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Prototype Design for Massive Open Online Courses: "Educação On" Project

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ABSTRACT

This article is part of the "Educação ON" project, an initiative aimed at studying the current state of distance education and developing an innovative digital platform to promote more interactive and collaborative learning environments. This project focuses on creating effective models of Massive Open Online Courses (MOOCs) for higher education, facilitating the dissemination of knowledge among university students in distance learning contexts. This particular study focuses on validating a MOOC course model adapted to higher education students, tested during the 2022/2023 and 2023/2024 academic years. The research was conducted by a multidisciplinary team of lecturers from a Portuguese higher education institution, with the participation of students from Portugal and Brazil, aiming to improve student engagement and retention in this educational context. The article presents a theoretical approach to the MOOC course prototype design, followed by the analysis of successful and unsuccessful cases. Additionally, it compares the characteristics, advantages, and disadvantages of different authoring software, culminating in the selection of the most appropriate technology for prototype development. This initial phase lays the groundwork for future implementations and tests within the project aimed at higher education students.

Keywords: E-learning, MOOCs, Pedagogical Innovation, Technologies, Artificial Intelligence

INTRODUCTION

Massive Open Online Courses (MOOCs) have emerged as one of the most revolutionary pillars of contemporary education, promoting universal access to knowledge and making distance education a widely accessible reality (Siemens 2014). Since their introduction, they have played a crucial role in democratizing education by breaking down geographical and socioeconomic barriers, providing millions of students worldwide with high-quality learning opportunities (Koller & Ng 2022).

However, as distance education expands, new challenges arise that require continuous innovation. Among these is the need for greater student engagement and strategies that promote active and personalized learning. Emerging technologies such as Artificial Intelligence (AI) offer an unprecedented opportunity to tailor education to the specific needs of each student, enriching the learning experience (Chen & Huang 2024).

In this context, the "Educação ON" project was designed with the goal of developing an innovative MOOC model adapted to higher education. To achieve this goal, an analysis of the characteristics and new trends of authoring software used in MOOCs was conducted, as well as a detailed comparison of successful and unsuccessful cases of implementation in various leading institutions. Based on these studies, a comparison of different authoring software was carried out, culminating in the definition of the course prototype design.

This article thus focuses on the description and analysis of this process, highlighting the tools and pedagogical methodologies used to develop an effective and interactive MOOC.

THEORETICAL FRAMEWORK - KEY CHARACTERISTICS, NEW TRENDS, AND AUTHORING SOFTWARE IN MOOCS

The theoretical framework serves as the conceptual and methodological foundation upon which this study is based. As MOOCs continue to evolve, it becomes essential to examine their fundamental characteristics, emerging pedagogical and technological trends, and the technological tools that underpin their development. This section will explore these aspects in detail, contextualizing them in light of current practices and demands in the field of online education.

Key Characteristics of MOOCs

Massive Open Online Courses (MOOCs) have emerged as an educational solution that democratizes access to knowledge on a global scale. The success of a MOOC depends on how the content is designed, organized, and delivered, often using authoring software to create interactive educational content tailored to students' needs, with the ability to scale to large audiences.

MOOCs possess characteristics that set them apart from other educational formats, notably accessibility, scalability, and flexibility. Accessibility refers to their open nature, allowing students from different socioeconomic backgrounds to access high-quality courses (Yuan & Powell, 2013). Scalability enables thousands of students to participate simultaneously without compromising the quality of instruction (Siemens, 2014). Additionally, MOOCs offer flexibility, allowing students to learn at their own pace and from any location (Anderson, 2018).

Another essential characteristic is multimodality, which combines various types of media (videos, texts, graphics, and quizzes) to create a diverse learning experience that caters to different learning styles and enhances knowledge retention (Anderson, 2018). Interactivity, provided through discussion forums, automated feedback, and practical tasks, also plays a central role in engaging students (Koller & Ng, 2022).

Understanding the characteristics that make MOOCs a scalable and flexible educational solution, it is crucial to analyze the technological and pedagogical innovations that have emerged to enhance these characteristics and make learning more effective.

New Technological and Pedagogical Trends in MOOCs

The evolution of MOOCs in recent years has been shaped by several technological and pedagogical innovations, aimed at improving the quality of education and offering a more personalized learning experience. The following trends demonstrate how interactivity, scalability, and flexibility are intensified through new approaches.

- **Adaptive Learning and Personalization:** The use of Artificial Intelligence (AI) in MOOCs has enabled unprecedented personalization. AI algorithms monitor students' progress and adjust content based on their individual needs, recommending additional materials and adjusting the difficulty of activities (Chen & Huang, 2024). This personalized adaptation is essential for ensuring that students remain motivated and engaged throughout the course.
- **Gamification:** Gamification in MOOCs has been widely adopted to increase student participation and retention. Elements such as badges, rankings, and scores are frequently integrated to encourage healthy competition and active participation (Zhang & Zheng, 2023). Studies show that the proper application

of gamification elements can significantly boost student motivation (Gordon et al., 2022). However, its implementation must be carefully balanced to avoid discouraging students who may not respond well to competition.

- **Virtual Reality (VR) and Augmented Reality (AR):** The integration of Virtual Reality (VR) and Augmented Reality (AR) into MOOCs has provided immersive learning experiences, particularly in practical courses such as engineering or medicine. These technologies allow students to practice and develop skills in simulated environments before facing real-world situations (Laurillard, 2013). However, implementing VR and AR requires considerations of cost and technical complexity.
- **Microcredentials and Certifications:** The growing popularity of microcredentials has made MOOCs an essential tool for developing specific skills for the labor market. Platforms such as Coursera and edX offer certifications that formalize acquired knowledge, increasing students' employability (Yuan & Powell, 2013).

The technological trends discussed, such as gamification, adaptive learning, and the use of VR/AR, depend heavily on robust tools for their implementation. The next section focuses on the authoring software that enables the development of innovative and interactive courses within MOOCs.

Authoring Software and Technological Tools

Authoring software is fundamental in creating interactive and engaging content for MOOCs. These tools allow instructors to develop courses that integrate multimedia, such as videos, animations, and quizzes, ensuring that the content is dynamic and tailored to the students' needs.

Characteristics of Authoring Software

To be effective, authoring software must possess the following key characteristics (Chen & Zhang, 2023; Koller & Ng, 2022; Laurillard, 2013):

- **Flexibility**: The ability to create and customize content according to pedagogical objectives.
- **Interactive Elements**: Support for creating quizzes, simulations, and case studies, promoting student engagement.
- **Ease of Use**: An intuitive interface, allowing instructors with varying levels of technical expertise to develop content without difficulty.
- **Compatibility with LMS**: Integration with Learning Management Systems (LMS) such as Moodle or Blackboard to facilitate course delivery.
- **Multimodal Support**: Offering support for formats such as videos, audio, and animations, providing a rich and diverse learning experience.

Authoring Software and Artificial Intelligence

The authoring software used in the creation of MOOCs, such as Articulate 360, Adobe Captivate, and iSpring Suite, is constantly evolving but currently does not have native Artificial Intelligence (AI) integration. However, these software solutions can be complemented by AI through other tools, such as Learning Management Systems (LMS).

Although authoring software provides robust tools for creating multimodal and interactive content, integration with platforms that use AI, such as Moodle and Blackboard, adds an additional layer of automation and adaptation, as described by Yuan & Powell (2013). AI allows content to be dynamically adjusted based on students' needs and progress, providing a more personalized learning experience (Chen & Zhang, 2023). This combination of AI with authoring tools creates a more flexible learning environment, tailored to the individual needs of each student.

Examples of Authoring Software:

- **Articulate 360**: Known for its ease of use and versatility, it is widely used to create interactive, branching courses, supporting gamification and simulations (Zhao et al., 2020).
- **Adobe Captivate**: Used for creating interactive simulations and multimedia tutorials, Adobe Captivate allows the development of augmented reality content and is particularly effective for highly interactive courses (Browning & Dufresne, 2019).
- **iSpring Suite:** Integrated with Microsoft PowerPoint, it facilitates the conversion of presentations into interactive courses and is popular for its simplicity and quick usage (Clark & Mayer, 2016).

Authoring software differs from LMS platforms, which focus on course delivery and management. These tools allow the creation of dynamic educational materials, such as quizzes, interactive videos, and simulations, ensuring that courses are interactive and adaptable. Furthermore, these software solutions follow interoperability standards, such as SCORM and xAPI, facilitating integration with various LMS platforms (Watson & Lee, 2018).

METHODOLOGY

This article is part of the "Educação ON" research project, which aims to validate a MOOC course model applied to higher education and tailored to the context of distance learning. To achieve this goal, the project was developed in several stages, fitting into the phase of developing the MOOC Course Prototype. The target audience included approximately 800 students from Brazilian universities and the Polytechnic Institute of Viseu (IPV). The development team consisted of IPV faculty members and specialists in educational technology and design.

The research project methodology was structured into the following phases:

Literature Review and Analysis

The project began with a comprehensive review of the literature on MOOCs, online education, and pedagogical methodologies. This analysis helped identify best practices and challenges associated with the development of online courses and served as a foundation for the subsequent steps.

Student Surveys and Expert Consultations

Surveys were conducted with 50 students from Portugal and Brazil, alongside consultations with eight experts, to validate the pedagogical and technological strategies to be implemented in the project. This data provided a clear understanding of the expectations and needs of the end users.

Definition of Pedagogical and Technological Requirements

Based on the literature review and surveys, pedagogical and technological requirements necessary for the development of the MOOCs were defined, with a focus on active and personalized learning.

Creation and Configuration of the Technical Platform

The creation and configuration of the technical platform involved selecting a Learning Management System (LMS) and integrating collaborative tools, ensuring that the solution met the defined pedagogical and technological requirements. Several educational platforms, such as Coursera, edX, and NAU, were evaluated through a SWOT analysis, focusing on scalability, flexibility, and integration with emerging technologies.

Analysis of Pedagogical Methodologies

Pedagogical methodologies applied to the development of MOOCs were analyzed, with a focus on promoting active and personalized learning to maximize student engagement.

Development of the MOOC Course Prototype

The development of this research followed several interconnected stages. One of the key tasks involved the creation of a prototype design for a Massive Open Online Course (MOOC). This process began by studying the characteristics, new trends, and authoring software, and comparing them, along with the analysis of educational trends, successful and unsuccessful case studies, and deciding on the technologies to be used in the instructional design. The methodology was structured into four main phases:

a) Literature Review and Theoretical Framework

This phase included a review of literature covering new technological trends such as gamification and artificial intelligence (AI) applied to education, alongside pedagogical methodologies aimed at personalizing learning in large-scale online courses. The selection of articles included studies indexed in databases like Scopus and Web of Science.

b) Analysis of Successes and Failures

Implementation cases of MOOCs were examined, focusing on aspects like design, technology use, and student participation. The conclusions from this analysis guided the prototype development by incorporating effective practices and avoiding potential obstacles.

c) Comparative Analysis of Authoring Software

Various authoring software, such as Articulate 360, Adobe Captivate, H5P, and Moodle, were analyzed and compared based on usability, accessibility, personalization, and integration with emerging technologies. This analysis provided a clear view of the most suitable tools for developing the prototype.

d) Design and Development of the Prototype

Based on the previous stages, the design of the technologies and the structure of the MOOC course modules were decided. The methodological process involved analyzing different technological and pedagogical tools, aiming to create a modular structure that allowed for flexible and interactive learning. Learning objectives were defined, and appropriate technologies were selected to integrate synchronous and asynchronous functionalities. This process ensured an implementation aligned with the students' needs, enabling the creation of a tailored and effective learning experience.

Based on the defined requirements, a prototype of the MOOC course was developed, allowing for continuous adjustments in the design and functionalities before the final implementation, which will be discussed in detail in another study.

Development of Digital Educational Resources

Digital educational materials were created to complement the course content, aligned with the pedagogical practices established in the previous phases.

Implementation and Monitoring

The course will be implemented on the chosen platform and continuously monitored, ensuring the quality of the learning experience and identifying potential improvements.

Final Evaluation of Results

After implementation, a final evaluation of the results will be conducted, based on collected data, to measure the course's effectiveness and propose adjustments for future improvements.

SUCCESS AND FAILURE CASES OF MOOCS

Massive Open Online Courses (MOOCs) have been a significant innovation in the field of education, providing large-scale access to knowledge. However, as discussed in the theoretical framework, the success or failure of MOOCs depends on various factors, such as pedagogical design, interactivity, student support, and technological infrastructure. This section analyzes practical examples, connecting them to the theoretical concepts previously presented.

Success Cases

Successful MOOCs are characterized by the effective integration of relevant content, interactive design, student support, and flexibility – all essential elements discussed in the theoretical framework.

Coursera: "Machine Learning" by Andrew Ng

Andrew Ng's Machine Learning course on the Coursera platform is widely regarded as one of the most successful MOOCs globally. Its success can be directly related to the factors discussed in the theoretical framework:

- **Content Quality**: Created by a world-renowned expert, the course was developed based on fundamental concepts of machine learning, ensuring credibility and trust in the materials, as discussed in the section on critical factors for MOOC success.
- **Interactivity and Practical Projects**: As mentioned in the theoretical framework, interactivity is crucial for MOOC success (Anderson, 2018). The course included interactive quizzes and practical projects that allowed students to apply their knowledge in real-life situations, enhancing engagement (Zhang & Zheng, 2023).
- **Support and Flexibility**: The ability for students to progress at their own pace and the availability of discussion forums provided continuous support, which is highlighted as crucial for student retention in the theoretical framework (Koller & Ng, 2022).

NAU Platform: "Technological Innovation" MOOC

The NAU platform, created in Portugal by the Foundation for Science and Technology (FCT), stands out for offering MOOCs in Portuguese. The Technological Innovation course is an example of success, particularly due to the application of principles discussed in the theoretical framework:

- **Accessible and Intuitive Interface**: The platform's accessibility, both in terms of interface and content, reflects the need for scalability and flexibility discussed in the theoretical framework (Silva & Pereira, 2023). This ease of use allowed instructors with varying levels of digital literacy to create interactive courses.
- **Multimodal Integration**: The combination of videos, quizzes, and animations in the course is a clear example of multimodality, which, according to Anderson (2018), improves knowledge retention, increasing participation and student engagement.
- **Personalization and Data Analysis**: The NAU platform uses data analysis tools to adjust content based on student needs, aligning with adaptive learning and personalization trends discussed in the technological trends section (Gomes et al., 2024).

Udacity: Nanodegree in "Artificial Intelligence"

The Artificial Intelligence Nanodegree, offered by Udacity in partnership with companies like Google and IBM, is another example of success. This course stands out for its practical relevance to the job market, a factor emphasized in the theoretical framework:

- **Corporate Partnerships**: As discussed in the framework, the relevance of the content and its connection to the job market are fundamental to the success of MOOCs (Yuan & Powell, 2013). Partnerships with leading companies ensured that the content was up-to-date and applicable, enhancing students' employability.
- **Focus on Practical Projects**: As mentioned in the framework, the application of practical projects improves knowledge retention and student motivation (Gordon et al., 2022). In this case, students developed skills applicable to real-world scenarios, facilitating their transition to the job market.

Failure Cases

While many MOOCs have been successful, there are also examples of failure. These cases are directly related to shortcomings in the critical factors discussed in the theoretical framework, such as lack of interactivity and insufficient student support.

University of Edinburgh: Big Data MOOC on Coursera

This course faced low completion and student engagement rates due to failures in key aspects identified in the theoretical framework:

- **Lack of Interactivity**: As discussed by Anderson (2018), interactivity is fundamental to the success of MOOCs. However, this course had highly theoretical content without practical activities that would allow students to apply the knowledge, resulting in a lack of motivation and dropouts (Hollands & Tirthali, 2014).
- **Insufficient Support**: Continuous support, mentioned as an essential factor in the framework, was absent. The lack of active tutors and discussion forums made students feel unsupported throughout the course, harming their experience and completion rates.

Stanford University: Advanced Engineering Course on EdX

Despite Stanford University's prestigious reputation, the Advanced Engineering course offered on EdX did not meet the expected success due to issues already discussed in the theoretical framework:

- **Excessively Theoretical Content**: The course failed to balance theory with practical applications. As Zhang & Zheng (2023) and the theoretical framework suggest, more successful MOOCs offer opportunities for practical learning. However, this course focused too much on theoretical concepts, frustrating students' expectations (Chen & Huang, 2024).
- **Technical Problems**: Technical issues on the EdX platform hindered the learning experience, resulting in high dropout rates, which also compromised the scalability and accessibility discussed in the theoretical framework (Hollands & Tirthali, 2014).

Common Factors in Success and Failure Cases

The analysis of these practical cases reveals that the critical factors identified in the theoretical framework – interactivity, content quality, continuous support, and flexibility – are the main determinants of the success or failure of MOOCs. These cases illustrate how the presence or absence of these factors can directly impact students' experience and course outcomes.

AUTHORING SOFTWARE IN THE CREATION OF MOOCS

Authoring software plays a fundamental role in creating interactive and engaging content for MOOCs. These tools are essential for developing online courses that incorporate various multimedia elements, such as videos, audio, simulations, and interactive quizzes, allowing for dynamic learning tailored to students' needs. To ensure course effectiveness, authoring software must include key features like flexibility, ease of use, and multimodal support (Laurillard, 2013).

Key Features of Authoring Software

Authoring software for MOOCs should offer a range of functionalities that facilitate the creation of high-quality educational content. The main features to consider include:

- **Flexibility in content creation**: The tool should allow for content customization, adapting to the specific needs of students and the course format.
- **Interactive elements**: Interactivity is crucial for maintaining student engagement. Authoring software must offer functionalities for creating quizzes, simulations, and study scenarios.
- **Ease of use**: The interface should be intuitive, enabling instructors with varying technical expertise to create content without the need for advanced programming skills.
- **Compatibility with LMS platforms**: The software should be compatible with Learning Management Systems (LMS) like Moodle or Blackboard, to facilitate course integration and distribution.
- **Multimodal support**: The tool should support various media formats, such as videos, audio, animations, and text, providing a rich and diverse learning experience (Chen & Zhang, 2023; Koller & Ng, 2022; Laurillard, 2013).

Comparison of Authoring Software Used in MOOCs

Authoring software varies in terms of functionality and cost, making them suitable for different types of educational projects. Below are the main tools used for creating MOOCs, along with their respective advantages and disadvantages.

Table 1. Comparative Analysis Authoring Software : Characteristics, Advantages, and Disadvantages

Software	Features	Advantages	Disadvantages
Adobe Captivate	Responsive content, screen recording, software simulation	Advanced simulation features	Steep learning curve, high cost
Articulate 360	Storyline 360, Rise 360, gamification	User-friendly interface, interactive features	High cost, initial learning curve
Camtasia	Screen and webcam recording, video editing, quizzes	Robust video editing, quiz creation	Focus on video, fewer features for full course creation
Elucidat	Responsive content, real-time collaboration	Easy to use, real-time collaboration	Less flexible, high cost for small organizations
H5P	Quizzes, presentations, interactive videos, gamification	Free, easy to use, LMS compatible	Fewer advanced editing and customization features
iSpring Suite	PowerPoint conversion, quizzes, dialogue simulations	PowerPoint integration, easy to use	Fewer advanced interactivity features

Source: Developed by the authors

It is important to note that the authoring software presented does not have native Artificial Intelligence (AI) capabilities, but they can be enhanced with AI through other tools, such as LMS platforms.

Choosing the Right Authoring Software for MOOCs

When selecting authoring software for creating MOOCs, it is essential to consider the specific needs of the course and students. Using different authoring tools to create a MOOC allows for combining various resources and features, resulting in more comprehensive content tailored to students' needs. For example:

- **Adobe Captivate** is ideal for courses that require technical simulations and complex scenarios, often used in disciplines like engineering or medicine (Browning & Dufresne, 2019).
- **Articulate 360** is widely used in educational and corporate environments, offering a user-friendly interface and interactive features like Storyline 360 and Rise 360 (Zhao et al., 2020).
- **H5P** is an open-source solution that is accessible and compatible with multiple LMS platforms, making it ideal for institutions with limited budgets (Watson & Lee, 2018).

The choice of the appropriate software should take into account factors such as budget, the level of interactivity required, ease of use, and compatibility with LMS platforms.

COURSE DESIGN AND TECHNOLOGIES FOR MOOC PROTOTYPE IMPLEMENTATION

In the previous stages of the "Educação ON" research project, the foundational infrastructure was established, incorporating the complementary use of Moodle and StreamYard platforms for the dissemination of MOOCs. This decision was based on their flexibility, scalability, and ability to integrate synchronous and asynchronous functionalities.

This article aims to define the design of the MOOC course prototype. The design was developed based on solid pedagogical principles and the strategic use of authoring software and educational technologies. The course was designed to be modular, accessible, and adaptable to the individual needs of students, promoting flexible and personalized learning.

Course Design

The MOOC course prototype was designed around three main pillars: the Theoretical Framework, the studied Success and Failure Cases, and the use of Authoring Software. The course is organized into independent modules, each covering specific topics and structured to allow self-paced learning. This means that students can progress at their own pace and availability.

The modules were designed to include the following components:

- **Clear learning objectives**: Each module presents well-defined objectives, enabling students to understand what will be achieved in each phase of the course.
- **Multimodal content**: Various content formats are used, such as videos, texts, interactive presentations, and simulations. This approach caters to different learning styles, reflecting the best practices observed in the Success Cases studied.
- **Practical activities**: To ensure the application of learned concepts, each module includes exercises, quizzes, and practical projects. Experience with MOOC Failure Cases highlighted the importance of promoting interactivity and practical application of knowledge, which was incorporated into the prototype design.
- **Continuous feedback**: The course incorporates automated feedback mechanisms for instant evaluations, as well as peer feedback, allowing students to learn from each other. Systems will be used to monitor and manage peer feedback, ensuring quality even on a large scale, with support from tutors and analysis tools.

To promote an active learning experience, advanced pedagogical methods were integrated, such as:

- **Problem-Based Learning (PBL)**: Students face real-world scenarios and problems, applying acquired knowledge, reinforcing active and applied learning practices, which have proven effective in many of the MOOCs analyzed.
- **Gamification**: Gamification elements such as badges, scores, and rankings were included to increase motivation and student engagement. Previous case studies have shown that gamification enhances student involvement and persistence throughout the course.
- **Collaborative discussions**: The course also promotes collaboration through structured discussion forums, allowing students to debate and exchange ideas. To ensure effective collaboration, moderators and data analysis tools will be implemented to monitor forum activity.

The course was designed with inclusive design principles, including captions, transcripts, and responsive navigation, facilitating access on mobile devices. This ensures that all students, regardless of their abilities or the device used, can fully participate.

Additionally, recognized completion certificates were established in partnership with higher education institutions to credential students upon course completion. The prototype was adjusted based on user feedback during pilot phases, ensuring greater cohesion and a more interactive and engaging learning experience.

As a future plan, AI modules will be introduced as pilot projects, aiming to explore personalization and adaptation in learning. AI will be used to personalize learning paths, adjusting content according to student progress and performance.

Technologies Used

The implementation of the MOOC prototype was based on various technological tools, selected for their ability to support the creation of interactive and multimodal content. As previously discussed, these tools do not have native Artificial Intelligence (AI), but can be complemented with AI through Learning Management Systems (LMS). The main technologies used were:

- **Articulate 360**: Used to create interactive content, adaptable to different devices. This tool allowed real-time collaboration between course developers and the integration of media such as videos, quizzes, and interactive scenarios. Although Articulate 360 does not natively integrate AI, the content generated can be enhanced with AI tools when integrated into LMS platforms like Moodle.

- **iSpring Suite**: Integrated with Microsoft PowerPoint, this tool was used to create interactive courses from existing presentations. It allows the creation of quizzes, dialogue simulations, and video lessons. iSpring Suite does not have AI natively but can be complemented by LMS platforms that use AI.
- **Camtasia**: Used for screen recording and video editing. Camtasia enabled the production of video lessons, tutorials, and software demonstrations. Camtasia does not offer AI natively, but the videos created can be integrated into platforms that use AI for interaction analysis and content adaptation.
- **H5P**: Used to create quizzes, interactive videos, and gamification activities. H5P is an open-source solution integrated with LMS platforms such as Moodle. Although it does not offer AI natively, the interactive activities created can be optimized through platforms that use AI for content personalization.

The combined use of these tools allowed the creation of content tailored to the needs of students. Integration with LMS platforms, such as Moodle, ensured the scalability of the course and allowed the use of complementary AI tools to personalize the learning experience and automate feedback.

CONCLUSION

The initial results of this study allowed the development of a MOOC course design prototype, integrating advanced methodologies and educational technologies. The prototype was developed based on solid pedagogical principles and user-centered design best practices, providing an efficient and flexible structure that could be further tested and implemented on a larger scale in the future.

Although the study focused solely on the prototype design phase, the theoretical potential of integrating tools such as AI, gamification, and multimodal technologies suggests that these can enhance the learning experience and personalize students' learning pathways. The use of authoring software and the flexibility provided by the modular course design reflect the importance of creating adaptable and inclusive educational solutions.

However, the implementation and validation of the prototype require subsequent phases of development and testing with real target audiences. For future research, it will be essential to conduct empirical tests to validate the prototype in practical contexts and explore the incorporation of emerging technologies, such as augmented and virtual reality, into MOOCs, aiming to create more immersive and interactive learning experiences.

This study provides an initial foundation for MOOC development, proposing a design that can be expanded and improved as new technologies and pedagogical approaches are tested and applied.

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