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Study and analysis of the need for an intelligent lesson content management system for undergraduate digital technology education

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Abstract

This research focuses on the development and implementation of an intelligent learning content management system (AI-LMS) designed for undergraduate digital technology education, aiming to meet user needs and improve personalized learning experiences. A mixed-method approach was used, involving the collection of data from a purposefully selected sample of students, teachers, and experts. Statistical analysis, including calculation of means and standard deviations, was used to assess system requirements and user expectations. The study identified 12 main elements for an effective AI-LMS, including ease of use, 24-hour chatbot support, online quizzes, personalized content recommendations, assessment tools, AI-driven analytics, cloud integration, and security. The results highlight the platform's ability to support adaptive learning, enhance student engagement, and provide real-time insights to lecturers through interactive data visualizations. The AI-LMS framework enhances digital education by using artificial intelligence to enhance content delivery, assessment, and student progress tracking. The framework serves as a scalable, intelligent solution that promotes efficient and effective learning experiences. The system provides higher education institutions with a personalized, data-driven learning approach, enabling educators to improve teaching strategies while offering learners an engaging and flexible educational environment.

Keywords: AI-LMS, Content Management system, LMS framework, Platform.

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1. Introduction

In the digital era, where technology is rapidly evolving, Artificial Intelligence (AI) has gained increasing prominence due to its strategic value for education [1]. AI, a highly discussed technology, holds the potential to transform society and the global economy in the near future. AI applications span a wide range of business areas, such as marketing, sales, research, production, customer service, accounting, and finance. If utilized effectively, it is projected that by 2027, AI will enhance both the economy and the quality of life in the country, aligning with the National AI Action Plan (2022-2027) [2, 3] which focuses on three main goals: developing human capital and technology, driving economic growth, and creating positive social and environmental impacts [4].

AI has been developed through several eras, initially aiming to mimic human abilities in learning and problem-solving to perform tasks that may be beyond human capacity. This concept forms the foundation of modern AI, which includes self-adaptive automated systems tailored to specific scenarios. Examples include online learning platforms and automated question-answering services, where educational institutions leverage AI in the form of autonomous machine learning, which has gained widespread acceptance [5-7].

Although Thai higher education institutions have integrated AI into teaching and learning, the adoption rate remains limited compared to that of developed countries. Key reasons include the lack of governmental support, limited exchange of AI application practices, and the absence of a clear national objective [8-10] Consequently, it is crucial for senior management to understand AI's functionalities and benefits, fostering new ideas to improve educational quality and support various operations through AI's capacity for reasoning, independent problem-solving, and decision-making.

The application of AI in education significantly alleviates instructors' workloads, such as managing lesson content, grading assignments, and conducting formative assessments to gauge students [11-13] learning progress. Data collected can predict students' chances of passing and understanding, allowing educators to tailor content for students who need additional support. Additionally, AI enables personalized learning, acting as a tutor that adjusts subject content to match each student's capabilities through online systems, reducing repetitive questions for instructors and improving learning efficiency.

One high-potential and widely noted technology is Natural Language Processing (NLP), a branch of AI aimed at enabling machines to understand and respond effectively to human language in daily communication [14-17]. The use of NLP to create automated lessons and exercises is an innovation that can make learning processes more efficient and responsive to individual needs [2]. NLP processes, including intent recognition for welcoming and tutoring, can help generate high-quality learning content, such as accurate and updated lessons, diverse exercises tailored to learners' proficiency levels, and quick, precise assessments. Employing NLP for automated lesson and exercise creation not only lightens teachers' workloads but also significantly enhances students' learning outcomes [18-22].

This research focuses on the application of NLP technology for automated lesson and exercise creation, exploring various techniques and methods while evaluating the effectiveness of NLP in learning processes [3, 10, 23-25]. The expected outcomes are practical applications that will contribute to the development of modern, highly efficient educational systems.

2. Literature Review

2.1. Leveraging NLP Techniques for Privacy Requirements Engineering in User Stories

This research proposes a novel approach for Privacy Requirements Engineering (PRE), leveraging Natural Language Processing (NLP) in an Agile software development environment. The approach uses user stories as the primary input and employs NLP techniques to perform traditionally labor-intensive tasks, such as identifying personal information and generating data flow diagrams from user stories. These diagrams serve as a foundation for automatically generating privacy requirements, represented as user stories, enabling Agile teams to focus on functional requirements while NLP assists in generating privacy requirements [23]. The research evaluates the feasibility of the NLP-based approach using a dataset of user stories. The results demonstrate strong performance in identifying personal data disclosures, extracting privacy-related entities, and creating data flow diagrams. Additionally, the authors developed a GUI tool, named Privacy Story, to support the integration of the proposed workflow.

2.2. Enhancing Education with Artificial Intelligence: The Role of Intelligent Tutoring Systems

This article describes Intelligent Tutoring Systems (ITS) that leverage Artificial Intelligence (AI) technology to provide a personalized and adaptive learning experience. It discusses the evolution of ITS, highlighting key AI technologies such as machine learning, natural language processing, and adaptive algorithms. The article demonstrates how ITS transforms traditional educational practices through case studies and examples, such as Carnegie Learning's MATHia for mathematics and Duolingo for language learning [26]. It also addresses challenges and limitations, such as data privacy concerns and system biases, as well as future directions like multimodal learning and adaptive learning environments [27]. In summary, this article aims to provide a comprehensive understanding of ITS and the role of AI in enhancing the educational experience.

2.3. Frontiers of Intelligent Education: Artificial Intelligence Reshaping the New Landscape of Chinese Higher Education

This article explores the impact of Artificial Intelligence (AI) on higher education in China, focusing on AI's role in transforming workforce training concepts and innovating teaching and learning models. AI enables personalized learning by tailoring content and learning pathways to each student. Additionally, AI enhances digital competency by equipping students to effectively understand, analyze, and utilize digital data and technology [3]. The article provides examples of

intelligent teaching platforms that can assess students' progress, adapt content, and offer diverse learning resources, as well as intelligent question-answering and advising systems that assist students in problem-solving and understanding cutting-edge research. Furthermore, AI shifts learning from traditional to convergent models, emphasizing adaptive and lifelong learning through online platforms like MOOCs [28]. However, the article also addresses challenges in adopting AI in higher education, including technology integration, educational equity, ethics, and the need to balance AI technology with humanistic education.

2.4. AI-Based Education Tools for Enabling Inclusive Education: Challenges and Benefits

This research article examines AI-powered educational tools that support inclusive education, highlighting the benefits and challenges of using AI in learning. The article begins by underscoring the importance of digital, participatory education, particularly for students with special educational needs and disabilities (SEND), and the role of AI technology in creating equitable opportunities. It explores concepts like digital accessibility and frameworks for inclusive digital education, such as Universal Design for Learning (UDL) and Differentiated Instruction (DI). The article presents various AI tools for processing visual and media content, learning management systems (LMS), analytics, intelligent tutoring, and knowledge assessment. It analyzes challenges associated with AI in inclusive education, including technological challenges (e.g., compatibility, maintenance), instructional challenges (e.g., algorithmic bias), concerns around datasets and privacy, and cultural challenges [10]. At the same time, the article highlights benefits such as enhancing student motivation, personalizing learning, supporting students with learning disabilities, advancing teaching skills, and reducing teacher workload. The article concludes by emphasizing the transformative potential of AI tools in inclusive education while addressing the need to resolve challenges to ensure ethical, effective, and comprehensive implementation [11].

2.5. AI-based learning style detection in adaptive learning systems: a systematic literature review

This research article focuses on the automated detection of learning styles using Artificial Intelligence (AI) within adaptive learning systems. The study emphasizes the use of AI to tailor content and teaching strategies to match individual students' learning preferences. The research finds that the Felder–Silverman model is the most widely used model for automatic learning style detection. AI algorithms such as decision trees and neural networks have proven effective in classifying learning styles [29]. Moodle is highlighted as a prominent learning platform in this research due to its ability to collect data on learning behaviors. The article recommends further research into the effectiveness of AI algorithms in diverse educational settings and underscores the importance of leveraging learning behavior data for dynamic, AI-driven adaptation [30].

3. Materials and Method

1. Comprehensively analyze and study the literature related to intelligent content management systems in undergraduate digital technology courses, including surveys of AI-driven learning management systems (AI-LMS), natural language processing (NLP) applications, machine learning techniques, and digital education frameworks.
2. Design and implement a customized intelligent content management system for undergraduate digital technology courses.
3. Evaluate the suitability of the intelligent system through various data collection methods. The system will be evaluated using statistical analysis, such as means, standard deviations, and Likert scale rankings.
4. The population consists of students, lecturers, and experts with expertise in educational technology and AI applications.
5. The sample consists of 120 students from undergraduate digital technology courses, 20 teachers with experience in digital education, and 20 experts with expertise in educational technology and AI applications.

After the study and analysis of related documents and literature to design an intelligent knowledge content management system for digital technology education, as mentioned above, and considering the appropriateness of the tools that are suitable for the system, the details are shown in Figure 1.

Figure 1, the concept of studying and analyzing needs for system design and development, with guidelines and applications in the field of digital technology, consisting of the following subsystems.

1. Content Management System, the main functions are to store and organize content, manage lesson content such as documents, videos, learning media, and upload and manage documents, which are the functions of uploading, editing, organizing documents, which can be connected to the Content Recommendation System, Assessment System, and Tracking and Analytics System.
2. Content Recommendation System, there are 2 main functions, the function of recommending related lessons using Machine Learning to recommend appropriate content, and the function of analyzing learning data, such as improving recommendations from learning behavior data, and connecting to the Content Management System and Tracking and Analytics System.
3. Assessment System, it consists of the main functions, the function of creating and managing tests, such as creating and managing tests or assessment activities, and the function of providing automatic feedback, which is providing automatic feedback after evaluation. The system can be connected to the Content Management System and the Tracking and Analytics System.
4. Tracking and Analytics System, the main function is the progress tracking function, such as tracking students' learning progress, and the student behavior analysis function, which is analyzing learning behavior data to

improve teaching and learning. It also connects to the Content Recommendation System, Assessment System, and Content Management System.

5. User Management System, it consists of the main function, which is the user account management function, such as managing student and teacher registrations and accounts, and the access control function, which means setting access rights to content and functions, and connecting to the Content Recommendation System, Assessment System, and Tracking and Analytics System.
6. Communication and Collaboration System, the main function is the online chat function, such as forms, chats, and real-time chats, etc., and the collaboration function, such as sharing documents and group work. It can be connected to the Content Management System. Recommendation System), Assessment System, and Tracking and Analytics System.
7. Integration System, consists of integration functions with other educational tools, such as connecting to existing learning systems, and API support functions, such as developing APIs for connecting to external applications or systems, etc., which are connected to the Content Recommendation System, Assessment System, and Tracking and Analytics System.
8. Security and Data Management System, consists of data security functions, meaning the protection of user data and educational content, and data backup and recovery functions, such as data backup and recovery, and connection to the Content Recommendation System and User Management System.

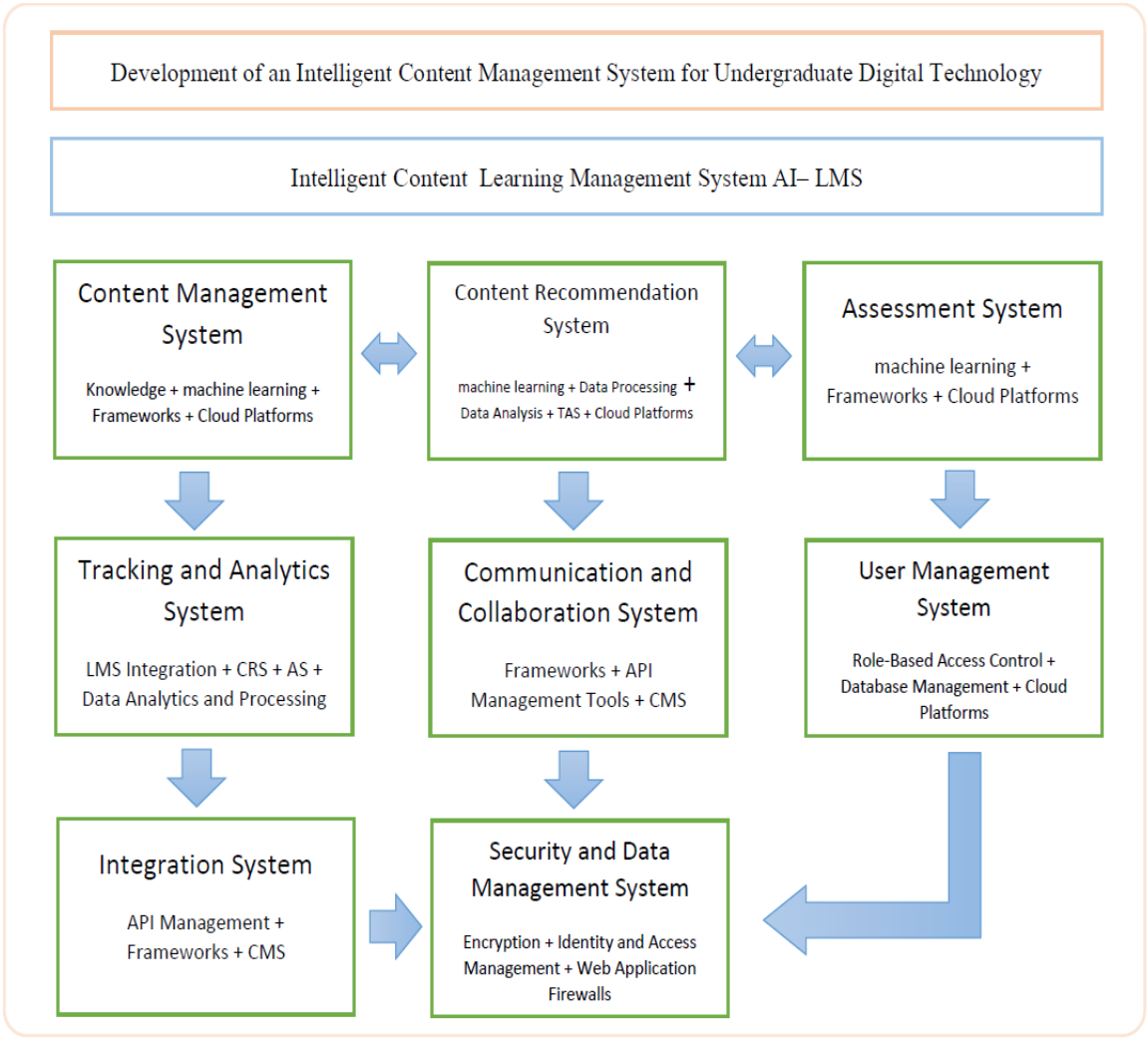

Figure 1.
Conceptual diagram for an intelligent content learning management system. (AI-LMS)..

Design an intelligent learning content management system (AI-LMS) by studying the suitability, which has main components as shown in Figure 2 as follows.

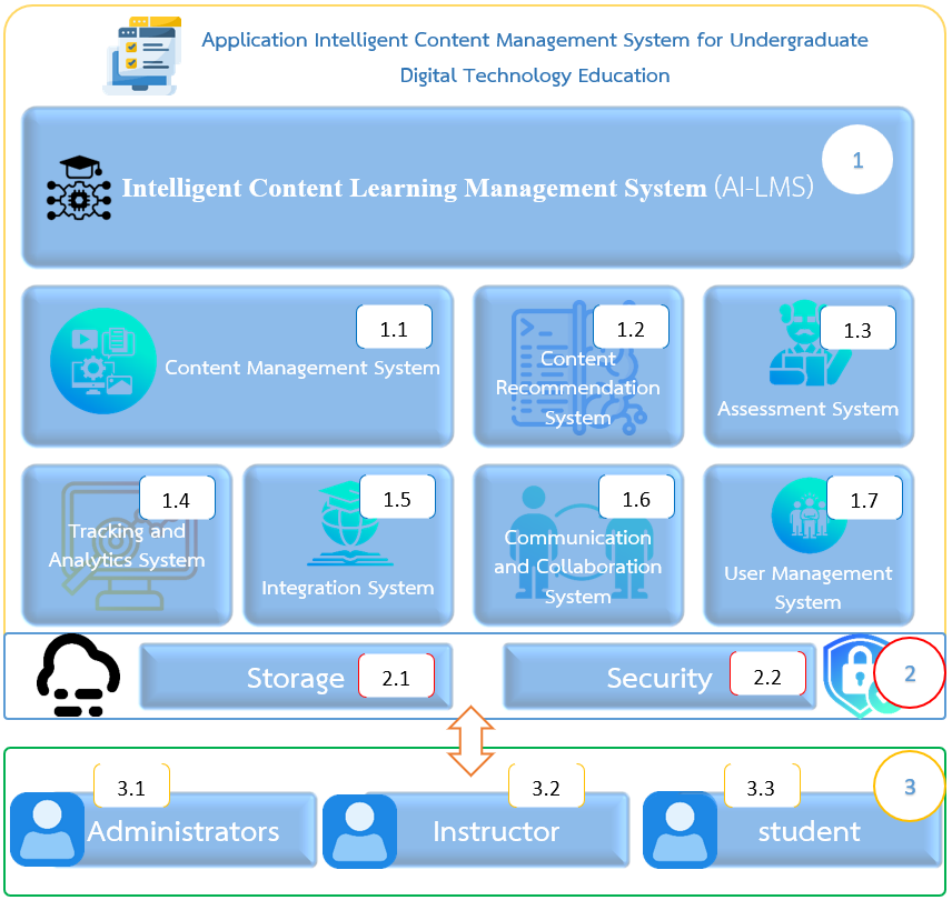

Figure 2.
Overview of the study of the operation of intelligent content learning management system. (AI-LMS).

Figure 2 shows the framework and implementation of an intelligent content management system (AI-LMS) for undergraduate digital technology education. The system consists of eight interconnected subsystems, with the Learning Management System (LMS) at its core. The outermost layers include Storage and Security, which handle data storage and system protection. The main component, the AI-driven Learning Management System (AI-LMS), integrates seven subsystems: the Content Management System (CMS) for organizing educational materials, the Tracking and Analytics System for monitoring student progress, the Integration System for connecting with external tools, the Content Recommendation System powered by machine learning, the Communication and Collaboration System for real-time interaction, the Assessment System for automated evaluation, and the User Management System for handling user roles and permissions.

Additionally, Storage and Security ensure data integrity and application security. The system supports three primary user roles: Administrators, Instructors, and Students. Administrators manage user accounts, content, system configurations, and security settings. Instructors create and oversee learning materials, track student progress, communicate with learners, and manage classroom activities. Students access course content, submit assignments, take assessments, engage in discussions, and monitor their learning progress. This intelligent system enhances personalized learning experiences, fosters collaboration, and optimizes educational management.

4. Results and Discussion

The overall evaluation results of the Intelligent Learning Content Management System (AI-LMS) for undergraduate digital technology education include system expectations, system requirements, system suitability, and comparison of evaluation results by groups of stakeholders in the system, as follows

4.1. Evaluation Results of Expectation Data

The results of the analysis of user expectations in terms of the use and functionality of the Intelligent Learning Content Management System (AI-LMS) are detailed in Figure 3.

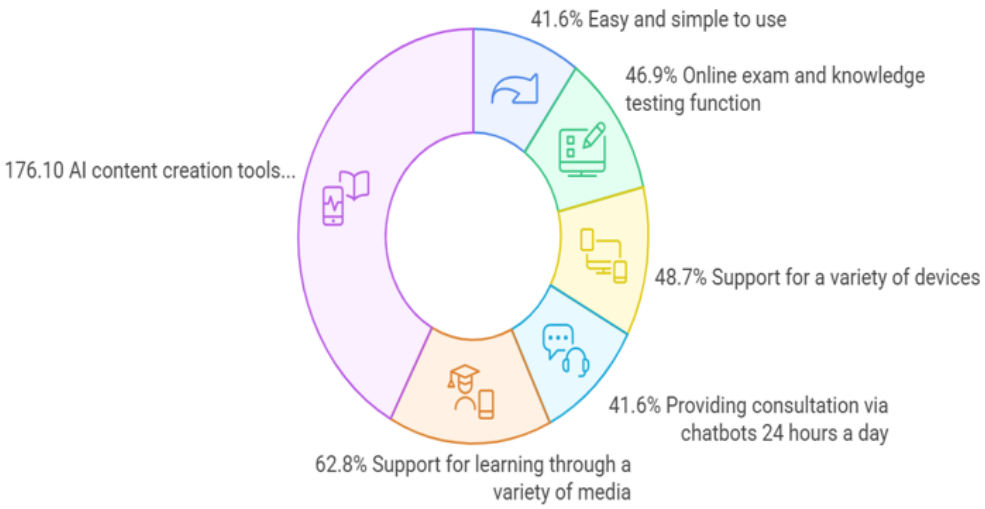

Figure 3.
User Expectations from Intelligent Lesson Content Management System.

The survey results of student system expectations in using the lesson content management system, focusing on the most expected features: ease of use (41.6%) and access to content anywhere, anytime (34.5%). The most important functions are online exams and knowledge tests, which received the highest interest (46.9%). Progress tracking and assignment notification functions are also important. It is also expected that the system will support use on a variety of devices (48.7%) and have 24-hour chatbot support to achieve maximum efficiency in teaching, as shown in Figure 3.

4.2. Results Of Evaluation of System User Needs

The results of data analysis indicate teachers' needs in using the intelligent content management system (AI-LMS), as detailed in Table 1.

Table 1.
Data indicates teachers' need for intelligent content management systems. (AI-LMS).

Evaluation list	$\bar{x}$	S.D	Interpretation
1. Intelligent Content Learning Management System AI-LMS	4.66	0.42	Most in demand
1.1 Content Management System	4.45	0.47	High demand
1.2 Content Recommendation System	4.59	0.52	Most in demand
1.3 Assessment System	4.73	0.38	Most in demand
1.4 Tracking and Analytics System	4.68	0.43	Most in demand
1.5 User Management System	4.73	0.40	Most in demand
1.6 Communication and Collaboration System	4.73	0.38	Most in demand
1.7 Integration System	4.73	0.40	Most in demand
2 User Interface	4.71	0.39	Most in demand
3 User	4.64	0.46	Most in demand
Total	4.66	0.46	Most in demand

The data analysis results show that teachers' needs in using smart content management systems for teaching digital technology, with an overall score of 4.66, which is the most in demand of system needs. Teachers gave high scores in various aspects of the system (4.55 - 4.82), reflecting the importance of the system, such as content management systems (CMS), content recommendation systems, assessment systems, learning behavior tracking and analysis systems, and API integration systems. The important assessment results are as follows: 1) Content management systems are important (4.64) and should be connected to other systems, such as CMS and tracking systems (4.18); 2) Content recommendation and assessment systems are necessary (4.55 - 4.82) to present information relevant to learners' interests and effectively track progress; and 3) The need for security and effective user management is at a level of (4.73), as shown in Table 1.

4.3. The System Evaluation Results Show the Appropriateness of Technology in Intelligent Content Management System. (AI-LMS)

To study the suitability of tools and techniques used in developing an intelligent lesson content management system (AI-LMS) from 20 experts as shown in Table 2.

Table 2.
The results of the evaluation of the suitability of the intelligent lesson content management system for undergraduate digital technology education (AI-LMS).

Evaluation list	$\bar{x}$	S. D	Interpretation
1. Intelligent Content Learning Management System AI-LMS			
1.1 Content Management System	4.69	0.43	Most suitable
1.2 Content Recommendation System	4.56	0.49	Most suitable
1.3 Assessment System	4.56	0.49	Most suitable
1.4 Tracking and Analytics System	4.64	0.46	Most suitable
1.5 User Management System	4.53	0.50	Most suitable
1.6 Communication and Collaboration System	4.56	0.49	Most suitable
1.7 Integration System	4.53	0.50	Most suitable
Total	4.58	0.49	Most suitable
2 User Interface			
2.1 Cloud Storage	4.58	0.49	Most suitable
2.2 Security	4.58	0.49	Most suitable
Total	4.58	0.49	Most suitable
3 User			
3.1 Administrators	4.67	0.44	Most suitable
3.2 Instructors	4.71	0.43	Most suitable
3.3 Students	4.63	0.48	Most suitable
Total	4.64	0.45	Most suitable

From Table 2, the results of the evaluation of the suitability of the intelligent lesson content management system for digital technology education at the undergraduate level (AI-LMS) show that the evaluation results by experts found that the evaluation of the suitability of the technology used to develop the system had an average score (Mean) from 4.58 to 4.67, which is considered high, with a standard deviation (S.D.) between 0.44 and 0.49. The results of the evaluation of the suitability of the techniques used to develop the AI-LMS system in many dimensions, such as the use of machine learning techniques, cloud platforms, and data management, each technique had an average score between 4.42 and 4.75, with a standard deviation between 0.38 and 0.50. The evaluation results show that experts believe that these techniques are appropriate and effective in developing the system at a high level.

4.4. Comparison of Evaluation Results by Groups of Stakeholders in the Intelligent Learning Content Management System (AI-LMS)

The results of the analysis of research data from relevant groups were divided into 3 groups: students, lecturers, and experts. The topics studied included user expectations, system requirements and suitability, and necessary characteristics, as detailed in Table 3.

Table 3.
A comparative study of the results of intelligent lesson content management systems for undergraduate digital technology education (AI-LMS)

Sample	Key Features/Functions	Expectation/Evaluation Data	Mean/Percentage (%)
Student Group	- Ease of use	- Highest Expected Functions	41.6%
	- Access content anytime, anywhere	- Ease of Use	34.5%
	- Online exams and knowledge tests	- Secondary Functions	46.9%
	- 24 hours chatbot support	- Access to Content Anywhere	41.9%
	- Multi-device support	- Most Interested Functions	48.7%
Teacher Group	- Content management system (CMS)	- Additional Functions to Enhance Teaching Efficiency	4.64 (Mean)
	- Content recommendation system	- Multi-Device Usability Expectations	4.18 (Mean)
	- Evaluation system	- CMS is of High Importance	4.55-4.82 (Mean)
	- Security and user management	- Functions That Should Be Connected to Other Systems, Such as Tracking Systems	4.73 (Mean)
Expert Group	- System suitability	- Assessment Functions Needed for Progress Tracking	4.58-4.67 (Mean)
	- Machine learning techniques	Security in Education Systems	4.42-4.75 (Mean)
	- Cloud platform usage	Assessment of the Objectives and Suitability of AI-LMS Systems	4.42-4.75 (Mean)

Relationship between the user groups of Intelligent Learning Management System (AI-LMS). Students and teachers agreed that the system should have a comprehensive content management system and easy-to-use functions. The average student score was 4.2-4.8 and the average teacher score was 4.5-4.9. Experts agreed that in terms of user interface, students gave an average score of 4.4 for access to information from anywhere, while teachers gave an average score of 4.6 for data security. In terms of users, there were administrators, teachers, and students. Students and teachers wanted a system with an easy and simple account creation process, with students giving an average score of 4.3-4.7 and teachers giving an average score of 4.6-4.9. Both students and teachers had specific needs for the system, especially in terms of content management and security. Access to information was an important factor for students, as shown in Table 3.

The summary data can be used as a guideline for developing a system that is consistent with the expectations, needs of users, and the appropriateness of the Intelligent Learning Management System (AI-LMS) that focuses on learners and teachers appropriately and efficiently.

5. Conclusion

From the study on the necessity of developing an intelligent lesson content management system (AI-LMS) for undergraduate digital technology education, this research provides a detailed analysis of user expectations and the essential technologies for an efficient platform. The proposed AI-LMS framework consists of several core components, including a Content Management System (CMS) that prioritizes accessibility and ease of use, receiving a high average preference score of 4.64. The Assessment System, which enables online evaluations and automated feedback, was rated at 4.73, emphasizing its role in enhancing learning efficiency. The Recommendation System, leveraging machine learning to provide personalized content suggestions, achieved a preference score of 4.59. Additionally, a strong Security and User Management framework, with an average rating of 4.73, ensures data protection and controlled access. Cloud-based storage and system integration further contribute to scalability and flexibility, with experts rating this feature at 4.58 for its role in maintaining a resilient learning environment.

In terms of user needs, students prioritized ease of access (41.6%) and interactive learning experiences, while instructors emphasized the importance of data-driven decision-making, streamlined content management, and integration with other educational tools. Experts validated the feasibility of AI-driven analytics, cloud platforms, and NLP-based automation, with ratings ranging from 4.42 to 4.75. Overall, this study highlights the significant potential of an AI-powered LMS in improving the efficiency of digital education and aligning with modern pedagogical demands. The findings serve as a strong foundation for future developments, including adaptive learning pathways, real-time analytics, and AI-driven automation, which will further optimize digital education methodologies.

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