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E-LEARNING STRATEGIES IN HIGHER EDUCATION: LESSONS FROM TOP LMS PLATFORMS

ESTRATÉGIAS DE E-LEARNING NO ENSINO SUPERIOR: LIÇÕES DAS PRINCIPAIS PLATAFORMAS LMS

ESTRATEGIAS DE E-LEARNING EN LA EDUCACIÓN SUPERIOR: LECCIONES DE LAS PRINCIPALES PLATAFORMAS LMS

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ABSTRACT: The paper aims to suggest options for using an e-learning system at a university based on an analysis of LMS systems used at the top 200 universities according to the ARWU ranking. The research combines the analysis of publicly available data with a questionnaire survey among students. It compares the three most widely used systems – Moodle, Blackboard, and Sakai – in terms of functionality, user accessibility, and costs. The findings indicate that Moodle is the most suitable solution for Slovak higher education institutions due to its modularity, low financial requirements, and localizability. Based on the research results, a three-phase implementation model is proposed, which includes pilot testing, system expansion, and subsequent optimisation. However, the successful implementation of e-learning also depends on technical support, teacher training, and methodological integration into teaching. The paper offers an applicable proposal for developing digital education in the conditions of the Slovak higher education environment.

KEYWORDS: E-learning. Learning Management Systems (LMS). Higher Education. Moodle Implementation. Digital Education Strategy.

RESUMO: *Este artigo propõe opções para a adoção de um sistema de e-learning em universidades, com base na análise de sistemas LMS utilizados pelas 200 melhores universidades segundo o ranking ARWU. A pesquisa combina a análise de dados públicos com um questionário aplicado a estudantes. Foram comparados os três sistemas mais utilizados — Moodle, Blackboard e Sakai — em termos de funcionalidade, acessibilidade e custo. Os resultados indicam que o Moodle é a solução mais adequada para instituições eslovacas de ensino superior, devido à sua modularidade, custo reduzido e capacidade de localização. Com base nos dados, propõe-se um modelo de implementação em três fases: teste piloto, expansão e otimização. No entanto, o sucesso do e-learning depende também de suporte técnico, formação docente e integração metodológica no ensino. O artigo oferece uma proposta prática para o desenvolvimento da educação digital no ensino superior eslovaco, alinhada com práticas internacionais e adaptável a diferentes contextos institucionais.*

PALAVRAS-CHAVE: *E-learning. Sistemas de Gestão da Aprendizagem (LMS). Ensino Superior. Implementação do Moodle. Estratégia de Educação Digital.*

RESUMEN: *Este artículo propone opciones para implementar un sistema de e-learning en universidades, basándose en el análisis de sistemas LMS usados por las 200 mejores universidades según el ranking ARWU. La investigación combina el análisis de datos públicos con una encuesta dirigida a estudiantes. Se comparan tres sistemas ampliamente utilizados —Moodle, Blackboard y Sakai— en términos de funcionalidad, accesibilidad y costos. Los resultados indican que Moodle es la opción más adecuada para las instituciones eslovacas por su estructura modular, bajo costo y posibilidad de localización. Se propone un modelo de implementación en tres fases: prueba piloto, expansión y optimización. Sin embargo, el éxito del e-learning también depende del soporte técnico, la capacitación docente y la integración metodológica en la enseñanza. El artículo presenta una propuesta concreta para desarrollar la educación digital en el contexto eslovaco, alineada con buenas prácticas internacionales y adaptable a diferentes condiciones institucionales.*

PALABRAS CLAVE: *E-learning. Sistemas de Gestión del Aprendizaje (LMS). Educación Superior. Implementación de Moodle. Estrategia de Educación Digital.*

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INTRODUCTION

The development of information and communication technologies is fundamentally changing education at all levels, with universities facing increasing pressure to digitize teaching. E-learning, as a form of education through digital platforms, represents an essential tool for modernizing the university environment. Higher education is thus becoming more accessible, flexible, and efficient, meeting the needs of both students and society (Kozík, 2006; Bednár, 2008; Fabus & Fabusova, 2016).

E-learning involves using electronic media and the Internet to distribute study materials, facilitate communication between teachers and students, assign tasks, conduct testing, and provide evaluations. It enables studying regardless of time or place, reduces teaching costs, and supports independent learning. Its advantages include personalized teaching and the archiving of materials (Sun et al., 2008; Tothova & Fabus, 2015).

Learning Management Systems (LMS), such as Moodle, Blackboard, or Sakai, play a key role in implementing e-learning. These systems support the organization of teaching, course administration, assessment, and feedback. Technical, economic, and pedagogical factors often influence their selection. International comparisons show that open-source solutions, such as Moodle, are gaining popularity due to their low cost and wide range of customization options (Kaznowska et al., 2011).

Despite the advantages of e-learning, its implementation faces several challenges, including insufficient infrastructure, low digital literacy among teachers, and concerns about losing personal contact with students (Nikolaeva et al., 2023). Therefore, the successful adoption of LMS platforms depends on their technical quality, user readiness, support from university management, and effective methodological integration into teaching (Lee, 2008).

This paper aims to suggest approaches for implementing an e-learning system at a university, based on an analysis of LMS platforms used at the top 200 universities according to the ARWU ranking. It presents the results of quantitative research, compares selected LMS solutions, and proposes specific steps for implementing an appropriate system, with a focus on adapting it to Slovak conditions.

Literature Review

E-learning has evolved alongside the rise of the Internet and digital technologies, undergoing significant transformation since the 1990s. Initially based on offline systems (CBT), teaching has now shifted to online environments, where LMS platforms such as Moodle, Blackboard, and Sakai dominate (Kozík, 2006; Khan, 2001). Higher education institutions use these platforms to distribute materials, organize courses, administer tests, provide feedback, and communicate with students (Fabus et. al.2013).

E-learning responds to the demand for flexible, inclusive, and personalized education. It allows students to learn at their own pace, anytime and anywhere (Zabolotska & Bakhov, 2022). At the same time, it creates the conditions for more efficient teaching and reduces implementation costs. These benefits became especially evident during the COVID-19 pandemic, when LMS platforms formed the backbone of academic continuity.

LMS systems: classification and main characteristics

The LMS platforms can be classified into open-source and commercial solutions. The most widespread open-source platform is Moodle, known for its openness, modularity, and active developer community (Fabus et. al., 2016). Commercial solutions, such as Blackboard and Canvas, offer comprehensive tools and technical support but come with higher licensing costs (Kaznowska et al., 2011).

Moodle is characterized by features ranging from course management and testing to discussion forums, feedback tools, and student performance analytics. Its key advantages include adaptability and integration with other tools (Kozík, 2006). Conversely, Blackboard is praised for its reliable support, though its interface is often considered less intuitive (Sun et al., 2008).

Differences in LMS use also depend on the type of university and field of study. In technical and natural sciences, these systems are adopted more extensively than in the humanities, where personal interaction remains dominant.

Advantages, limitations and user experience

The main advantages of e-learning include flexibility, accessibility, cost savings, and the potential for personalization. LMS platforms promote independent learning, enable continuous assessment, and enhance the organization of teaching. They also facilitate archiving of results and documents (Bednár, 2008; Lee, 2008).

On the other hand, significant challenges have also been identified: low digital literacy among teachers, poor technical support, passive use of LMS as a repository of materials, or resistance to change by some teachers (Vartiak, 2015). Therefore, effective use of LMS requires technical, methodological, and organizational prerequisites.

Questionnaire research confirms that students find LMS useful if the systems are clear, intuitive, and support communication. The most appreciated features include task calendars, automatic testing, and feedback (Sun et al., 2008).

Models for evaluating LMS success

The quality and effectiveness of e-learning cannot be assessed solely from a technical perspective. Therefore, various models in the literature consider user behavior and satisfaction (Garbarova et al., 2017). The DeLone and McLean model works with system, information, and service quality concepts (Jankalová & Vartiak, 2017). The Technology Acceptance Model focuses on perceived usefulness and ease of use (Lee, 2008). The BELS model, in turn, evaluates the success of blended learning from the perspective of the educator, student, course design, and technological context (Dorobat, 2014).

METHODOLOGY

The research focused on analyzing the use of LMS systems at the 200 best universities according to the ARWU ranking and proposing options for their implementation under the conditions of Slovak higher education institutions. It combined two primary methods: analysis of publicly available data and a questionnaire survey among students.

Analysis of LMS systems at universities

In the first phase of the research, LMS platforms used at universities were identified based on their official websites. Universities were classified by system type—open source, commercial, or proprietary. Most universities used Moodle (27%), Blackboard (35%), and Sakai (10%). The rest employed smaller systems or combinations of multiple platforms.

This analysis aimed to determine the frequency of use of the main LMS platforms and their geographical or institutional distribution. These data provided the basis for selecting a system suitable for the conditions of Slovak higher education institutions (Kaznowska et al., 2011; Nemcek et al., 2015).

Questionnaire survey among students

The second part of the research consisted of an online questionnaire survey conducted via the Typeform platform. It was completed by 99 respondents, which corresponds to the minimum statistically valid sample size. The survey investigated the most frequently used LMS functions, how users learn to work with the system, and perceptions of user accessibility (Sun et al., 2008).

Students often use tools such as uploading assignments, accessing materials, and viewing announcements and calendars (Cannistrà et al., 2022). They used forums and

interactive modules less frequently. Moodle was rated the easiest to use, while Blackboard was considered the least intuitive.

Comparison of platforms

At the end of the methodological section, Moodle, Blackboard, and Sakai were compared according to several functional and user criteria. The results showed that Moodle offers the best ratio between functionality and costs, positioning it as the optimal choice for the Slovak academic environment (Kozík, 2006; Bednár, 2008).

RESULTS

An analysis of LMS systems at the top 200 universities according to the ARWU ranking showed that all institutions surveyed use some form of e-learning system. The most commonly used system was Blackboard (35%), followed by Moodle (27%) and Sakai (10%). The remaining 28% represented alternative or proprietary solutions such as Canvas, Desire2Learn, etc.

A breakdown by system type showed that 45% of universities use open-source solutions, mainly Moodle and Sakai, 40% use commercial systems, and 10% have proprietary LMS platforms (Kaznowska et al., 2011). These data confirm the growing interest in flexible and cost-effective open-source solutions that allow for more localization and customization (Kozík, 2006; Bednár, 2008).

Student Survey

A student survey showed that 87% of respondents regularly use the LMS system to access study materials, submit assignments, and follow announcements. The most frequently used tools were uploading assignments (85%), announcements (81%), access to study materials (76%), and the calendar (70%).

Students used discussion forums and interactive learning options less often, which indicates a passive use of the system—LMS is perceived mainly as a tool for teaching administration, not as a platform for active learning (Sun et al., 2008).

From the perspective of user accessibility, Moodle was evaluated as the most intuitive, perceived by students as clear and accessible from mobile devices. Conversely, Blackboard was criticized for its complex interface and high degree of functional fragmentation.

Comparison of Moodle, Blackboard and Sakai Systems

Based on functional, technical, and user criteria, a comparison was made of three central systems:

- Openness, modularity, an intuitive interface, and low costs characterize Moodle. It supports various functions, from course management to testing and feedback. Community support makes it flexibly expandable (Kozík, 2006; Bednár, 2008);
- Blackboard is a complex system with extensive functionality and integrated analytical tools, but it is more demanding to operate and has a licensing burden (Lee, 2008);
- Sakai is stable and secure but less widespread and has a smaller user community. Its advantage is its university background. The disadvantage is limited possibilities for visual and functional customization.

The comparison showed that Moodle is the most suitable solution for Slovak conditions, thanks to its free availability, Slovak language support, and the possibility of self-administration (Kaznowska et al., 2011).

Proposal for the implementation of the Moodle system

Based on the results of the analysis, a three-phase model for the implementation of the Moodle system was proposed:

- Pilot phase: testing at selected faculties, identification of teachers' needs;
- Expansion: integration of the system into all study programs, creation of course templates;
- Optimization: training, expansion with additional modules (e.g., analytics, mobile applications), and ongoing evaluation.

Successful implementation requires creating an LMS team (administrator, methodologist, trainer), developing a methodological manual, establishing a technical background, and receiving support from university management. Only under these conditions can the system be expected to contribute to increasing the quality of teaching (Jaseckova, Konvit & Vartiak, 2022).

DISCUSSION

The research results highlight the widespread adoption of LMS systems at universities worldwide and confirm that these tools form the foundation of modern higher education. The fact that all universities in the ARWU ranking use some type of LMS underscores their

universality and importance for academic practice. However, there are differences in how these systems are utilized, with key factors influencing their selection including cost, technical support, user interface, and teaching philosophy (Kaznowska et al., 2011).

The finding that Moodle is the most suitable solution for Slovak universities is supported not only by its free availability and functional complexity but also by its adaptability and strong community support. Moodle also offers localization options, which is a significant advantage in the Slovak contex (Kozík, 2006; Bednár, 2008).

Despite these advantages, e-learning faces certain obstacles. Many universities lack the technical infrastructure or human resources needed to use LMS platforms effectively. Another crucial factor is the willingness of teachers to change their teaching practices and integrate digital tools into their courses. Passive use of LMS—treating it merely as a repository of materials – remains a common limitation (Sun et al., 2008).

In this context, the proposed three-phase implementation model appears realistic and considers the need to introduce changes gradually. The first phase (pilot) allows system testing; the second phase (scale-up) incorporates feedback; and the third phase (optimization) focuses on long-term sustainability.

FINAL CONSIDERATIONS

The digital transformation of higher education is an irreversible process in which LMS systems play a central role. Research conducted on a sample of the world's top 200 universities confirmed that e-learning has become a standard component of the academic environment. The analysis revealed that the most widely used solution is the commercial Blackboard system; however, open-source platforms—especially Moodle—are gaining popularity. Moodle stands out for its modularity, low cost, intuitive interface, and extensive user community. In the context of Slovak universities, it emerges as the most appropriate candidate for implementing an LMS system.

A student survey revealed that LMS platforms are effective when they are intuitive, user-friendly, and support both administrative and didactic functions. However, the findings also indicated that many systems are still used passively, without leveraging their full potential for interactive learning and feedback. Therefore, the successful implementation of an LMS requires more than technical deployment; it demands teacher training, methodological support, and continuous student feedback.

The proposed three-phase Moodle implementation model reflects the importance of a gradual approach, including testing solutions, scaling up, and optimizing the system. Only by considering technical, human, and pedagogical factors can an e-learning platform become a truly effective tool for modernizing higher education in Slovakia.

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