Testing Platforms Augmented with Artificial Intelligence and Educational Templates

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Abstract. This paper reflects on the integration of artificial intelligence (AI) to enhance the analysis of students' assessments. Modern Learning Management Systems (LMS) possess optimal functionalities for administering assessments and analyzing the resulting data. However, technological advancements require augmentation of these basic LMS capabilities with AI. AI in this case can assist students in improving their performance after course completion and testing by offering detailed feedback on the list of mistakes and providing concise suggestions to avoid similar issues in the future. Furthermore, if a student struggles to answer a test's question, the AI assistant can offer brief advice without directly providing the answer to it, which alongside improves assessment outcomes without student's attention and engagement being diminished. The implementation of AI in such systems requires the development of templates to guide for creation of such systems, ensuring they operate effectively and aid other developers in planning assessment-related systems. This research focuses on an application specifically developed for the Lyubotynsky Professional Lyceum of Rail Transport, specifically designed to test students and assist teachers in the assessment process. The application, accessible via the internet, is a web-based platform that has a server for assessment logic and a database for data storage. This paper focuses on the integration of artificial intelligence (AI) tools into the educational process, deliberately omitting the technical implementation details of specific features, as they are deemed irrelevant to the current research. The author provides a comprehensive overview of potential future directions for further scientific investigation in this domain.

Keywords: Education · Artificial Intelligence · Educational Patterns · Digitalization · Professional Education · Student Teacher Interaction · Educational Process Optimization

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1 Problem Statement

Assessment is a highly effective tool for student performance evaluation, and most systems currently incorporate static analysis of assessment results, whether for large groups of students or individual participants. The system described in this paper presents various visual perspectives in regards to the potential representations of testing results. However, this static analysis solely presents raw data pertaining to the overall performance during the test [1].

AI could serve as a valuable assistant for both educators and students, it facilitates results analysis and offers constructive advice to enhance performance. The typical approach in interaction with LMS entails utilizing it primarily as a basic repository for storing data accessible to both instructors and learners. When a student acquires information and engages in a task, the teacher subsequently assesses the student's task performance. The straightforward management of these use cases entails both students and educators performing similar tasks over an extended period, culminating in the provision of a summary at the conclusion of a course.

Current utilization of generative AI has become prevalent in addressing routine tasks, providing responses to commonplace inquiries. However, within the realm of education and assessment, this functionality falls short, as mere retrieval of standard answers fails to facilitate comprehensive understanding. Contemporary discourse underscores the significance of comprehension, rooted in profound knowledge acquisition, which in turn, stems from reflective processes. Consequently, there arises the potential to construct a system tailored to let individuals analyze their own outcomes through a personalized treatment, improved by AI integration. Nevertheless, the integration of AI into LMS poses challenges due to the absence of standardized guidelines [2]. Despite the array of feasible approaches to implementation, adherence to established norms remains uncertain. This paper endeavors to advocate for the development of educational frameworks for AI integration within LMS, exemplified through the creation of a cost-effective experimental system.

2 Analysis of Recent Research and Publications

One of the primary challenges in implementing Learning Management Systems (LMS) with augmented AI capabilities stems from a software development perspective, closely tied to existing operational systems [3]. These systems offer a wide spectrum of features that enhance performance and user experience. Notably, Moodle is extensively utilized within the Ukrainian educational system, characterized by its diverse array of typical LMS patterns and its foundation on the Apache2 PHP web server with data stored in a MySQL database [4]. Moodle facilitates task management, assessment, and result monitoring for both teachers and students [5]. However, its integration with AI necessitates additional third-party module integration [6], which involves the development of plugins that require comprehensive knowledge of the Moodle system and its implementation. While this approach offers flexible system extensibility, it demands additional software development expertise and support [7].

As it is common in software evolution, novel challenges continually arise, prompting numerous businesses to pursue the goal of integrating AI capabilities with LMS behavior. However, the proliferation of such new software solutions imposes an additional cognitive burden on students and teachers. Consequently, societal practices often advocate for common patterns, considered best practices to implement such systems, derived from the collective experience of previously developed systems. Noteworthy examples include EDUBOT [8], designed to enhance individual learning experiences through personalized chat-GPT-like interactions. Despite its optimization and user-friendliness, EDUBOT lacks comprehensive analysis and specialization, rendering it less suitable for educational purposes. Similarly, ChatGPT [9], another widely recognized AI-powered chatbot application, offers extensive features but lacks a personalized approach and may not possess the specific knowledge required for educational tasks, often relying heavily on user-provided context.

Various approaches exist for enhancing the educational process with modern technologies, such as integration of Augmented Reality (AR) and Virtual Reality (VR), albeit requiring specialized equipment and resources [10]. While Sharma and Dash emphasize the importance of integration for such methods with existing LMS approaches, their applicability remains specific rather than universal. This paper aims to elucidate the most convenient and effective method to implement such systems, with an example of the Lyubotynsky Professional Lyceum of Rail Transport assessment project.

In a highly digitalized educational landscape governed by rules and recommendations for effective implementation [11], the rising prominence of AI cannot be overlooked. Thus, this paper seeks to establish guidelines and a structural framework for integrating AI into the educational process, introducing the concept of "Educational templates" for AI-driven LMS.

3 Statement of Basic Material and the Substantiation of the Obtained Results

The development of a new educational tool, particularly a LMS, presents considerable challenges. Although most management and assessment features can be implemented similarly to analogues that exist, the primary challenge lies in integration of AI into such a system. Ensuring that the system is sufficiently extensible to remain relevant for many years into the future is a crucial issue. This paper details the implementation of a system for the Lyubotynsky Professional Lyceum of Rail Transport, utilizing technologies specifically tailored to the stakeholders' requirements. To ensure the system functions effectively and supports extensive operations with large volumes of textual data, the most recent available technologies were used. The system is constructed as a web-based application that performs HTTP requests to a Node.js-based web server, with data stored on a MongoDB database server. This technology stack offers an extensible and practical approach, facilitating efficient development and convenient usage through access to comprehensive documentation. The primary focus of the project described in this paper is its users, and consequently, Material Design has been adopted as the best practice for the implementation of the user interface. LMS architecture is implemented as a client-server web-based application with a database that stores user-relevant

data. To incorporate AI functionality into this project, the GPT4ALL API is utilized to generate precise responses within predefined contexts [12]. This approach enables the integration of a well-tested, current technology with an LMS built on widely recognized methodologies [13].

The implementation of a custom LMS for the Lyubotynsky Professional Lyceum of Rail Transport is tailored to meet specific needs, particularly concerning the requirements for an assessment system. The primary objective of developing this system is to furnish students with proper feedback and provide teachers with comprehensive information on student testing results. The system includes a registration form (see Fig. 1), where users input their basic registration information to create an account.

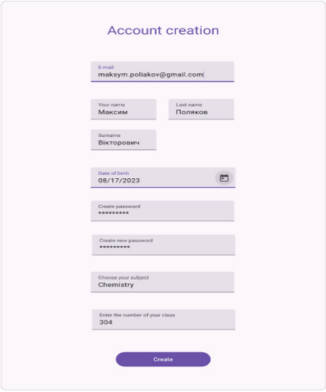

Fig. 1. Registration screen with user data.

Once the account is created, the user can successfully log in using a combination of login credentials and a password (see Fig. 2). The authentication feature is implemented using OAuth 2.0, which follows the general recommendations outlined in RFC 6750 [14]. OAuth provides a secure, standardized, and user-friendly method to handle authorization, that makes it an essential protocol for modern applications that need interaction with external services while ensuring the protection of user data and enhancing the overall user experience.

Upon logging in, the user is directed to the home page (see Fig. 3) of the system. This home page displays a list of assigned tasks, which primarily consist of assessments that the user must complete to receive a grade.

Subsequently, the student can select one of the assessments and focus on completing the test (see Fig. 4). On this screen, the student can open or close a dialog with a context-specific bot that provides explanations for the questions. This approach reduces the need for examiners or teachers to explain every detail about each question to the class, as the bot maintains comprehensive information on the topic. If the bot encounters information beyond its knowledge base, it responds with the universal prompt, “Ask a teacher,” indicating that certain queries can only be resolved with the teacher’s assistance. Upon completing a test, the user receives a result, which is accessible on the result

page (see Fig. 5). The test page result incorporates AI-enhanced responses and recommendations that clarifies why answers were incorrect and suggests relevant literature to address knowledge gaps. These five screens encompass the core functionality pertinent to assessment, while the remaining features of the system predominantly pertain to user profiles and basic management components, which are currently extraneous to the scope of this paper.

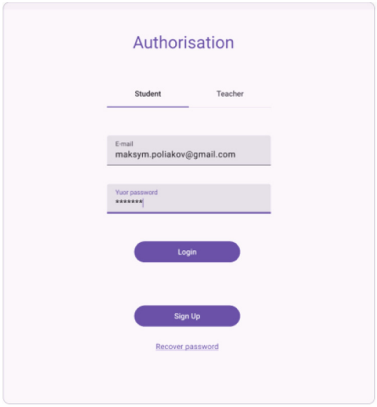

Fig. 2 Login form with user email and password fields

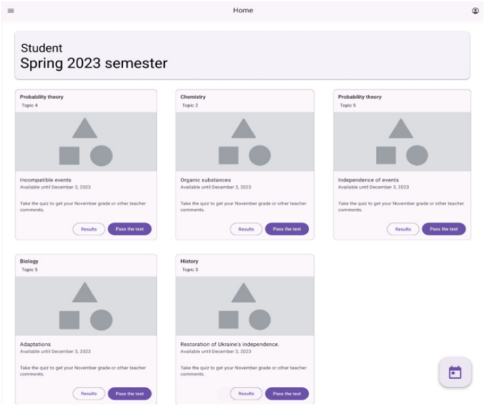

Fig. 3. Home page that represents basic LMS page with student tasks and assessment activities

Currently implemented features epitomize the AI templates for education previously discussed. These proposed patterns delineate the role of AI in education, particularly in the era of digitalization, where leveraging all pertinent tools and available mechanisms is imperative for achieving effective outcomes. However, the integration of these tools and technologies can at times be complex, which leads to subsequent challenges as individuals familiarize themselves with contemporary solutions only to transition to newer iterations over time [15]. This evolution engenders confusion as users acclimate to specific system behaviors that subsequently alter due to system upgrades or the integration of new technologies into the educational framework. Consequently, this presents inconvenience for educators and imposes an additional burden on the educational system to furnish more learning materials and courses elucidating the utilization of these novel tools. The initial pattern employed is the “Assistant pattern” characterized by an AI-based chatbot designed to address topic-specific inquiries and provide explanations for each question within the current test. Rather than simply providing direct answers, this assistant aids in resolving comprehension issues pertaining to the questions themselves. By prompting students to engage more actively with the system, this pattern stimulates recollection of pertinent material and encourages deeper contemplation, fostering a more profound understanding. Through the provision of tailored information and behaviors, the AI effectively transforms student confusion into comprehension, facilitating a comprehensive grasp of the subject matter [16].

The second pattern employed is “The Hint” which enables students to discern the source of a question, thereby enhancing its relevance. This approach facilitates students’

recognition of the question's association with a specific topic, preempting potential confusion.

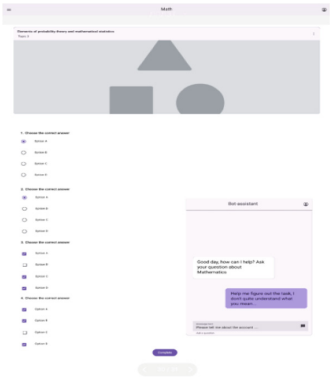

Fig. 4. Test page where user selects answers and asks questions topic AI powered chat

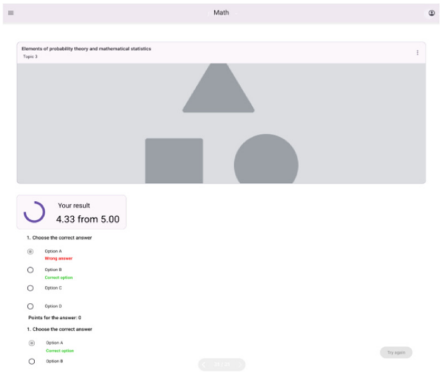

Fig. 5. Test results with comments provided by the AI

In conventional assessments, queries may pertain to multiple analogous topics, potentially perplexing respondents. Typically, individuals seek clarification from examiners, educators, or test organizers; however, in this scenario, AI automation enables individuals to direct their thought processes within the appropriate context. The third pattern enables students to access common explanations regarding their errors during the result stage, along with advice on areas of study to address knowledge gaps. In instances where questions are answered correctly, the hint will confirm the accuracy of the response. Given the common practice of conducting retrospectives, this AI-enhanced functionality streamlines this process. In summary, the system integrates cutting-edge technologies and features an intuitive user interface modeled after established analogs in the market. With technology advancing rapidly, the system is poised to evolve in the near future. Initial feedback from beta testing indicates widespread acceptance of the approach, suggesting its potential to become a foundational methodology for future system implementations. This study aimed to evaluate the effectiveness of a newly developed AI-assisted educational system implemented at the Lyubotyn Professional Lyceum of Rail Transport. The system was designed to assist in monitoring and assessment procedures for the discipline "Construction and Operation of Passenger Carriages."

The experiment took place in the spring semester of 2024, testing whether an AI-assisted educational system improves the assessment process's convenience and efficiency compared to traditional methods. The independent variable was the AI-assisted system, while the dependent variables were students' perceptions of convenience and simplicity, teachers' perceptions of efficiency and effectiveness, and students' performance. Participants included 46 students and 12 teachers, divided into an experimental group (using the AI-assisted system) and a control group (using traditional methods). Random assignment ensured differences could be attributed to the independent variable. The experiment had three phases: pre-test, implementation, and post-test. Pre-Test Phase:

Both groups took a pre-test to establish baseline performance and perceptions. Implementation Phase: The experimental group used the AI system to answer 60 questions on "Construction and Operation of Passenger Carriages," while the control group used traditional methods. Students in the experimental group could ask a bot for additional information and hints, whereas the control group received standard teacher support. Post-Test Phase: Both groups took a post-test to measure changes in performance and perceptions. Students' perceptions were measured through surveys on the AI system's usability, hint helpfulness, and any concerns. Teachers' perceptions were also surveyed, focusing on time saved, ease of managing assessments, and perceived student performance impact. Students' performance was measured by comparing pre-test and post-test scores. Statistical tests, such as t-tests, compared pre-test and post-test scores between groups. Survey responses were analyzed for significant differences in perceptions, and qualitative analysis of open-ended responses provided insights and improvement suggestions. Most students in the experimental group (87%) found the AI system convenient and easy to use, with 78% appreciating the bot's hints. However, 14 students had concerns about potential negative impacts on their scores. Teachers reported a substantial reduction in time required for administering and grading assessments.

4 Conclusions

In this era of rising Artificial Intelligence, it is imperative to remain stable in the fundamental spirit of education. The integration of AI stands as a pivotal stride within the educational paradigm, augmenting rather than diminishing efficiency. However, there exists a potential for misapprehension among technology users regarding their intended utility, precipitating costly errors in resource allocation and time management. To mitigate such missteps, standardization or the delineation of rules is customary, offering a symbolic framework of patterns to guide scientists and developers in crafting AI-driven LMS and other educational software. This initiative heralds a novel avenue for research, aimed at expanding the repertoire of these educational patterns and bolstering the overarching perception of AI within the educational domain.

Preliminary beta testing conducted at the Lyubotynsky Professional Lyceum of Rail Transport elicited positive feedback from both attendees and organizers, who lauded the program's clarity and convenience. Educators offered insights into the system's functionality, highlighting its pros and cons. Foremost among the system's advantages is its comprehensive integration of familiar LMS features, coupled with an intuitive user experience, a critical consideration for stakeholders. Human nature inherently craves feedback, especially within the realm of academic pursuits, where assessment serves as a cornerstone experience. However, educators often grapple with time constraints, precluding the provision of comprehensive individualized feedback within traditional classroom settings. Herein lies the promise of AI, poised to revolutionize personalized assessment methodologies, leveraging its formidable capabilities transcending conventional LMS and assessment practices. Each educational tool bears its own set of advantages and drawbacks, yet the pursuit of continuous refinement and evolution remains viable. However, this evolution necessitates normalization through the implementation of rules, standardized patterns, and best practices, fostering an effective yet uncomplicated educational milieu.

In conducting the research and preparing this article, we have laid down the concepts and approaches that have been formed and implemented at UEPA as part of the Erasmus + project ERASMUS-EDU-2022-CBHE: CRED4TEACH - MOOC-based micro-credentials for teacher professional development (CRED4TEACH).

References

1. Bondarenko, T., Kupriyanov, O.: Implementation of mobile testing system for control of students' educational outcomes. In: Auer, M., Guralnick, D., Simonics, I. (eds.) Teaching and Learning in a Digital World. ICL 2017. Advances in Intelligent Systems and Computing, vol. 715, pp. 760–765. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-73210-7_88
2. Iqbal, S., Qureshi, I.A.: Learning management systems (LMS): inside matters. Inf. Manage. Bus. Rev. **3**(4), 206–216 (2011). http://bit.ly/3XovioP
3. Muhammad, A., Muhammad, Y., Ghulam, B.: Artificial intelligence in learning management system: a case study of the students of mass communication. Voyage J. Educ. Stud. (VJES) **3**(2) (2023). https://bit.ly/3Voc1lE
4. Lengyel, P., Herdon, M.: E-Learning course development in Moodle. In: Proceeding of the International Conference BIOATLAS (2008). https://bit.ly/3VsHiEo
5. Christopher, M.: Learning management systems (LMS) towards helping teachers and students in the pursuit of their E-learning methodologies (2021)
6. Aldahwan, N.S., Alsaeed, N.I.: Use of artificial intelligent in learning management system (LMS): a systematic literature review. Int. J. Comput. Appl. **175**(13) (2020). https://bit.ly/3WZAE9I
7. Kovalenko, D., Bondarenko, T.: Cloud monitoring of students' educational outcomes on basis of use of BYOD concept. In: Auer, M., Guralnick, D., Simonics, I. (eds.) Teaching and Learning in a Digital World. ICL 2017. Advances in Intelligent Systems and Computing, vol. 715, pp. 766–773. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-73210-7_89
8. Lakshmi, G., Brindha, S., Revanya Devi, M., Divya, J., Shobhanali, N.: AI-powered digital classroom. In: International Conference on Communication, Computing and Internet of Things (2022). https://bit.ly/3X0LH2p
9. Chat GPT and education (2023). https://bit.ly/4aESS3q
10. Dash, B.: AI and VR enabled modern LMS for students with special needs. J. Foreign Lang. Educ. Technol. **8**(1) (2023). https://bit.ly/4e7Xdio
11. Arisoy, B.: Digitalization in education. Cypriot J. Educ. Sci. **17**(5), 1799–1811 (2022). https://bit.ly/4dXaZEy. Accessed 02 Jun 2024
12. Anand, Y., Nussbaum, Z., Duderstadt, B., Schmidt, B.: GPT4ALL API (2023). https://docs.gpt4all.io/gpt4all_nodejs.html
13. Andersson, T.: Learning management systems (2019). https://bit.ly/4aNm9J8
14. Jones, M.: OAuth 2.0 IETF. https://datatracker.ietf.org/doc/html/rfc6750
15. Kovalenko, O.E., Cardoso, L.M., Kupriyanov, O., Bondarenko, T.S.: Online education and monitoring of quality indicators of e-learning use. In: IOP Conference Series: Materials Science and Engineering, Volume 1031, International Conference on Technics, Technologies and Education 2020 (ICTTE 2020), Yambol, Bulgaria, 4th–6th November 2020. https://doi.org/10.1088/1757-899X/1031/1/012118
16. Entwistle, N.: Student learning, understanding, and implications for teaching. In: Student Learning and Academic Understanding, pp.237–268 (2018). https://bit.ly/4bXtN4E