Assessing Accessibility in MOOCs: A Comparison of Moodle and Coursera for Users with Hearing Impairments, Visual Impairments, and the Elderly

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Abstract. *With technological advancements, Massive Open Online Courses (MOOCs) have become widely adopted, supporting course management and content delivery. However, many platforms still face accessibility challenges due to inconsistent adherence to guidelines. This study evaluates the accessibility of Moodle and Coursera using WCAG 2.0, the WAVE tool, and Nielsen's Heuristics. A mixed-methods approach combines qualitative and quantitative analyses. Results show that while Moodle demonstrates better overall accessibility, Coursera is more suitable for elderly and visually impaired users. This research contributes to digital accessibility and offers practical recommendations to enhance inclusion in MOOCs.*

1. Introduction

The COVID-19 pandemic accelerated the adoption of virtual learning environments, highlighting the potential of MOOCs to broaden access to education and promote inclusion [Ingavélez-Guerra et al. 2022]. By incorporating assistive technologies and designing intuitive interfaces, these platforms can offer equal opportunities for learners with diverse backgrounds and abilities [Iniesto and Rodrigo 2016]. Continuous evaluation is essential to ensure that MOOCs remain accessible to all, including those facing physical, cognitive, or environmental barriers [Mrayhi et al. 2023].

Prior research has identified several accessibility challenges in MOOCs, such as usability issues, barriers for visually and hearing-impaired users, and inconsistent application of accessibility standards [Nuñez et al. 2019, Sauer et al. 2020, Inal et al. 2020, Robles et al. 2019]. These findings underscore the need for a more systematic and integrated approach that combines accessibility best practices with usability principles.

This study addresses that need by proposing a methodology that integrates Nielsen's Heuristics with the WCAG 2.0 guidelines. The evaluation was conducted manually and supported by the WAVE tool to identify barriers such as insufficient color contrast. This dual-framework approach provides complementary perspectives — technical compliance and practical usability — on accessibility in MOOCs. It also aligns with regulatory and ethical standards, offering actionable insights to improve the design and delivery of inclusive online learning environments.

This paper is organized as follows: Section 2 discusses related work. Section 3 describes the research method, detailing the procedures and techniques used. Section 4 presents the results. Section 5 analyzes these results and discusses their implications. Section 6 addresses threats to validity and the strategies adopted to mitigate them. Finally, Section 7 summarizes the main conclusions, practical implications, and prospects for future work.

2. Related Works

Several studies have explored accessibility assessment methods, the intersection of usability and user experience (UX), and the use of automated evaluation tools.

[Nuñez et al. 2019] conducted a systematic review of web accessibility evaluation methods, analyzing application domains and identifying gaps in these approaches. While the study provides a comprehensive theoretical overview, it lacks an applied focus. Similarly, [Sauer et al. 2020] investigated the overlap between usability, UX, and accessibility, highlighting similarities and distinctions in their definitions, methods, and metrics.

[Inal et al. 2020] surveyed UX professionals in Nordic countries, examining their perceptions and practices regarding digital accessibility and offering insights from an industry perspective. [Álvarez Robles et al. 2019] focused on visually impaired users, using Thinking Aloud tests to evaluate a mobile geolocation system. Another relevant study, by [Nurhudatiana and Caesarion 2020], analyzed UX in MOOCs using the UX Honeycomb framework, assessing dimensions such as usefulness, usability, desirability, and accessibility to better understand user experiences with platforms like Coursera and Udemy.

Regarding automated accessibility evaluation, [Mateus et al. 2020] examined the use of automated tools, emphasizing both their efficiency and limitations, such as false positives and false negatives. A similar approach was adopted by [Sousa et al. 2024] and [Barros et al. 2024], who assessed government portals using tools such as ASES, AccessMonitor, and WCAG guidelines. Additionally, [Menezes et al. 2023] evaluated the MEC RED platform using the MeTA method, highlighting the importance of inclusive design in educational technologies.

Compared to these studies, our research makes distinct contributions by (1) combining automated and manual evaluations specifically within the MOOC context; (2) focusing on Moodle and Coursera, two of the most widely adopted online learning platforms; (3) addressing the needs of underrepresented user groups, such as elderly and visually impaired users; and (4) providing actionable recommendations for improving accessibility and usability in MOOCs, grounded in empirical findings.

By integrating insights from related works, our study offers a practical and applied perspective on accessibility, usability, and UX in online education, contributing to developing more inclusive and accessible digital learning environments.

3. Research Method

This research investigates the accessibility and usability of MOOC platforms to identify how they meet the needs of users with visual impairments, hearing impairments, and elderly users. Using a mixed-methods approach, the study integrates qualitative and quantitative analysis by employing WCAG 2.0 and Nielsen's Heuristics to assess accessibility

and usability. The study focuses on two widely used MOOC platforms, Moodle[1] and Coursera[2], representing diverse online educational scenarios. The objects of study include the platforms' interfaces, analyzed for both users with and without disabilities. The procedures involve detailed human analyses and the use of automated assessment tools to collect data on accessibility and usability. The analysis instruments include checklists based on WCAG and Nielsen's Heuristics, as well as specialized software such as the WAVE tool to identify and document accessibility issues, facilitating a comparative analysis between the studied platforms.

The methods adopted (Figure 1) involve several stages: selection of platforms, selection of participant user groups, definition of evaluation techniques, execution of evaluation procedures, and analysis of results. Regarding ethical issues, we highlight that this work is exempt from ethics committee evaluation and, therefore, there is no stage related to it included in the methodology.

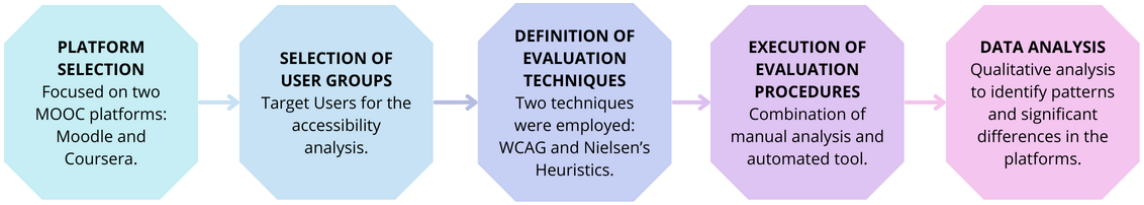

Figure 1. Research Methodology.

Platform Selection: Moodle, with which the authors have prior experience, and Coursera, a widely used MOOC platform frequently referenced in the literature [Yousef et al. 2014], were selected due to their global popularity and the large volume of educational content they offer. This selection allows for a comprehensive analysis of accessibility practices for the chosen user groups.

1. Moodle: Developed by Martin Dougiamas to provide an accessible, flexible, and high-quality online learning solution for all[3]. As an open-source platform, its use as a MOOC varies depending on implementation. In the research in question, the Moodle platform of *Universidade Estadual de Maringá* (UEM) was used, a platform frequently used by the institution's students and familiar to most of the researchers. The instance used follows the xMOOC model.
2. Coursera: Founded in 2012 by Daphne Koller and Andrew Ng, Coursera is a global online learning platform offering courses and programs from internationally recognized universities and companies[4]. Coursera follows the xMOOC model.

Selection of User Groups: To conduct the accessibility analysis, it was necessary to define specific user groups. Three main groups were selected: individuals with visual impairments due to the broad availability of support resources, individuals with hearing impairments who face distinct challenges, and elderly individuals who may experience a

[1]https://moodle.org
[2]https://www.coursera.org
[3]https://moodle.com/pt-br/sobre/a-moodle-story/
[4]https://about.coursera.org/

combination of visual, auditory, and usability barriers when interacting with digital platforms. Groups with physical, intellectual, and psychosocial disabilities were not included in this initial analysis due to the limited availability of evaluation materials and methodological challenges related to assessing accessibility for these populations. Additionally, user-based testing was not conducted due to time constraints for participant recruitment and application of the method.

Definition of Evaluation Techniques: Two manual evaluation techniques were selected: the WCAG 2.0 guidelines, which form the basis of the ISO/IEC 40500:2012 standard, and Nielsen's Heuristics, known for their general yet restrictive approach. The choice of these widely adopted techniques, as highlighted by Inal et al. [Inal et al. 2020], was based on their proven effectiveness and relevance. Methods requiring user participation were excluded due to time constraints related to participant recruitment, method application, and data analysis. The combination of guidelines and heuristics aimed to ensure a comprehensive and robust evaluation of accessibility and usability issues.

1. **Web Content Accessibility Guidelines (WCAG) 2.0:** As presented by [Nuñez et al. 2019], WCAG 2.0 provides detailed guidance and practical examples for achieving accessibility, with three compliance levels: A (minimum), AA (intermediate), and AAA (advanced). Full compliance is achieved when all guidelines at a given level are met or when a compliant alternative version is provided. These guidelines include specific criteria for improving accessibility for individuals with visual or hearing impairments and elderly users. The analysis focused on levels A and AA, covering principles such as permeability, operability, understandability, and robustness.
2. **Nielsen's Heuristics:** This set of 10 user interface design principles, developed by Jakob Nielsen, was applied to assess platform usability. The heuristics address key aspects such as system status visibility, the match between the system and the world, user control and freedom, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency, aesthetic and minimalist design, error recovery, and help and documentation.

Execution of Evaluation Procedures: The evaluation combined manual analysis and an automated tool. The human evaluation was conducted by one of the researchers, a computer science undergraduate student, while the automated evaluation employed WAVE (Web Accessibility Evaluation Tool), a widely recognized tool based on WCAG 2.0, 2.1, and 2.2 guidelines. WAVE was beneficial for identifying issues such as low color contrast, which are difficult to detect manually.

1. **Human Analysis**: This approach involved manual navigation of the platforms using a student profile to assess the implementation of accessibility features. Key aspects analyzed included keyboard navigation, screen reader compatibility, text resizing, and color contrast. This method identified usability barriers and provided insight into user experience from multiple perspectives, contributing to a more comprehensive accessibility evaluation. Human analysis complements automated tools by offering contextual, hands-on insights into functionality and interface behavior.
2. **Automated Tool:** The WAVE tool[5] was used to detect technical accessibility is-

[5]https://wave.webaim.org/

sues, such as missing alternative text, improper heading structure, and contrast errors. Its popularity and effectiveness, highlighted by [Inal et al. 2020], support its selection. WAVE provides visual feedback and detailed reports, making it valuable for developers and designers. In this study, the WAVE browser extension was used to evaluate contrast errors specifically, as these are difficult to assess visually with accuracy.

Data Analysis: The data were qualitatively analyzed to identify patterns and significant differences in the accessibility practices of Moodle and Coursera. The analysis aimed to detect deficiencies, suggest improvements and highlight practices that could inform other educational platforms. The process was organized into two stages: (i) the creation of a consolidated spreadsheet with the initial results and (ii) the refinement of this spreadsheet through the application of specific weights to guidelines and heuristics. The complete results and the process of applying the guidelines and heuristics—available in both Brazilian Portuguese and English—are provided in the public repository[6].

To support a comprehensive evaluation, the analysis relied on the following spreadsheets:

1. **General Spreadsheet:** Consolidated the initial findings, offering an overview of each platform's accessibility performance without applying weights.

2. **Weighted Analysis Spreadsheet:** Applied differentiated weights: level A guidelines received a weight of 1, level AA a weight of 2, and level AAA a weight of 3, while all heuristics were uniformly weighted at 2. Although heuristics are more general than WCAG 2.0 guidelines, overlaps were observed. When a heuristic corresponded to a guideline, its level varied between A and AAA. Since heuristics do not have defined levels, a weight 2 was assigned to each. This approach highlighted the importance of guidelines and ensured consistency in heuristic evaluation, forming the basis for calculating each platform's accessibility percentage.

3. **Targeted Spreadsheets:** Three additional spreadsheets focused on the platforms' impact on specific user groups — elderly individuals and people with visual and hearing impairments. These spreadsheets outlined accessibility for each group and offered tailored recommendations for improvement.

Together, these spreadsheets provided a structured framework for assessing and comparing accessibility, enabling the identification of best practices and areas requiring improvement.

4. Results

This section presents the results of the accessibility analysis conducted on the Moodle and Coursera MOOC platforms, examining how each adheres to established accessibility guidelines and heuristics. The study reveals key differences in their approaches, highlighting both commendable practices and areas needing significant improvement. These findings underscore the inherent challenges of designing accessible online learning environments and reinforce the importance of sustained commitment to inclusive design principles.

[6]bit.ly/3GXqi45

To support a clearer understanding of each platform's performance, the applicable guidelines and heuristics are detailed in the spreadsheet titled *Evaluation of Accessibility Guidelines and Heuristics for the Moodle and Coursera Platforms*, available in the public repository. This document identifies the criteria met or unmet by each platform and indicates the user groups affected by these outcomes. The analysis not only highlights areas of compliance but also identifies where improvements are needed to better accommodate diverse users and promote a more inclusive learning experience.

4.1. Accessibility Assessment of the Three Selected Groups

Table 1 shows that the ideal total weight is 128 for Coursera and 125 for Moodle. Regarding the total score achieved, Coursera obtained 59 points, while Moodle reached 61, resulting in a 2-point difference in favor of Moodle. This corresponds to a 0.45% higher accessibility score for the selected user groups, indicating that Coursera demonstrates slightly lower accessibility than Moodle.

Table 1. Achieved Weight (Overall).

Weight	Moodle	Coursera
Ideal	125	128
Achieved	61	59

As shown in Table 2, although Coursera's overall accessibility score is lower than Moodle's, it satisfies twice as many of Nielsen's Heuristics. This may be attributed to the broader and more general nature of the heuristics, in contrast to the WCAG 2.0 guidelines, which target specific accessibility scenarios. Thus, despite Coursera's lower accessibility score, the results suggest that its usability may be more advanced. However, confirming this would require additional usability evaluation methods.

Table 2. Heuristics met (Legend: *M*-Met, *N*-Not Met).

Heuristics	Moodle	Coursera
H1	M	N
H2	N	N
H3	N	N
H4	N	N
H5	N	M
H6	N	M
H7	N	N
H8	N	M
H9	N	N
H10	M	M

Table 3. Weight achieved (Elderly).

Weight	Moodle	Coursera
Ideal	104	101
Achieved	40	40

Finally, it is important to note that neither MOOC fully met the A, AA, or AAA levels, indicating that both platforms fell short of full compliance with WCAG 2.0.

4.2. Accessibility Assessment for Elderly Users

An analysis of the specific guidelines and heuristics related to elderly users shows that Coursera's total ideal weight exceeds Moodle's by three units. However, as presented in Table 3, both platforms achieved the same effective weight. As a result, the accessibility percentage for elderly users is 38.46% for Moodle and 39.60% for Coursera.

Coursera demonstrated several advantages that contributed to better accessibility for elderly users. These include the absence of contrast issues below acceptable thresholds, the ability to suppress automatically initiated content, improved error prevention mechanisms, reduced reliance on memory, and a more minimalist interface. These factors made Coursera more accessible than Moodle for this user group. Additionally, Coursera satisfied twice as many of Nielsen's Heuristics as Moodle.

Elderly users exclusively represent 22% of the total guidelines analyzed. However, many of these guidelines also overlap with those affecting users with visual and hearing impairments. The intersection of visually impaired and elderly users accounts for 68% of the total, while the overlap between hearing-impaired and elderly users represents 6%. Guidelines relevant to all three groups combined account for 4%.

4.3. Accessibility Evaluation for Visually Impaired Users

An analysis of the specific guidelines and heuristics for visually impaired users shows that Coursera's total ideal weight exceeds Moodle's by one unit. As shown in Table 4, Coursera achieved a total of 56 points, while Moodle reached 54. Consequently, the accessibility percentage for visually impaired users is 56.84% for Moodle and 58.33% for Coursera.

Table 4. Weight Achieved (Visual Impairment).

Weight	Moodle	Coursera
Ideal	95	96
Achieved	54	56

Table 5. Number of items per user group.

Users	Quantity
Elderly	50
Visual Impaired	51
Hearing Impaired	6

Several of Coursera's advantages for this group mirror those observed for elderly users, including appropriate contrast levels, the ability to suppress automatically initiated content, enhanced error prevention, reduced reliance on memory, and a minimalist interface. In contrast, Moodle exhibited lower performance in these aspects, with Coursera fulfilling twice as many of Nielsen's Heuristics.

This user group benefits significantly from targeted guidelines and heuristics, as shown in Table 5. These findings highlight the importance of implementing diverse strategies to improve accessibility for visually impaired users.

4.4. Accessibility Evaluation for Users with Hearing Impairments

The analysis of guidelines and heuristics specific to users with hearing impairments revealed that the number of relevant items for this group is significantly lower compared to others. Additionally, the number of criteria effectively met by the platforms is also limited, as shown in Table 6.

Table 6. Accessibility achieved.

Users	Moodle	Coursera
General	47,65	47,2
Elderly	38,46	39,6
Visual Impaired	56,84	58,33
Hearing Impaired	0,33	0,33

Table 7. Weight Achieved (Hearing Impairment).

Weight	Moodle	Coursera
Ideal	12	12
Achieved	1	1

Coursera and Moodle presented the same ideal weight in this evaluation, indicating comparable levels of accessibility for users with hearing impairments (Table 7).

However, it is important to note that Coursera provides video transcripts — a key accessibility feature for users with hearing impairments — even though it is not consistently available across all content. This resource gives Coursera a relative advantage over Moodle in meeting the needs of this user group.

5. Analysis and Discussions

The application of accessibility guidelines to Moodle and Coursera revealed several key aspects, along with notable differences between the two platforms. Elements such as captions, contrast, navigation, and interface consistency were evaluated to assess how well each platform meets the needs of diverse user groups.

In terms of caption availability in pre-recorded videos, Moodle includes this feature in only a few cases. Coursera, in contrast, frequently provides both manual and automatic captions and, in some cases, transcripts — resources absent in Moodle. These elements improve accessibility for users with hearing impairments and also enhance usability for those who prefer to follow content in written form.

Using the WAVE tool, several contrast ratio errors were identified in Moodle, which can impair visibility for users with visual impairments or those in low-light environments. Coursera did not present such issues, indicating better alignment with WCAG 2.0 contrast requirements and offering improved readability.

Unlike Moodle, which does not feature automatically updated content, Coursera includes a small message/help box in the lower right corner. While this element can be easily closed, it appears near the end of the keyboard focus sequence, which may hinder efficiency for users relying on keyboard navigation.

Regarding the ability to bypass repetitive content blocks, Moodle provides a visible “skip to content” link, facilitating efficient navigation. Coursera adopts a different strategy, collapsing content blocks by default and expanding them upon user request—an approach that may be beneficial depending on user preferences.

Moodle uses concise and direct titles in its course modules, aiding quick content identification. Coursera, in turn, uses more descriptive titles, which offer additional context but may slow down navigation. Moodle’s interface follows a predictable structure, favoring users who rely on consistency, whereas Coursera’s minimalist layout reduces visual clutter.

Both platforms offer basic contextual help. Coursera includes a structured help center, while Moodle links to frequently asked questions and tutorials with auto-generated

captions. Nonetheless, enhancing in-page help features would make navigation more intuitive and support user autonomy.

While neither platform includes robust error prevention systems, Coursera applies some validation procedures (e.g., email confirmation and input field checks) during registration. Moodle, on the other hand, shows interface inconsistencies — such as displaying instructor links within student profiles — that may confuse users.

Language accessibility also presents challenges. Both platforms use technical jargon, and Coursera frequently displays content in English even when Portuguese is selected, creating barriers for non-English-speaking users. Additionally, Coursera's dynamic search suggestions — although useful — may disrupt the navigation flow for users who depend on keyboard interaction.

In summary, neither Moodle nor Coursera fully complies with WCAG 2.0 or Nielsen's heuristics, revealing critical areas for improvement. Moodle stands out for its consistency and interface predictability, while Coursera excels in specific accessibility features, particularly for older adults and users with visual impairments. These findings reinforce the need for continuous enhancement of MOOC platforms to ensure broader accessibility and inclusion.

6. Threats to validity

Following the validity definitions by Runeson and Höst [Runeson and Höst 2009], the threats to this study's validity are as follows:

Construct Validity: The use of WCAG 2.0 guidelines and Nielsen's Heuristics may not cover all dimensions of accessibility and usability, especially for diverse disabilities. Interpretation may also vary among evaluators. *Mitigation:* Automated and human evaluations were combined, and evaluators received training to ensure consistent application of the frameworks.

Internal Validity: Evaluations may be influenced by uncontrolled external factors, such as user settings or technological environments, as well as by evaluator expertise. *Mitigation:* A standardized protocol guided evaluations, and peer reviews were conducted to minimize subjective biases.

External Validity: The representativeness of the evaluated platforms is limited, which may hinder the generalization of results to other MOOCs. *Mitigation:* Widely recognized platforms were selected, and future studies are encouraged to expand the sample for greater diversity.

Reliability Validity: Reproducible results depend on clear methodological descriptions and consistent application of evaluation techniques. *Mitigation:* Detailed procedures were documented, and cross-checks among evaluators ensured consistency.

7. Conclusions and Future Work

Accessibility is fundamental to ensuring inclusion and full participation in 21st-century society. As technology advances, platforms must support the integration of individuals who rely on accessible features. This study highlights a critical issue: neither Moodle nor Coursera reached 50% accessibility for elderly, visually impaired, and hearing-impaired

users. While both platforms perform similarly in general accessibility, Coursera stands out for its effective contrast, error prevention, and minimalist design—beneficial for visually impaired and elderly users. Conversely, Moodle's consistent navigation and interface make it slightly more accessible to the general population, with both platforms showing equivalent performance for hearing-impaired users.

The analysis reveals key nuances in accessibility and usability. Coursera, for example, includes captions and transcripts, which are essential for users with sensory impairments, while Moodle lacks this functionality. Additionally, WAVE detected contrast errors in Moodle but not Coursera, reinforcing the importance of visual clarity. Coursera's interface simplifies navigation for elderly users, while Moodle's predictable structure benefits broader audiences. These findings underscore the need for tailored design strategies to address the diverse needs of all users.

Each platform has strengths and limitations. Moodle offers consistent navigation, whereas Coursera excels in structured headers and minimalist layout. However, Coursera's English-only content—despite language settings—poses a barrier for non-English speakers. Its advanced search, though efficient, may hinder users dependent on keyboard navigation. These results emphasize that accessibility and usability require continuous refinement rather than static compliance.

Based on the findings, the study recommends: (1) adopting **consistent interfaces**; (2) including **subtitles and transcripts** in all videos; (3) respecting **user language preferences**; (4) addressing **contrast issues in Moodle**; (5) **simplifying Moodle's interface** for better usability; and (6) **improving navigation feedback in Coursera** to enhance accessibility.

While neither platform fully complies with WCAG 2.0 or Nielsen's Heuristics, the progress observed in Coursera demonstrates the potential for meaningful improvement. This study contributes to the broader discourse on educational equity and digital inclusion, offering practical insights for designing more accessible MOOCs.

Future work should expand the validation of this methodology across a broader range of MOOC platforms. Integrating additional tools, techniques, and guidelines could enrich the analysis. Involving target users directly and assessing the accessibility of other user groups will provide deeper insights. Moreover, tracking the impact of platform updates and involving diverse participants will support more accurate and inclusive evaluations, fostering long-term accessibility improvements in online education.

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