# DEVELOPMENT OF A THEORETICAL FRAMEWORK FOR SELF-EVALUATION OF ADAPTIVE DIGITAL LEARNING PLATFORMS BASED ON ARTICIAL INTELLIGENCE: A SYSTEMATIC REVIEW

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## Abstract

This study aims to develop a Theoretical Framework for the self-evaluation of adaptive digital learning platforms through Artificial Intelligence, focused on promoting meaningful interaction and personalizing content based on user profiles. A Systematic Literature Review was conducted with the aim of exploring processes and indicators of effectiveness, as well as the challenges and opportunities associated with digital adaptive learning platforms, with a special focus on the role of automatic, real-time self-assessment as an essential tool for the continuous improvement of the performance, personalization and quality of these platforms. The results point to gaps in the literature related to the integration of AI in the self-assessment of adaptive digital learning platforms and suggest the need for new approaches to improve self-assessment systems.

*Keywords: Adaptive digital learning platforms, Artificial Intelligence, PRISMA protocol, Systematic Literature Review*

## Introduction

The evolution of digital innovation has led to significant transformations across various sectors of society, including education. In the current context, adaptive digital learning platforms play an increasingly important role in the dissemination of knowledge and the facilitation of personalized learning processes. Technological advances, particularly in the field of Artificial Intelligence, have driven substantial changes in these platforms, impacting key areas of education such as pedagogical objectives, content, teaching methods, and assessment processes (Kalota, 2024).

This Systematic Literature Review aims to explore the effectiveness, challenges, and opportunities associated with adaptive digital learning platforms, with a particular focus on the role of automatic and real-time self-assessment as a key tool for the continuous improvement of performance, personalization, and the overall

quality of these platforms. The focus is not only on the effectiveness of these platforms but also on the challenges and opportunities related to their implementation in educational settings. Additionally, given that self-assessment remains an underexplored area, the review also seeks to investigate current and potential approaches to automatic self-assessment within these platforms.

## Methodology

To analyze the impact of adaptive digital learning platforms in the educational context, a systematic literature review was conducted based on studies published in open-access databases. The objective of this review was to gather and synthesize existing evidence, ensuring a rigorous and objective analysis. This rigorous process allows for the development of credible and reliable research (Ramos et al., 2014), which, by following a structured analysis process, ensures consistency of results and the validity of conclusions. Likewise, the development of systematic research enables the construction of comprehensive and unbiased syntheses of publications within a given scientific domain, reporting data and results rather than theories or concepts. Aromataris and Pearson (2014) state

> the 'systematic review,' also known as the 'research synthesis,' aims to provide a comprehensive, unbiased synthesis of many relevant studies in a single document. While it has many of the characteristics of a literature review, adhering to the general principle of summarizing the knowledge from a body of literature, a systematic review differs in that it attempts to uncover 'all' of the evidence relevant to a question and to focus on research that reports data rather than concepts or theory. (p. 54)

This systematic literature review follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) model, as described by Galvão et al. (2015), which aims to assist authors in improving the reporting of systematic reviews and meta-analyses.

Considering the central objective of this research – to develop a Theoretical Reference Framework for the self-assessment of adaptive digital learning platforms, with an emphasis on the integration of Artificial Intelligence (AI) – the systematic review was structured to include not only the effectiveness of AI-powered adaptive learning platforms but also to explore approaches to their self-assessment, an area still underexplored in the literature. The following steps were outlined for the development of the analysis.

The objectives of the systematic literature review were defined as follows: (i) to identify studies on the effectiveness of adaptive digital learning platforms, with a focus on AI integration; (ii) to identify the main challenges and opportunities in the implementation of these platforms in educational settings; and (iii) to explore

the concepts and approaches to automatic self-assessment of adaptive digital platforms – a topic still rarely addressed in the literature, yet essential for the construction of the intended Theoretical Reference Framework.

A set of inclusion criteria was also established: (i) studies on adaptive digital learning platforms that use AI, focusing on personalized learning and self-assessment; (ii) studies defining and characterizing personalized and adaptive digital learning platforms; and (iii) studies on strategies for overcoming challenges in implementing adaptive digital learning platforms in educational environments.

Exclusion criteria included: (i) articles that do not address adaptive digital learning platforms, such as those focused on other methodologies or teaching models; (ii) articles whose full content is not available online; (iii) duplicate articles; (iv) articles that do not directly address the integration of Artificial Intelligence in adaptive digital learning platforms or are not relevant to the research objectives; and (v) articles published in languages other than English or Portuguese.

After defining the inclusion and exclusion criteria, a search key was created based on the research theme and the defined criteria. Keywords were combined using Boolean logic operators (AND, OR, NOT) to establish links between research terms.

The following search strings were used, with terms in both Portuguese and English (see Table 1):

**Table 1**

*Search Strings in Portugese and English for Articles on Adaptive Learning Platforms*

| Portugese | English |
|---|---|
| Plataforma Digital <OR> Plataforma de Aprendizagem <AND> Inteligência Artificial <OR> Ensino Personalizado ALL FIELDS <AND> Autoavaliação <OR> Avaliação IN TÍTULO <OR> Desafios ALL FIELDS <NOT> Ensino Tradicional ALL TEXT | Adaptive Learning Platform <OR> Learning Platform <AND> Artificial Intelligence <OR> Personalized Learning ALL FIELDS <AND> Evaluation <OR> Assessment IN TITLE <OR> Challenges ALL FIELDS <NOT> Traditional Teaching ALL TEXT |

These search strings were applicable and replicable in the selected databases using the advanced search mode. The databases chosen for the search were EBSCO, MDPI Open Access Journals, SCOPUS, and Web of Science.

To select the studies to be included in this systematic review, the PRISMA model, was used as a methodological guide. This model is a methodological tool used in systematic literature reviews, consisting of sequential steps including: (i) identification of the initial research question; (ii) search and selection of relevant studies; (iii) quality assessment of the studies; (iv) data extraction and synthesis; and (v) results.

# Results

## Overview of Relevant Studies

The research identified 18 relevant articles on the use of Artificial Intelligence in adaptive digital learning platforms, published between 2020 and 2024. These articles were grouped into three main categories: Adaptive Digital Learning Platforms, AI Technologies and Personalization, and Implementation Challenges and Opportunities.

*Adaptive Digital Learning Platforms*: This category includes studies that analyze how adaptive digital learning platforms can be adjusted to tailor content and teaching methods based on users' progress and learning styles, emphasizing the flexibility and personalization of pedagogical approaches.

*AI Technologies and Personalization*: This category encompasses studies that explore how emerging Artificial Intelligence technologies can be applied in the educational context, focusing on how these tools can be integrated into adaptive digital learning platforms to personalize teaching and learning experiences. The use of AI to adapt content according to users' needs is a central theme in this category.

*Implementation Challenges and Opportunities*: This category refers to articles that discuss the challenges faced in implementing adaptive and personalized digital learning platforms, as well as the opportunities that arise from the use of AI in this process. It also addresses issues related to overcoming technical, pedagogical, and ethical barriers in the adoption of these technologies in education.

## Adaptive Digital Learning Platforms

Adaptive digital learning platforms stand out as one of the most promising applications of AI in education. The seven studies identified as relevant to this category analyze how such systems can personalize teaching based on the individual needs of users. Studies like that of Kumar et al. (2024) demonstrate that the use of AI in adaptive environments can significantly enhance academic performance, particularly in STEM and mathematics courses, by providing

immediate feedback and adapting content in real time. These results reinforce the need to include self-assessment as a central element in evaluating the effectiveness of these platforms.

On the other hand, the reviewed studies also indicate that the effectiveness of adaptive digital learning platforms is not always guaranteed. Factors such as data quality, user and teacher resistance to personalization, and the lack of a clear pedagogical framework can limit the benefits achieved. Bhatt et al. (2024) analyzed AI-based adaptive learning tools, highlighting their effectiveness in increasing user engagement. Er-Rafyg et al. (2024) explores the barriers and benefits of adaptive teaching, emphasizing the need for effective technological integration. Pradeep et al. (2024) propose a personalized AI-based learning platform that monitors individual user progress and adapts the content accordingly. Vashishth et al. (2024) investigate the application of data analytics in adaptive digital learning platforms to deliver personalized feedback. Wang et al. (2020) compare adaptive systems with traditional teaching methods, demonstrating greater effectiveness of the former. Finally, Rani and Senthil (2024) examine the impact of the pandemic on the adoption of adaptive digital learning platforms, highlighting their effectiveness in remote learning scenarios.

## AI Technologies and Personalization

Personalized learning has emerged as one of the greatest benefits of Artificial Intelligence in education, with a growing number of approaches focused on adapting content according to the individual needs of users. As noted by Naseer et al. (2024), key strategies include machine learning algorithms, such as artificial neural networks, which dynamically adjust teaching based on user progress. The use of AI tools in personalization is transforming the educational environment, offering new possibilities for developing unique and effective learning pathways.

Recent studies, such as that of Alam and Mohanty (2023), explore the application of virtual avatars that, by interacting with users in online environments, create a more immersive and personalized learning experience. In these contexts, user-teacher interaction is adjusted by AI-based tools, promoting more fluid and adaptive communication. This approach is particularly effective in distance learning environments, where personalization can be difficult to achieve through conventional means.

Additionally, Fu et al. (2020) investigated how automated scoring tools, which assess user performance in real time, influence motivation for continuous learning. The use of AI-based assessment systems can provide immediate feedback, allowing rapid adjustments to each user's learning path, thereby enhancing motivation and engagement. Conversely, Gupta et al. (2024) examine the impact of generative AI

tools on personalization and educational assessment. By enabling the creation of tailored instructional materials and continuously evaluating user progress, these tools may contribute to more learner-centered education, fostering more effective and personalized learning.

Moorhouse et al. (2023) propose guidelines for the use of AI tools in educational assessment, emphasizing ethical and effective practices. They highlight the importance of using AI responsibly, ensuring that assessment systems are fair and transparent, protecting user privacy, and avoiding algorithmic bias.

Naseer et al. (2024) integrated deep learning techniques to create personalized learning paths in higher education. By using complex models to analyze individual user performance, these tools are capable of adapting content in real time, offering a unique and efficient learning experience.

Finally, Zhai and Nehm (2023) analyzed the impact of AI on formative assessment, highlighting how AI technologies can enhance the consistency and objectivity of feedback. This allows teachers to provide precise and clear information about user performance, facilitating the identification of areas needing improvement.

## Challenges and Opportunities in Implementation

The implementation of Artificial Intelligence in education faces a series of challenges that must be addressed to ensure its effective and ethical integration. The absence of a clear theoretical-methodological framework is one of the main difficulties, with many studies highlighting the need for models adapted to the local educational context. Although AI has the potential to enhance learning, few studies offer a systematic approach to how these technologies should be practically and sustainably implemented in educational institutions. In many cases, AI implementation has been treated as an isolated technical solution, without adequately considering integration with existing pedagogical methodologies.

The six studies analyzed in this category address a variety of obstacles but also highlight opportunities to overcome them. Deeva et al. (2021) classified automated feedback systems, identifying significant issues such as a lack of transparency in algorithmic processes and potential biases in automated decisions. These challenges raise crucial questions about user trust in AI technologies, making it necessary to ensure that systems are transparent and fair.

Delello et al. (2024) explores how AI is transforming education, emphasizing issues of accessibility and equity. The authors noted that although AI has the potential to democratize access to education, there are also risks of increasing

inequality if implementation is not carefully planned to include all users, regardless of their circumstances.

Kalota (2024) introduces basic concepts about generative AI and its practical applications in education. While generative AI offers great opportunities to personalize learning, the lack of adequate technological infrastructure and resistance to change may hinder its large-scale adoption.

Lee et al. (2024) propose an ethical framework for AI integration in education, highlighting the importance of transparency and fairness. The authors argue that for AI to be truly beneficial, systems must be designed to ensure that all users have equal learning opportunities, without discrimination or bias.

Naithani et al. (2024) investigate the transformative impact of AI in post-pandemic education, noting how lockdowns accelerated the adoption of educational technologies. Despite the progress, the study reveals that many institutions struggle to effectively integrate AI due to a lack of adequate training and resources.

Lastly, Nguyen et al. (2023) address fundamental ethical principles for applying AI in education, such as user data privacy and fairness in decision-making processes. Protecting privacy and ensuring that algorithmic decisions do not favor certain groups over others are central issues to gaining user acceptance and ensuring AI's success in education.

## Conclusions

The results of the analyzed studies demonstrate the growing recognition of Artificial Intelligence's potential for learning personalization. Personalization, by adjusting content to individual user needs, has shown a positive impact on both performance and motivation. Real-time content adaptation is a core feature of AI-based platforms, as highlighted in studies such as Bhatt et al. (2024) and Kumar et al. (2024), which underline the importance of tailoring content based on each user's progress. The ability to dynamically personalize learning materials has been identified as one of the greatest benefits of AI platforms, promoting greater user engagement and, consequently, better outcomes.

However, effective implementation of these adaptive solutions continues to pose a challenge. The analyzed studies point out that although AI-based platforms have high potential, their implementation depends on factors such as available infrastructure, teacher acceptance, and the quality of the data used. The absence of a clear theoretical and methodological framework, as well as a systematic adaptation model, may hinder the large-scale application of these solutions. Moreover, the diversity of educational contexts requires a flexible model capable

of adapting to different realities, a gap often mentioned in the literature (Alam & Mohanty, 2023; Deeva et al., 2021).

The use of AI models for personalization has also proven relevant, especially in the context of automated feedback systems. These systems are essential for content adaptation, particularly in intelligent tutoring and assessment platforms (Rani & Senthil, 2024).

Nevertheless, true personalization of education is not achieved solely through tools like ChatGPT, which, although capable of offering dynamic responses, do not deeply tailor learning content. The effectiveness of these models depends mainly on their ability to integrate user data to create personalized experiences that meet their specific needs (Bhatt et al., 2024; Vashishth et al., 2024).

Furthermore, AI implementation in education is often influenced by ethical concerns, as mentioned in the study by Nguyen et al. (2023). Issues related to data privacy, the risk of algorithmic bias, and the need for greater transparency in AI systems are widely discussed. Trust in AI platforms is essential for user acceptance, and the lack of trust can compromise the successful implementation of these technologies. Therefore, it is crucial to ensure that AI-based solutions adhere to ethical standards, minimizing biases and ensuring transparency in algorithmic decision-making (Delello et al., 2024; Kumar et al., 2024).

In terms of impact, the results of the selected and analyzed studies indicate that AI has positive effects on user motivation, especially when associated with personalized learning pathways. Studies such as Moorhouse et al. (2023) and Zhai & Nehm (2023) report that personalized learning paths help increase user engagement, creating a more motivating and collaborative environment that can lead to improved performance and better knowledge retention. Additionally, Er-Rafyg et al. (2024) emphasize that AI's ability to automate assessments and provide real-time feedback helps reduce teachers' administrative tasks, allowing them to focus more on users' pedagogical needs.

Inclusion and equity are also key issues raised in the literature. AI has the potential to reduce educational inequalities by promoting equitable access to learning through adaptive systems that accommodate different learning styles (Lee et al., 2024; Naithani et al., 2024). This ability to inclusively personalize content ensures that all users, regardless of their level or context, have access to learning opportunities tailored to their needs.

However, challenges related to teacher training and the adaptation of pedagogical methodologies to AI-based technologies still represent significant obstacles. Teacher resistance to adopting new technologies is often cited as a barrier to

effective AI implementation in schools. The lack of continuous training and support in integrating new pedagogical tools with traditional methods may limit the full potential of AI. Therefore, proper teacher training and the provision of support resources are essential to ensure the effective use of AI-based platforms in teaching practices (Alam & Mohanty, 2023; Bhatt et al., 2024).

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