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Development of Learning Management System with Gamification Approach for Project-Based Learning

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Abstract

This study focuses on the development of the Learning Management System for Innovation in Graphic and Visual Media with a gamification approach in the context of teaching the Graphic and Visual Media Innovation course. Currently, learning management utilizes the SIPEJAR Learning Management System (LMS) and the Progress Report Card (PRC), but their separate existence poses challenges to efficiency and effectiveness. Students are required to monitor their own learning resources and track their learning performance through the PRC. The optimal learning environment would be one in which all learning resources and progress are accessible in a single, integrated platform, allowing for convenient access from any location at any time. The objective of this research is to develop a Learning Management System (LMS) that incorporates gamification elements into project-based learning. Research design employed is Research and Development (RnD), adopting the Web-Based Instructional Design model. The sample for this research is composed of 134 students. The research was conducted between October and December. The data collected for this study is quantitative data obtained using the Technology Acceptance Model questionnaire and the level of student engagement in the learning process. The result is that students perceive the IMGV LMS as a beneficial addition to their learning experience. The LMS enables students to monitor their performance in the final course project and access assignment materials in a centralized location. Additionally, the LMS facilitates knowledge acquisition through the incorporation of quizzes, which are designed to engage students in a competitive learning environment.

Keywords: *Learning Management System; Gamification; Project Based Learning; Students Engagement; Higher Education*

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INTRODUCTION

Project-Based Learning (PjBL) is a student-centered form of learning based on three constructivist principles: contextual learning, active student engagement in the learning process, and the achievement of goals through social interaction and the sharing of knowledge and understanding (Cocco, 2006; Soepriyanto, Azzahra Fazarini, et al., 2022). The course "Graphic and Visual Media Innovation (2D & 3D)" is a learning course that applies Science, Technology, Engineering, and Mathematics (STEM). The Learning Environment in this course facilitates the learners to learn in the context of Graphic and Visual Media by developing, using, evaluating, and managing Graphic and Visual Media. To achieve the learning objectives, the "Graphic and Visual Media Innovation (2D & 3D)" course employs Project-Based Learning (PjBL) as its learning model.

To enhance motivation and student engagement in the development process of the final product for the Graphic and Visual Media Innovation (2D & 3D) courses, gamification activities are implemented throughout the lectures. With the implementation of gamification activities in project-based learning, students show a deeper interest in the learning process (Khuluq et al., 2023; Soepriyanto & Kuswandi, 2021). Gamification is implemented by incorporating game elements into a non-game context (Deterding et al., 2011), such as the learning process (Papadakis & Kalogiannakis, 2018) in the "Graphic and Visual Media Innovation" course. Incorporating game elements enhances the enjoyment and depth of the learning experience, fostering motivation and active engagement among learners (Putra & Soepriyanto, 2022; Zhang & Fang, 2019).

In the management of learning, the "Graphic and Visual Media Innovation" course utilizes two parallel systems: the SIPEJAR LMS and the progress report card. Both systems are used side by side by the course instructors and students for learning purposes. SIPEJAR is a web-based Learning Management System (LMS) developed by Universitas Negeri Malang (Adi et al., 2024; Soepriyanto et al., 2021). SIPEJAR serves as a tool for managing learning resources, students, and project tasks. Meanwhile, the Progress Report Card (PRC) is used as a record of student performance in developing course products, doubling as a medium for implementing gamification activities such as badges, time constraints, and avatars. The PRC takes the form of a table containing information on progress or product development performance printed on colored buffalo paper.

From this phenomenon, redundancy in learning management tools is observed, i.e., the use of SIPEJAR and PRC. Each tool operates independently without any connection between them. Historically, SIPEJAR has been employed for online learning activities, functioning both as a repository and a platform for applying common models or strategies (Adi et al., 2024; Soepriyanto et al., 2021). SIPEJAR includes inherent features that can be correlated with game elements, such as Course, Badge, Point, and Progress (Soepriyanto et al., 2021). Despite having these built-in features suitable for gamification, SIPEJAR doesn't explicitly showcase gamification activities (Adi et al., 2024). Moreover, its stringent access permissions and complete learning control overseen by instructors make it incapable of adapting to learners with diverse learning speeds and abilities. Moreover, the use of the PRC requires economic efforts, which is regrettable as it becomes an additional burden for students taking the "Graphic and Visual Media Innovation" course. Gamification activities and the learning flow do not occur on SIPEJAR, which functions as a learning management system.

The coexistence of these two disparate systems gives rise to challenges in the student learning experience. Students are required to monitor their own learning resources and track their learning performance through the PRC. The optimal learning environment would be one in which all learning resources and progress are accessible in a single, integrated platform, allowing for convenient access from any location at any time. In such a system, students would no longer need to pay for the purchase of PRC in the event of damage, nor would they need to worry about feeling lost. Students are no longer required to utilize two distinct systems for the purposes of learning the requisite material and monitoring their learning performance in the course. To address this issue, there is a need for a Learning Management System specifically designed for project-based learning with gamification activities. In previous research, the application of gamification has been widely conducted, utilizing elements such as points, achievements, leaderboards, and levels (Bernik et al., 2017; Handayani et al., 2021; Kristiadi & Mustofa, 2017; Limantara et al., 2020; Sanova, 2018, p. 3) The existence of an LMS specifically designed for gamification facilitates the management and supervision processes and involves students in the learning process. The objective of this research is to develop a Learning Management System (LMS) that incorporates gamification elements into project-based learning.

METHODS

The research design to develop the Learning Management System is Research and Development (RnD) using Web-Based Instructional Design development model (Davidson-Shivers et al., 2018). This model was chosen specifically for its process that tailored to web-based learning development. The Learning Management System (LMS) is also a form of online learning technology categorized under Fully Online Instruction (Davidson-Shivers et al., 2018; Wahyuni et al., 2024). The sample for this research is composed of all students enrolled in Graphic and Visual Media Innovation courses, for a total of 134 students. The research was conducted over the course of eight lecture meetings between October and December. The data collected for this study is quantitative data obtained using the Technology Acceptance Model questionnaire and the level of student engagement in the learning process. In addition to the quantitative data, product validation data are also collected to assess the feasibility of the LMS product prior to its implementation.

In the Analysis stage, there are four target analysis aspects: (1) learning flow, (2) user targets, (3) content and learning resources, and (4) specifications of the developed product. The target users for this development are students taking the Graphic and Visual Media Innovation (2D & 3D) course, totaling 133 students.

In the Evaluation Planning stage, in-depth evaluation planning is conducted on how the product will be developed and the parties involved in the development process. Aspects evaluated in the IMGV LMS include: (1) the accuracy of the LMS with the learning flow, (2) the accuracy of the material on the LMS with the course topic, (3) the ease and usefulness of the LMS for users in conducting the course. Evaluation is conducted over 4 months from the analysis stage to product evaluation. The validation questionnaire is developed by adopting from previous research by (Davis, 1985; Purwodani, 2018; Sukardi, 2015).

Following the analysis and evaluation planning, the process continues with the concurrent design stage. In this stage, the design, development, and evaluation processes are integrated and interconnected, forming a series of activities. Once all designs are determined, development can proceed based on the approved design or blueprint. In this stage, the framework of the application owned by (Nugroho & Ubaiddillah, 2023) is used as the foundation for development. The use of the application framework aims to expedite the development process and minimize technical infrastructure errors.

Formative evaluation is conducted by experts to validate the LMS based on predefined aspects in the evaluation planning. The product is tested by experts to assess the product's feasibility. This assessment is carried out by competent experts in the field to be validated. The experts are Doctoral that have capabilities and research field in Learning Management System, Gamification and Online Learning. They will validate the LMS products according to criteria and aspects that have been determined in the evaluation planning stage.

After the product has undergone a series of major revisions based on the results of the Formative Evaluation and Limited Implementation stages, the LMS product will be fully implemented in the learning process (Gagné, 2005). In this stage, the process of facilitating learning and maintaining the product occurs simultaneously and is the focus of the full implementation phase (Davidson-Shivers et al., 2018; Sallu et al., 2023).

RESULTS & DISCUSSION

After understanding the development goals and background, the learning flow

becomes the main guide for the development process. From the analysis of the existing learning flow, it is found that the LMS requires a design that can accommodate gamification elements, including avatars, leaderboards, badges, points, content unlocking, and stages. LMS development is carried out using project-based learning syntax as the main instructional design flow. Meanwhile, gamification activities use a circular flow. The circular flow occurs at each stage of the course of product development. The circular flow is chosen to provide a consistent yet progressively challenging experience (Zichermann & Cunningham, 2011) as learners' abilities improve. The gamification design framework used in this LMS development adopts the engagement framework for gamified online learning by (Alsubhi et al., 2021). In this framework, there is alignment between LMS components and gamification elements.

Following the development stages, a product in the form of a Learning Management System with a gamification approach for project-based learning has been created. The developed product is functional and can be utilized by both students and instructors in the IMGV 3D course. For a more detailed specification of the development results, refer to Table 1.

Table 1. Product Specification

Criteria	Description
Product Name	Learning Management System IMGV 3D
Brand Name	LMS IMGV 3D
Product Type	Learning Management System
Domain	https://imgv.my.id
Learning Material	Development of 3D Animation-based Learning Media
Learning Syntax	1. Project Based Learning 2. Gamification
Framework	Educational Technology Exhibition 1.0 by (Nugroho & Ubaiddillah, 2023)
Programming Language	Typescript
Hosting	Google Cloud Indonesia
Platform	Adaptive Website (Smartphone & Desktop)

The features available for LMS users are as in Table 2.

Table 2. Finished Product Features

Feature	Description
Authentication	Users can log in using their UM (Universitas Negeri Malang) SSO account (UM email)
Dashboard	The dashboard provides brief information on student progress and accessible materials based on learning achievements
Update Profile	Users can update their name, student ID, and WhatsApp number
Update Product	Students can upload information about the products they will develop in the course
View Material	Students can view a collection of materials in the form of videos according to their learning achievements
View Grade Summary	Students can view a summary of grades obtained based on completed activities
Take Quiz	Students can take quizzes on each material topic
Take Survey	Students can provide feedback and suggestions on their learning process through the LMS
View Leaderboard	Users can view rankings and positions in the class based on their learning achievements

View Confessions	Users can give confessions or anonymous public messages
Add Grade	Lecturers can assess student performance in completing products through the LMS
Update Progress	Lecturers can modify student performance progress through the LMS
View Student Progress	Lecturers can view overall student progress, both in-depth and general

The usage flow of the Learning Management System is created in accordance with adopting a project-based learning syntax. The selection of this flow is tailored to the needs of the Graphic and Visual Media Innovation course, which focuses on the development of products undertaken by students. The role of the Learning Management System is used to manage student activities in developing products along with the supervision process carried out by the course instructor. The learning flow managed through the LMS is as in Figure 1.

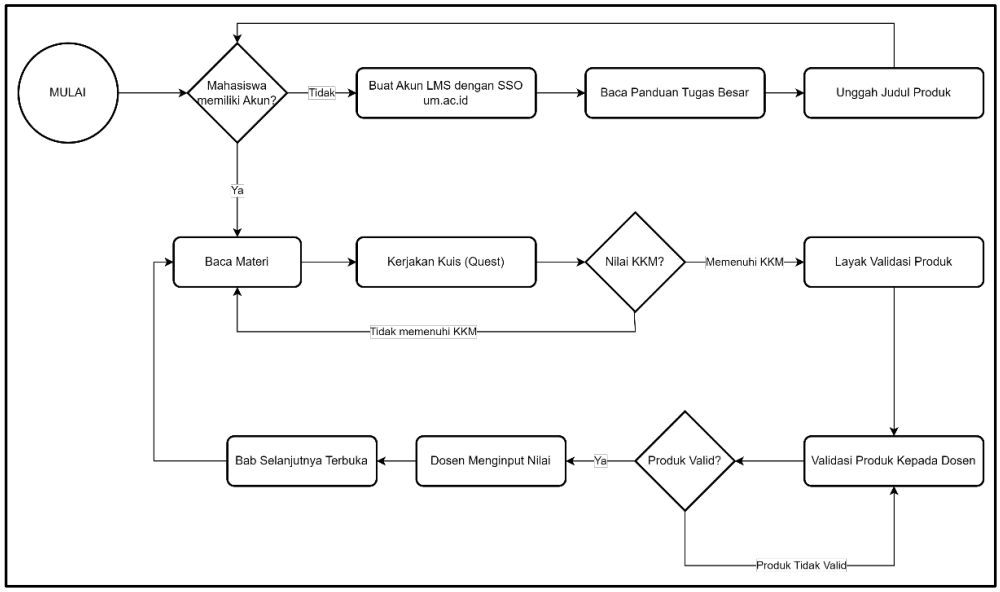

Figure 1. LMS IMGV Learning Experience Flow Chart

Students accessing the LMS for the first time will be prompted to fill in their student profile. After completing the profile, students will be allowed to read the guidelines for the major assignment in the course. Access to submit the product concept for the course will simultaneously open after students update their profiles. Access to materials and development stages will be available after students upload their product concepts to the LMS. For each learning topic, there is a quiz that must be completed by students as a requirement for validating the product with the course instructor. Grades and access to the next chapters will automatically open based on the product's grade input process by the course instructor.

The development period for the course product extends from the 9th meeting to the 15th meeting. Students are encouraged to undertake the development of the course product at their own pace and ability. To ensure continuous engagement in the learning process, gamification activities are implemented through the LMS, and learning rules serve as external stimuli. In the project-based learning syntax proposed by (Arends, 2012), the problem orientation process in the IMGV course occurs before the release of the LMS. The separate problem orientation process, distinct from the LMS, is intended to provide students with a knowledge framework about what will be developed and its philosophical foundation. After the problem orientation process is provided by the course instructor, the

organization for project planning is carried out independently by students through the LMS, following the given rules. In the supervision and development stages of the course project, continuous monitoring is conducted by both the instructor and students. Formative evaluations are briefly performed at each development stage to ensure that the product being developed is the result of each student's work. In the final stage of the project-based learning syntax, a summative evaluation is conducted through product validation in the final development stage, performed by the course instructor.

In the framework presented by (Alsubhi et al., 2021), gamification elements can be aligned with components in the Learning Management System. In this section, the brief implementation of game elements in the IMGV LMS is explained. For clarity, it is detailed in the following Table 3.

Table 3. Alignment of gamification elements with the LMS IMGV components

Game Element	LMS Components	Description
Point	Performance Score Accumulation	The scores obtained by students become points to determine their ranking on the leaderboard.
Levels	Learning Topics	Learning topics relate to different conditions and status of the spellings of the developed products. They contain different materials and quiz questions.
Badges	Badges / Stars	Stars and badges are given when students complete specific activities in the learning process (fastest and expertise).
Leaderboard	Ranking	The leaderboard provides an overview of student rankings against others in the class based on accumulated points.
Dashboard	Dashboard	The dashboard page provides an overview and quick information on the progress and status of students in the learning process.
Avatar	Student Profile	The student profile is the identity present on the LMS to provide a unique and personal impression from both the leaderboard and grade summary perspectives.
Content Unlocking	Learning Topics	Each learning topic can only be accessed by students if they have completed all activities in the previous topic.
Quest	Quiz, Validation, Survey	Quest is an activity that students can do and is a requirement to progress to the next topic. Each activity undertaken will be rewarded with points.
Timer	Development Contract	The development contract acts as a time limit that can affect a student's points according to their development performance.

Through the alignment process using the gamification framework for online learning by (Alsubhi et al., 2021), all game elements have been fully met in the IMGV LMS, including an additional element, Quest. Based on the research conducted by (Alsubhi et al., 2020, 2021), there has been no study using the Quest element in online learning. Essentially, a quest is an activity or process carried out to find out something, and the alignment of the quest with quizzes and product validation is because students are instructed to find answers and develop products in accordance with the course guidelines.

Upon examination through the framework developed by (Toda, Klock, et al., 2019), LMS IMGV tends to focus on the performance and social dimensions. Both

dimensions are evidenced by the elements applied to the LMS, including levels, points, stats, progression, reputation, competition, and social pressure. The social dimension is related to interactions among learners in the environment. Elements in this dimension include Competition, Collaboration, Reputation, and Social Pressure. The lack of social elements can isolate learners because they won't be able to interact with other students (Toda, Klock, et al., 2019). On the performance dimension, elements are associated with responses to learners, which can be used to provide feedback. This dimension includes Points, Progress, Level, and Statistics. The absence of this dimension can lead learners to feel confused and unmotivated because their learning activities and achievements lack feedback or any impact on themselves (Toda et al., 2017; Toda, Klock, et al., 2019; Toda, Oliveira, et al., 2019).

The implementation of gamification elements in a Learning Management System is not a new aspect in research (Alsubhi et al., 2020). This is evident from the numerous studies investigating the effects and impacts of implementing game elements in LMS. Alsubhi et al., (2021) captures the trend of implementing game elements in LMS and develops a framework that can serve as a guide for implementing these elements in LMS. Based on the development results, the implementation of gamification elements in LMS using the framework developed by Alsubhi et al., (2021) yields the result that all the offered elements can be implemented in IMGV LMS along with its learning scenarios.

Media validation is conducted by validating four aspects: (1) visual communication design, (2) software engineering, (3) content & learning, and (4) sustainability and usability. From the feedback provided by the validator, all aspects receive valid results. The validator concludes that the media is suitable for use in the learning process without the need for further revisions. Meanwhile, material validation is conducted by validating four aspects: (1) material relevance, (2) material organization, (3) evaluation/exercise questions, and (4) language. From the feedback provided by the validator, all aspects receive valid results. The validator concludes that the material is suitable for use in the learning process without the need for further revisions.

During the full implementation process, students were required to fill out the "LMS Acceptance" questionnaire, which served as a tool for collecting student responses regarding the usefulness and ease of use of the LMS in the Innovation of 3D Graphic and Visual Media course. The student response data is outlined as in Table 4.

Table 4. Tabulation of student acceptance data towards LMS IMGV.

	Aspect	Mean	Median	Mode
N	Usefulness	15	15	15
	Ease of Use	15	15	15
Mean	Usefulness	5.48	5.73	6.13
	Ease of Use	4.38	4.50	4.27
Median	Usefulness	5.57	6.00	6
	Ease of Use	3.98	4.00	4
Mode	Usefulness	5.52	6.00	6.00
	Ease of Use	5.68	6.00	2.00

From the tabulated data, considering the averages obtained for both tested aspects, very few students provided negative responses. However, in the usefulness aspect,

statements with codes U01 and U09 have lower values compared to other statements. These two statements state, "Validating the product will be difficult without using LMS IMGV" and "Using LMS IMGV reduces the time I spend on unproductive activities," respectively. Different responses to these two statements are reasonable because LMS IMGV is not designed to assist students in the product validation process and is not used to regulate students' study hours on project work.

In terms of ease of use, some students gave negative responses, with the highest negative response indicated in statement codes EOU09 and EOU05. These statements state, "When using LMS IMGV, I need to put in a lot of effort and thought" and "LMS IMGV often behaves unpredictably (error/hang)." The high negative responses to these statements are reasonable and were anticipated during the development stage. Errors in the LMS application can occur due to various factors such as internet connectivity, incompatible devices, and technical issues beyond the scope of the study. These errors provide a negative experience for students. However, overall, students feel the ease of use of LMS IMGV, as seen from the generally positive responses ranging from 4 to 6 in the questionnaire.

From the full implementation test results in terms of usefulness and ease of use, LMS IMGV received positive responses from the students involved in the trial. This indicates that the development of LMS IMGV provides convenience and benefits for students in the Innovation of 3D Graphic and Visual Media course. The findings align with those of previous research conducted by (Citra Kurniawan et al., 2022; Muslim et al., 2022) using the Technology Acceptance Model framework. This research demonstrated that the model can be effectively employed in the learning process, although it is not without limitations. These include issues related to network access, the use of incompatible devices, and external challenges encountered by students.

In addition to the acceptance of the Learning Management System (LMS), student engagement in the learning process regulated by the LMS is also measured through an involvement questionnaire. The questionnaire was given to students in the 10th meeting. Student response data is outlined as Table 5.

Table 5. Tabulation of the classification of the level of student engagement.

Engagement Aspect	Low Rate	Moderate Rate	High Rate
Attitude	0	56	67
Cognitive	1	42	80
Motivation	8	62	53
Combination	**1**	**67**	**55**

From the classification results, a finding was obtained. In the attitude aspect, all students have a positive level of engagement, with half of the students actively involved based on their adherence to the rules given during the learning process. In the cognitive aspect, most students actively participate in learning activities, but there is one student who shows cognitive disengagement in the learning process. This disengagement increases in the motivation aspect, with some students feeling a moderate level of engagement with the stimuli provided during the learning process. When observed based on statements in each aspect, students tend to choose negative responses to statements oriented towards competitive elements such as badges and leaderboards compared to rule-oriented elements such as rules, quizzes, and performance contracts. In contrast, statements oriented towards the cognitive side, such as quizzes, searching for materials, and learning, receive very positive responses, and students tend to strive to engage in activities related to the completion and validation of products. From this data, it is concluded that students'

engagement with the learning process and LMS falls into the moderate category, indicated by the number of students concentrated in the moderate category in the combination of the three aspects of student engagement. These findings also align with existing research on the use of virtual learning environments in hybrid learning models that incorporate project-based learning (Soepriyanto, Pratama, et al., 2022).

Examining from the perspective of student engagement with the LMS, although falling into the moderate category, most students are motivated to complete the learning process with stimuli provided through game elements in the learning management system. Game elements with the highest engagement value are rules, points, and leaderboards. These three elements, if classified into the gamification element taxonomy (Toda, Klock, et al., 2019), are found in the performance dimension. Therefore, these elements provide feedback that can be directly perceived by learners and serve as a reflection for learners to assess their performance both individually and with other learners. The elements with the least level of engagement are badges, which belong to the ecological taxonomy. Badges in the LMS can only be achieved under certain criteria, namely, two students who are the first to validate the product with the lecturer (fastest) or able to complete the product with the specified specifications (best). Ecological elements are intended to provide dynamics in the learning process and can create a competitive atmosphere among students in the learning process (Alsubhi et al., 2020). However, there are learners who feel uncomfortable with an overly competitive learning environment (Hamari et al., 2014; Legaki et al., 2019; Santos et al., 2021).

Of all the gamification elements applied to the LMS, quizzes are one of the elements that students perceive as being overlooked. However, the quiz element is the one that most involves students in the cognitive domain. This is evidenced by students seeking tutorials and learning sources outside the LMS to complete quizzes. In the gamification scenario developed, quizzes or quests become elements that must be undertaken by students in their learning. Students still try to complete quizzes to move on to the next learning activity. This aligns with the framework developed by (Alsubhi et al., 2021), directing that quizzes or quests are part of assignments that students must complete.

In his research, (M. Khalil et al., 2018; Mohd Kasim & Khalid, 2016) presented the implementation of game elements in MOOCs, yielding positive results, with no studies reporting negative outcomes. Similarly, (Hamari et al., 2014) stated eight years earlier that only a few studies revealed that the implementation in E-Learning did not have a positive impact. This supports the results of this study, demonstrating that implementing game elements in the LMS can generate a positive response in terms of student engagement in the learning process.

The learning stages carried out by students through the Learning Management System have received a positive response, as evidenced by students' positive feedback on the usefulness of LMS IMGV. This positive response in this study is consistent with the research conducted by (Bernik et al., 2017), which indicates that an LMS developed with gamification activities can enhance student participation in project-based learning. Additionally, gamification activities applied in project-based learning provide a space for development in line with the feedback given to students through the implemented game elements (Zhang & Fang, 2019).

CONCLUSION

With the positive assessment results provided by validators, the design of the IMGV LMS is declared valid and can be used for gamified learning activities with a project-based learning model. The IMGV LMS has proven to be a learning management

system that integrates features from the SIPEJAR and PRC course modules. Despite receiving some negative feedback on the performance of the LMS during the trial, students perceived the usefulness and benefits of using the IMGV LMS in the Graphic and Visual Media Innovation course. The features developed align with the framework of online learning with a gamification approach. The implementation of game elements is done by aligning LMS components with game elements. The IMGV LMS is also equipped with the ability to monitor student performance in developing course products according to the project-based learning syntax.

The result is that students perceive the IMGV LMS as a beneficial addition to their learning experience. The LMS enables students to monitor their performance in the final course project and access assignment materials in a centralized location. Additionally, the LMS facilitates knowledge acquisition through the incorporation of quizzes, which are designed to engage students in a competitive learning environment. In conclusion, based on the above presentation, it is inferred that the development of the IMGV LMS with a gamification approach for project-based learning can be utilized in the learning process and serve as an evaluation material for further research and development.

Further research could develop the LMS into a more flexible gamification framework, supporting a variety of learning rule scenarios and gamification activities to provide adaptive elements according to student learning needs. Additionally, it would be beneficial to utilize a larger sample size and more diverse learning models in future studies.

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