogical model has significant implications for improving access to education and promoting inclusivity for deaf students worldwide. By utilizing technological advancements and creating inclusive digital educational materials, it is possible to bridge the communication gap between deaf and non-deaf individuals, thereby enabling deaf students to acquire, expand, and improve their knowledge in various subjects.

Keywords: Deaf Education; Sign Language Accessibility; Technological Advancements; Inclusive Pedagogical Model; Digital Learning Materials for the Deaf

1. Introduction

Education is a fundamental right that should be accessible to all individuals, regardless of their abilities. However, deaf students encounter distinct challenges in education due to communication barriers. These barriers arise from differences between sign languages and spoken languages. Sign languages and spoken languages vary not only in phonology, morphology, vocabulary, and syntax, but also in visual and spatial dimensions. Consequently, deaf students who use sign language often face difficulties in reading and comprehending spoken language.

The digital era has widened the gap between deaf and non-deaf individuals in accessing educational resources. Most educational materials and digital information are primarily available in spoken languages, making them inaccessible to deaf students and limiting their knowledge acquisition.

Deaf individuals face challenges such as the need for sign language translators, difficulties in comprehending scientific subjects, and a lack of sign-language skilled teachers. Technological advancements offer potential solutions by developing tools to translate between spoken and sign languages, but their high cost and limited availability in educational settings leave many deaf students without proper support. Additionally, the minority status of sign language natives further hinders the provision of tailored educational solutions, leading to educational disparities.

Despite these challenges, there has been an increase in the number of deaf students completing high school and pursuing higher education, prompting the need for inclusive strategies that ensure equal access to educational content, enhance communication, and promote digital literacy for deaf students.

This paper seeks to address the aforementioned challenges by proposing a pedagogical model aimed at delivering inclusive educational materials to the deaf population. The model explores the combination of Massive Open Online Courses (MOOCs) with sign language automatic translation technology as a means of bridging the educational gap.

2. Background

In recent years, there have been advancements in improving the accessibility of education for deaf students in Portugal. However, challenges persist (Verma, 2017). The current educational offerings for Portuguese Sign Language (LGP) primarily focus on undergraduate degrees in education and pedagogical sciences, with limited availability of technical subjects in sign language. As a result, deaf students rely on interpreted classes, which hinders their ability to review content and study materials in sign language, making the presence of sign language interpreters in classrooms necessary due to the lack of adequate didactic materials and bilingual teachers. However, interpreters may face difficulties understanding educational complex content, leading to potential distortions in the translation process. Inadequate physical infrastructure and a lack of teaching methods based on sign language and deaf culture further contribute to the exclusion of deaf students from the academic community.

While progress has been made in enhancing educational accessibility, there is a lack of focus on developing Massive Open Online Courses with accessibility as a central concern. Gupta and Fatima (2016) highlighted the barriers faced by deaf learners in accessing e-learning environments and proposed ideas for MOOCs for individuals with hearing disabilities. These barriers include learning management systems not designed in sign language and challenges in communication requirements, course content, and materials.

Several noteworthy studies have addressed accessibility in e-learning systems for deaf and hard of hearing individuals. For example, Alcazar et al (2016) introduced a speech-to-visual approach e-learning system for teaching English to deaf students in the Philippines, resulting in better comprehension and addressing individual needs. Batanero et al (2019) redesigned a Moodle platform to include accessible learning objects for engineering students with sensory impairments, leading to improved academic performance. Esdras and Galasso (2020) designed a bilingual virtual learning platform with various tools to support learning, while Batanero-Ochaita et al (2021) evaluated the accessibility and usability of a learning platform prototype for deaf, deaf-blind, and blind students, receiving positive responses from participants.

These examples highlight the ongoing efforts within the field of digital accessibility for deaf students, emphasizing the importance of developing inclusive educational materials and platforms to support their learning needs. However, further research and development are necessary to address the specific challenges faced by deaf learners and ensure equal access to educational opportunities (Verma, 2017).

3. Methodology

Deaf students face significant challenges in accessing content written in spoken language, which hinders their academic performance. To address this issue, the researchers propose a pedagogical model that combines Massive Open Online Courses (MOOCs) with sign language automatic translation technology to improve educational accessibility for deaf students. The model aims to bridge the communication gap and empower deaf individuals with effective access to educational resources.

To enhance inclusivity, the MOOCs integrate VirtualSign technology, utilizing a 3D avatar for seamless translation between spoken language and sign language (Escudeiro et al., 2013, 2015; Oliveira et al., 2019). The VirtualSign application enables deaf individuals to access digital course content while providing a sound environment for non-deaf participants. The courses incorporate multimedia elements like video editing, image manipulation, animations, and graphics integration to create dynamic and visually engaging learning experiences (Oliveira et al., 2019).

The research model employed within these MOOCs integrates an automatic translation system built on VirtualSign, facilitating bilingual content and interaction for seamless communication between different languages. An audio add-on feature has been implemented to benefit individuals with visual impairments through text-to-speech conversion (Escudeiro et al., 2013, 2015; Oliveira et al., 2019). The MOOCs aim to be user-friendly for deaf students, providing an interactive environment that facilitates content interaction and task completion.

A vital component of these MOOCs is the sign language translation aspect, utilizing the Assistive Communication for Education (ACE) architecture (Escudeiro et al., 2017, Ulisses et al., 2018). This architecture addresses the unique communication settings of both deaf and non-deaf individuals. The sign language translation component incorporates modules for text recognition and sign language translation, leveraging advanced technologies such as Kinect for motion recognition and data gloves for recognizing static hand configurations.

By integrating VirtualSign technology, employing the ACE architecture, and incorporating multimedia elements, the inclusive MOOCs provide a comprehensive and engaging learning experience for deaf individuals while promoting accessibility and inclusivity for learners of diverse backgrounds.

4. Project Evaluation & Results

The inclusive MOOC was evaluated using the Quantitative Evaluation Framework (QEF) (Escudeiro & Bidarra, 2008) to assess its effectiveness and accessibility for deaf users. The evaluation considered three dimensions: pedagogical, ergonomic, and management. Positive outcomes were observed, with the MOOC achieving high ratings in various areas. In the pedagogical domain, it scored 82% for the learning factor and 32% for the evaluation factor. The ergonomic domain received a perfect score of 100% across usability, video/audio integration, and text integration factors, while the management domain achieved 100% in content management and adaptability.

Questionnaires were answered by 23 participants, including 8 deaf users and 15 non-deaf users. Separate questionnaires were prepared for deaf users, focusing on usability, adaptability, and content quality. The responses from both groups were overwhelmingly positive, with no negative responses and a majority selecting "strongly agree," indicating high satisfaction among all users.

The overall product quality received a rating of 82%, demonstrating the effectiveness and potential of the inclusive model in creating educational materials. Areas for improvement were identified, particularly in the pedagogical domain and ergonomic usability, highlighting the need for refinements to optimize the educational experience.

Feedback from users, including deaf individuals, reinforces the researchers' commitment to addressing diverse learners' needs and ensuring accessibility. Over 57% of respondents strongly agreed that the lesson content was accessible, emphasizing the positive impact of inclusive design principles on the learning experiences of individuals with disabilities.

The evaluation aligns with previous research emphasizing the importance of effective web-based education strategies tailored to the deaf community. It also highlights the limited availability of e-learning systems designed for communication between deaf and non-deaf individuals, underscoring the significance of the researchers' efforts in bridging this gap and fostering effective communication and interaction in educational settings.

Overall, the evaluation results, combined with user feedback and existing research, emphasize the importance of advancing inclusive education for individuals with diverse needs, particularly in web-based learning. Ongoing improvements and innovations are necessary to ensure equitable access to educational resources and opportunities for all learners. The findings contribute to the development of inclusive educational materials and underscore the significance of user satisfaction and accessibility in online learning environments.

5. Conclusions

The researchers have introduced an innovative MOOC designed to expand digital educational opportunities for deaf learners. Deaf individuals face clear disadvantages in education due to communication barriers and limited access to digital content and information. The presented inclusive pedagogical model aims to foster the development of inclusive and interactive learning environments, thereby minimizing barriers to knowledge and education.

To ensure the quality of the MOOC and its effectiveness in providing access to digital educational content, the researchers used QEF. This framework guides the development and production of digital content throughout the entire cycle, helping to maintain quality standards. The evaluation results have demonstrated the positive potential of this pedagogical model, although further enhancements are necessary, particularly in terms of evaluation and usability features.

Overall, the proposed pedagogical model presented by the researchers signifies a significant departure from traditional and inefficient methods of communication between the deaf and non-deaf communities. Its aim is to foster inclusivity and overcome barriers that hinder educational settings. By harnessing technology and adopting an inclusive approach, the researchers envision an educational environment that is accessible to all individuals, irrespective of their needs.

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