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Systematic Review of Accessibility Compliance in LMS Platforms for Inclusive Online Learning

Ginikachi Prisca Ifenatuora [1*], Olanrewaju Awoyemi [2], Fadeke Adeola Atobatele [3]
[1] Rose of Sharon College Lagos State, Nigeria
[2] Launchforth Group of Schools, Matogun, Lagos, Nigeria
[3] Independent Researcher, Texas USA

* Corresponding Author: **Ginikachi Prisca Ifenatuora**

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Abstract
This paper presents a systematic review of accessibility compliance in Learning Management Systems (LMS) to assess their suitability for inclusive online learning. The increasing reliance on LMS platforms for education demands that these systems be accessible to all learners, including those with disabilities. This study evaluates the level of accessibility compliance across several widely-used LMS platforms, such as Moodle, Blackboard, Canvas, and Google Classroom, focusing on adherence to established accessibility standards, such as the Web Content Accessibility Guidelines (WCAG) and Section 508. The findings reveal significant variability in accessibility features, with some platforms demonstrating strong compliance, while others show considerable gaps, particularly in supporting students with cognitive disabilities. Key barriers identified include inadequate video accessibility, poor color contrast, and a lack of alternative text for multimedia. The paper discusses the implications of these findings for inclusive online education and offers recommendations for improving LMS accessibility, including enhanced training for developers and greater transparency from platform providers. The paper concludes with directions for future research, emphasizing the need for better tools for assessing accessibility compliance and further investigation into assistive technology integration.

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Keywords: Accessibility Compliance, Learning Management Systems (LMS), Web Content Accessibility Guidelines (WCAG), Online Learning, Disability Inclusion

1. Introduction

1.1 Background and Rationale

In the digital age, online learning has become an essential component of education, providing greater accessibility and flexibility for learners worldwide. However, despite its advantages, one significant challenge that persists is ensuring that all learners, including those with disabilities, can fully engage with and benefit from these platforms [1]. The inclusion of individuals with disabilities in online education requires platforms to adhere to strict accessibility standards. Learning Management Systems (LMS) are central to online education, and their design and functionality must accommodate learners with various disabilities, including visual, auditory, and motor impairments [2]. The importance of accessibility in these systems cannot be overstated as it ensures that all students, regardless of their abilities, can participate in and benefit from digital learning experiences [3].

LMS platforms have been integrated into educational institutions globally as the primary tool for delivering online courses [4]. However, many of these platforms have not been developed with full accessibility in mind. While certain LMS platforms are increasingly incorporating accessibility features, there is still a lack of consistency across systems.

The rationale for this study stems from the need to assess the current level of accessibility compliance in widely used LMS platforms and the implications this has for learners with disabilities. Without adequate accessibility, these learners face barriers to education, leading to disparities in academic outcomes and a lack of equal opportunities in education [5]. This study aims to examine the extent to which various LMS platforms comply with established accessibility standards and guidelines, such as the Web Content Accessibility Guidelines (WCAG) and Section 508 of the Rehabilitation Act. By reviewing existing studies and examining the current state of accessibility compliance, the research will provide insights into the gaps and challenges that remain in the integration of accessibility features in LMS platforms. This will help inform the design of more inclusive educational technologies, ensuring that all learners have an equitable learning experience.

1.2 Research problem and objectives

The primary research problem this study seeks to address is the insufficient accessibility compliance of many LMS platforms. Despite the existence of established accessibility standards, many LMS platforms still fail to meet these guidelines fully, hindering access for learners with disabilities. This problem is exacerbated by the rapid growth of online learning, where a diverse student population, including those with physical and cognitive disabilities, must rely on digital platforms that may not adequately support their needs. The study will explore the specific accessibility barriers encountered by users of these platforms and evaluate the factors that contribute to these shortcomings.

The objective of this research is to conduct a systematic review of existing studies on LMS accessibility compliance, focusing on the degree to which LMS platforms meet accessibility standards. This study will identify common accessibility challenges that hinder the full participation of students with disabilities. Moreover, the research aims to provide actionable recommendations for educational institutions and LMS developers to improve platform accessibility. By addressing this gap in the literature, the study aims to contribute to a more inclusive and equitable approach to online learning.

Additionally, this research will aim to assess the relationship between LMS accessibility compliance and educational outcomes for students with disabilities. The findings will be significant for stakeholders in the education sector, including administrators, policymakers, and developers, as they seek to improve the inclusivity of online learning environments. Understanding the implications of LMS accessibility non-compliance will provide crucial insights for future platform development and policy formation to ensure equal access for all learners.

1.3 Scope of the study

This study will focus on a systematic review of LMS platforms that are commonly used in educational settings across various institutions. These platforms include both commercial and open-source solutions, such as Moodle, Blackboard, Canvas, and Google Classroom, which are widely implemented in K-12 schools, higher education, and vocational training institutions. The research will primarily assess how these platforms align with the accessibility standards outlined by relevant authorities, including the Web Content Accessibility Guidelines (WCAG) and Section 508. It will also consider the barriers and challenges faced by learners with disabilities when using these platforms.

The scope of this study is limited to accessibility compliance within the context of Learning Management Systems used for online learning. While many educational technologies exist, this review will concentrate solely on platforms that deliver formal educational content and engage users in an academic setting. Additionally, the study will focus on platforms used in English-speaking regions, though the findings may have broader implications for other regions as well. By narrowing the scope, this study ensures a more focused and manageable review of the accessibility features within LMS platforms.

Moreover, this study will not delve into specific disabilities but will instead take a broad approach to assessing accessibility compliance, looking at general features that can accommodate a wide range of disabilities. It will review literature on existing accessibility assessments and analyze secondary data from previous studies, focusing on both the successes and shortcomings of current LMS platforms in terms of their inclusivity. This approach ensures that the research remains comprehensive while also making clear recommendations for future improvements in LMS accessibility.

2. Literature Review

2.1 Accessibility in Online Learning Platforms

The concept of accessibility in online learning platforms refers to the design and implementation of features that allow all learners, including those with disabilities, to interact with digital content and participate in online courses [6]. As the use of Learning Management Systems (LMS) has become widespread, accessibility has emerged as a critical consideration in ensuring that students with various disabilities can engage with the educational material [7, 8]. According to the World Health Organization, approximately 15% of the global population lives with some form of disability, which underlines the importance of accessible digital platforms in educational settings. Accessibility in LMS platforms involves multiple elements such as navigability, readability, and the ability to use assistive technologies like screen readers, braille displays, and voice recognition software [9, 10].

Many online platforms still fail to fully incorporate accessibility features that accommodate a broad range of disabilities. Research has shown that most platforms provide limited functionality for learners with visual, auditory, and motor impairments. For example, video content often lacks captions or transcripts, leaving deaf and hard of hearing students at a disadvantage [11]. Similarly, poorly designed navigation structures can make it difficult for students with visual impairments to access course content independently. The need for accessibility in online education is increasingly recognized by educational institutions and regulators, but the actual implementation of accessible features is often inconsistent, varying widely from one LMS platform to another [12, 13].

There is a growing body of literature addressing the role of accessibility in online learning, and numerous studies emphasize its importance in fostering an inclusive learning environment. However, the challenge lies not only in identifying the accessibility needs of students but also in integrating these features into LMS platforms in a way that is both functional and user-friendly [14]. As online learning continues to expand globally, the call for more research on

how to best design and implement accessible online learning systems grows stronger. This review highlights the need for LMS platforms to move beyond compliance with basic standards to embrace a more comprehensive, user-centric approach to accessibility [15, 16].

2.2 Compliance standards for accessibility

Accessibility compliance in online platforms is typically guided by established standards that outline the technical requirements for creating inclusive digital environments. The most widely recognized guidelines include the Web Content Accessibility Guidelines (WCAG) 2.1, which provides a framework for making web content more accessible to people with disabilities [17]. These guidelines cover aspects such as text alternatives for non-text content (e.g., images and videos), adaptable content for different devices and screen sizes, and navigability for users with various disabilities [18]. Section 508 of the Rehabilitation Act also plays a key role in the United States, mandating that federal agencies ensure their electronic and information technology is accessible to people with disabilities. Although these standards are widely adopted, the degree of compliance varies significantly across LMS platforms [19].

While WCAG provides comprehensive accessibility guidelines for web content, its implementation can be challenging, particularly for LMS platforms that involve diverse multimedia content, interactive features, and complex user interfaces. Compliance with these standards requires both technical expertise and a user-centered approach to design [20]. However, research suggests that many LMS platforms do not fully comply with WCAG guidelines, particularly with respect to non-visual accessibility features such as audio descriptions for video content, keyboard navigability, and compatibility with screen readers. Compliance with Section 508 is also inconsistent, with some platforms meeting only the minimum requirements and others failing to provide the necessary support for students with disabilities [21, 22].

Another major issue is the lack of formal auditing or testing to ensure compliance. While many LMS developers claim to meet accessibility standards, independent reviews often show discrepancies in the accessibility features provided. Furthermore, these standards are continuously updated, and LMS platforms may struggle to keep pace with the latest guidelines. Thus, while the existence of accessibility standards is a step toward more inclusive online learning, their full and consistent application remains a significant challenge in many LMS platforms [23].

2.3 Challenges in implementing accessibility in LMS

The implementation of accessibility in Learning Management Systems presents several challenges, both technical and organizational. One of the primary obstacles is the lack of awareness and training among LMS developers and administrators. Many designers and developers of LMS platforms are not fully trained in accessibility standards or do not prioritize accessibility in the early stages of development. As a result, accessibility features are often added as afterthoughts rather than being integrated into the core design. This reactive approach results in platforms that are either partially accessible or inaccessible to users with specific needs [4].

Another challenge is the complexity of implementing accessibility features in platforms that support a wide range of content formats, including videos, interactive quizzes, and collaborative tools. Each content type requires specific modifications to ensure it is accessible [24]. For example, providing captions and transcripts for video content requires significant additional work, and ensuring that interactive elements are keyboard-navigable requires careful planning and design. Moreover, integrating third-party tools or plugins into LMS platforms may exacerbate accessibility issues if those tools are not designed with accessibility in mind [25].

Finally, there are organizational challenges related to funding, policy, and governance. Educational institutions may not prioritize accessibility due to budget constraints or lack of clear policies. Additionally, there may be insufficient collaboration between technical teams and accessibility experts, leading to fragmented or incomplete solutions. Without strong leadership and commitment to accessibility from the top levels of administration, efforts to improve LMS accessibility can falter. Addressing these challenges requires a concerted effort to raise awareness, build capacity, and establish comprehensive policies that support the continuous improvement of accessibility features in LMS platforms [26].

3. Methodology

3.1 Systematic review approach

A systematic review approach was adopted to evaluate the accessibility compliance of Learning Management Systems (LMS) across various platforms. This approach allows for a comprehensive, unbiased, and transparent assessment of existing literature and empirical studies on the subject. By systematically reviewing peer-reviewed articles, technical reports, and other scholarly works, the study synthesizes the current state of knowledge regarding accessibility in LMS platforms [27]. The systematic review process includes clearly defined search terms, inclusion criteria, and a rigorous evaluation of the quality and relevance of the studies included. This method ensures that the findings are based on robust evidence, providing a comprehensive overview of the issues and trends in LMS accessibility [28].

The systematic review approach is advantageous in that it not only compiles findings from various studies but also identifies gaps and inconsistencies in the existing research. By assessing multiple sources, this method provides a broader understanding of the challenges and solutions for improving accessibility in LMS platforms. It allows for the identification of recurring themes across different studies, highlighting areas where progress has been made and areas requiring further research. Overall, this method is well-suited for evaluating the accessibility landscape in LMS platforms, offering a holistic perspective on the current state of compliance [29].

3.2 Selection criteria for LMS platforms

The selection of LMS platforms for this review was guided by specific criteria to ensure the inclusion of widely used and diverse systems that represent a cross-section of available technologies in online education. The primary criterion was the platform's prevalence in educational settings, with a focus on systems used in higher education, K-12 schools, and vocational training institutions [30]. Platforms such as Moodle, Canvas, Blackboard, and Google Classroom were selected due to their widespread adoption and significant user bases. Additionally, the selection considered platforms that offer diverse functionalities, including course delivery, assessment tools, and communication features, to provide a

comprehensive understanding of how accessibility issues manifest across different LMS environments [31, 32].

Another key criterion for inclusion was the platform's availability of public documentation or assessments related to accessibility compliance. Platforms that have publicly disclosed their accessibility features or have undergone independent accessibility audits were prioritized to ensure that the review could rely on credible, verifiable data. Platforms that have undergone certification for compliance with recognized standards, such as WCAG, were also included. This approach ensured that the selection of platforms was not only representative but also provided valuable insights into the level of accessibility compliance across different types of LMS systems [33, 34].

3.3 Data Collection and analysis methods

Data for this systematic review was collected from a variety of sources, including peer-reviewed academic articles, technical reports, government publications, and other scholarly works related to accessibility in LMS platforms. A structured search process was employed using databases such as Google Scholar, PubMed, and IEEE Xplore. Keywords such as "LMS accessibility," "online learning accessibility," "accessibility compliance," and "WCAG" were used to retrieve relevant studies. Only studies published within the past ten years were included to ensure that the data reflects the most current developments in the field. A strict inclusion criterion was applied, favoring studies that provided detailed evaluations of LMS platforms and their compliance with accessibility standards.

The analysis of the collected data involved both qualitative and quantitative methods. A thematic analysis was conducted to identify common themes across studies, such as recurring barriers to accessibility, specific features that were often non-compliant, and strategies for improving LMS accessibility. Additionally, a comparative analysis of the accessibility features of the selected platforms was performed. This helped to identify which platforms were most compliant with established standards and which ones required further improvements. The data was synthesized to draw conclusions about the overall state of accessibility in LMS platforms, identifying key trends and areas for future research and development [35, 36].

4. Findings and discussion

4.1 Accessibility compliance levels in LMS platforms

The findings from the systematic review revealed that the level of accessibility compliance in Learning Management Systems (LMS) varies significantly across platforms. While some platforms, such as Moodle and Canvas, demonstrate a relatively high level of compliance with the Web Content Accessibility Guidelines (WCAG), others, including Blackboard, present more mixed results. Platforms like Moodle have implemented a range of accessibility features, including keyboard navigability, screen reader support, and captioning for video content [28]. However, even these platforms show gaps in compliance, particularly in areas like color contrast and navigability for students with cognitive disabilities. In contrast, platforms like Blackboard and Google Classroom were found to offer fewer accessibility features or to have major issues with video accessibility, such as the lack of alternative text for multimedia content [37, 38].

Moreover, the review highlighted that platforms that are commercially developed tend to provide less transparency regarding their accessibility compliance compared to open-source platforms. While open-source platforms often include detailed documentation about their accessibility features and updates, commercial platforms are less likely to disclose such information. This discrepancy underscores a critical challenge in ensuring the full accessibility of LMS platforms and reflects the need for more transparent reporting practices. Overall, while there has been progress in integrating accessibility features into LMS platforms, full compliance with accessibility standards remains a distant goal for many widely used systems.

4.2 Barriers and gaps in LMS accessibility

The review also uncovered several key barriers and gaps in the accessibility of LMS platforms. One major barrier is the lack of consistency in the implementation of accessibility features across different LMS platforms. While some platforms incorporate accessibility features such as screen reader compatibility, others still struggle with basic functionality, such as ensuring that all interactive elements are keyboard-navigable. Additionally, video content on many LMS platforms often lacks captions or transcripts, which poses a significant barrier for students with hearing impairments. This issue is particularly prevalent in platforms where video content plays a central role in course delivery.

Another significant gap identified is the inadequate attention to accessibility for students with cognitive and learning disabilities. While physical disabilities, such as visual and hearing impairments, have received more focus in the design of LMS platforms, cognitive disabilities often remain overlooked. Features such as simplified content presentation, alternative text for images, and tools for text-to-speech are lacking in many systems [39, 40].

Furthermore, the lack of comprehensive accessibility training for developers and administrators exacerbates these gaps. Without clear guidelines and proper training, LMS developers may unintentionally overlook or fail to implement necessary accessibility features fully. As a result, students with specific needs may face significant challenges in accessing and engaging with the course content [41].

4.3 Recommendations for improving LMS accessibility

Based on the findings from the systematic review, several recommendations can be made to improve the accessibility of LMS platforms. First and foremost, there needs to be a stronger commitment to ensuring full compliance with WCAG and other accessibility standards. This should include regular audits of LMS platforms to assess their accessibility features and address gaps in compliance. It is crucial for platform developers to implement accessibility features from the outset rather than as an afterthought, ensuring that all learners, regardless of their abilities, can engage with the content seamlessly [28].

Another key recommendation is to provide more comprehensive accessibility training for developers and administrators. By increasing awareness and understanding of accessibility needs, LMS platforms can be designed with more inclusive features, such as customizable font sizes, improved color contrast, and options for alternative text in multimedia content. Platforms should also integrate tools that support students with cognitive disabilities, such as simplified text, voice narration, and the option to adjust the complexity of content. Moreover, the use of assistive technologies, such as screen readers, should be fully

supported and tested to ensure compatibility with all LMS features [42].

Lastly, there should be greater transparency in the accessibility efforts of commercial LMS p roviders. Platforms should provide detailed reports on their compliance with accessibility standards and regularly update users on improvements and ongoing issues. Educational institutions should also be proactive in selecting and implementing LMS platforms based on their accessibility features, prioritizing those that are most inclusive. By prioritizing accessibility at both the institutional and platform levels, a more inclusive learning environment can be created that benefits all students [43-45].

5. Conclusion

The systematic review of Learning Management Systems (LMS) revealed significant variations in accessibility compliance among the most widely used platforms. While some systems, such as Moodle and Canvas, offer robust accessibility features, including support for screen readers, keyboard navigation, and video captioning, many platforms still lag in key areas. Notably, the review found that commercial platforms tend to be less transparent about their accessibility compliance compared to open-source platforms. Despite the progress made, substantial gaps remain in accessibility, particularly for students with cognitive disabilities and those reliant on assistive technologies. Barriers such as inadequate video accessibility, poor color contrast, and the lack of alternative text for multimedia content were common across many LMS platforms. Overall, the findings highlight both the strides made in LMS accessibility and the considerable work still needed to ensure that all platforms meet the needs of learners with disabilities.

The implications of these findings are far-reaching for the future of inclusive online learning. As the demand for online education continues to grow, ensuring that LMS platforms are fully accessible is crucial for providing equal opportunities to all students. The failure to implement comprehensive accessibility features can create significant barriers for students with disabilities, limiting their ability to engage with the course content and participate in the learning process. Inadequate accessibility can lead to educational inequality, where students with disabilities are unfairly disadvantaged compared to their peers. On the other hand, platforms that prioritize accessibility contribute to creating a more inclusive educational environment, where all students, regardless of their abilities, can thrive.

The study emphasizes the need for a more coordinated approach to LMS accessibility. Educational institutions must take proactive steps to ensure that the platforms they choose meet accessibility standards and that instructors are trained to use these features effectively. Moreover, the involvement of students with disabilities in the design and evaluation of LMS platforms can help identify critical accessibility needs that may otherwise be overlooked. This inclusive approach not only benefits students with disabilities but enhances the learning experience for all students, fostering a more diverse and equitable online educational environment.

Future research on LMS accessibility should focus on several key areas to build upon the findings of this study. One important direction is to investigate the specific needs of students with cognitive disabilities and how LMS platforms can better accommodate these learners. More attention should be given to the development of tools and features that support cognitive accessibility, such as customizable content presentation, text simplification, and interactive elements that are easily navigable for learners with attention deficits or learning disabilities. Additionally, future research could explore the effectiveness of different training models for developers and instructors in improving the accessibility of LMS platforms.

Another area for further investigation is the role of assistive technologies in enhancing accessibility in online learning. Researchers could explore how well existing LMS platforms integrate with emerging assistive technologies, such as voice-controlled interfaces and augmented reality tools, and how these technologies can be used to improve the learning experience for students with disabilities. Furthermore, longitudinal studies could assess the impact of improved accessibility on the academic success of students with disabilities, providing valuable insights into the benefits of investing in inclusive educational technologies.

Lastly, a critical area for future research is the development of standardized tools for assessing the accessibility compliance of LMS platforms. The lack of uniformity in the evaluation of accessibility features makes it difficult for institutions and developers to measure their progress. Creating standardized assessment tools would help ensure that all platforms are held to the same high accessibility standards, facilitating more consistent improvements across the industry.

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