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Author index

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Gamification of Learning Management System Improves Students' Engagement, Active Learning and Performance

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***Abstract*—Many researchers have implemented gamification elements, i.e., badges, leaderboards, points, and levels, to enhance active learning. Few researchers use game elements and activities in LMS (LMS gamification). This research aims to test whether performance is different between students taking LMS gamification and LMS non-gamification. In addition, we want to analyze the effect of student engagement and game activity on student performance. We used independent sample t-tests and regression to analyze the data. Active learning and student engagement in the LMS gamification significantly impact academic performance, with gamification leading to notable differences in achievement compared to students in LMS non-gamification. By incorporating gamified activities and promoting student engagement, LMS can provide access to resources, personalized learning experiences, and collaboration opportunities, resulting in a deeper understanding of subjects and higher levels of achievement. The combination of gamification and student engagement within LMS shows excellent potential for transforming education and facilitating long-term student success.**

Keywords—e-learning, LMS, gamification, engagement, student active learning, performance

I. INTRODUCTION

E-learning is growing along with advances in information and communication technology. Moodle is one of the open-source and widely used e-learning platforms to facilitate flexible and collaborative learning. It is also known as a Learning Management System (LMS). LMS allows educational institutions and organizations to effectively manage, organize, and provide online learning content. The COVID-19 pandemic led to a substantial surge in e-learning adoption due to physical constraints and widespread school closures across the globe [1]. Numerous primary and tertiary educational institutions have transitioned to online learning to ensure uninterrupted educational processes. To improve the LMS user experience, Moodle provides the facility to add new features called plugins. In 2022, more than 2,000 open-source plugins [2] were in the Moodle Plugin directory. The XP feature stands out as the leading choice for gamification within the LMS, having been adopted by approximately 10,000 websites and utilized by about 1.6 million learners through the plugin [3].

LMS remains highly pertinent for educating the Internet-savvy generation (Gen Z) who pursue higher education at universities [4,5,6]. Gen Z is considered capable of multi-tasking simultaneously, such as social media activities on cell phones, browsing with PCs, and listening to music. In addition, they have a close relationship with cyberspace and almost all activities in cyberspace. The generation embraces innovation as a part of life, and they have a more positive view of how innovation impacts their lives than any other generation. Gen Z learns faster and easier if they can use a smartphone or tablet. They are best suited to today's learning strategies. They lean on learning in a more open environment, anticipating momentary gratification, and appreciating a fun and flexible learning environment [7,8]. They like having control over their development and are comfortable taking advantage of innovation in the classroom. Gen Z inspires us to implement LMS gamification.

We have been teaching Management Information Systems (MIS) courses to School of Business and Management students who are Gen Z. MIS provides knowledge regarding applying digital technology concepts, especially information systems, in organizations and businesses to foster competitive advantage. Based on experience, students often encounter challenges comprehending certain concepts or technical terminology taught in MIS. However, when they work, MIS becomes very useful to support their work. We applied LMS gamification in one of the MIS classes, as done by [9,10], to enhance the motivation and engagement of students.

Most researchers [11–16] employed game elements plugins provided by developers in the Moodle community, such as badges, leaderboards, points, and levels, to integrate game-like experiences into the learning process. They have utilized game elements alongside conventional activities like Quizzes, Assignments, and Discussion Forums. So far, only a few researchers explored the potential of game activities in LMS, such as Crossword [1,6,7,14], Cryptex [7], Hangman [7,14,17], and Snakes and Ladders [7]. Researchers used non-Moodle Snakes and Ladders as a game activity [18,19]. Most analyses used questionnaires to survey students' perceptions and satisfaction with game elements [6,16,20–22]. Other researchers [4,5,15] analyzed further using the paired samples test to investigate student engagement differences using game elements. Research involving game activities and game elements is still rare. Researchers [7] only analyzed the paired sample test. They did not explore the relationship between student engagement and active learning in LMS gamification.

This study utilized the concept of gamification, which refers to incorporating not only game elements but also game activities within a learning environment to enhance the motivation and engagement of MIS students. The study will address the following research questions as our contribution: 1) Is there a difference in MIS student performance between classes that implement gamification (LMS gamification) and those that follow traditional teaching methods (LMS non-

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gamification)? 2) Is there a relationship between student engagement and active learning to MIS student performance at LMS gamification?

The analysis results show that the study highlights the positive impact of gamification and student engagement on LMS gamification on student performance. Gamification's interactive and immersive nature fosters deeper engagement and enhances critical thinking skills. Gamification provides immediate feedback and rewards, reinforcing positive learning behaviors and a growth mindset. Consequently, students exposed to gamified LMS experiences demonstrate improved performance, achieve higher academic results, and exhibit enthusiasm for their studies.

II. Literature Review

A. LevelUp plugin

LevelUp plugin enhances the educational journey of students through gamification [3,7,21,23]. It enables learners to accumulate experience points as they actively participate in their courses, fostering greater engagement and involvement. Motivating students to advance to higher levels and acknowledging their achievements upon reaching each milestone provides a sense of reward and encouragement. The LevelUp plugin offers various features, including a leaderboard that harnesses a friendly and motivating sense of competition, granting access to course content upon attaining specific levels and the ability to substitute experiential points with enticing images, thereby rendering the learning process even more captivating for the students. Five components of game mechanics are widely employed within the educational environment to enhance students' active involvement and overall engagement in online learning.

- **Experience points** (**XP**). Students have two avenues to accumulate XP: they would receive points automatically upon quiz completion and grant additional points for specific actions undertaken within LMS. These actions encompass logging into the system, engaging in forum discussions, and accessing reading materials. The quantity of XP awarded for each activity was contingent upon the level of effort required. For instance, posting to a forum garnered more XP than simply logging into the system.
- **Levels**. To establish the number of levels, utilize an exponential algorithm that dynamically determines the levels based on the XP needed to reach each level.
- **Badges**. There are two categories of badges. To inspire and incentivize students, devise a series of activities that students need to fulfill to acquire the badges. These activities included engaging in forum discussions, posing thoughtful questions, and displaying diligence in their efforts. Secondly, they were awarded a badge upon completing specific quests to gauge and acknowledge students' accomplishments.
- **Leaderboards**. To visualize student performance on a leaderboard system in each activity compared to their classmates. The system ranks students based on their XP, with the highest achievers at the top of the leaderboard. This feature enabled students to assess their progress and performance by comparing themselves to their peers within the same class.
- **Progress bars**. Recognizing the significant impact of providing feedback on student learning, utilize progress bars to visually represent the distance remaining for students to reach the next level. This approach aimed to enhance their understanding of their progress and encourage further engagement.

B. Game Activities

Game activities are a Moodle plugin to support gamification in LMS [2,7]. In this study, the following game activities were used: Crossword, Cryptex, Hangman and Snakes and Ladders. Each game will be explained as follows.

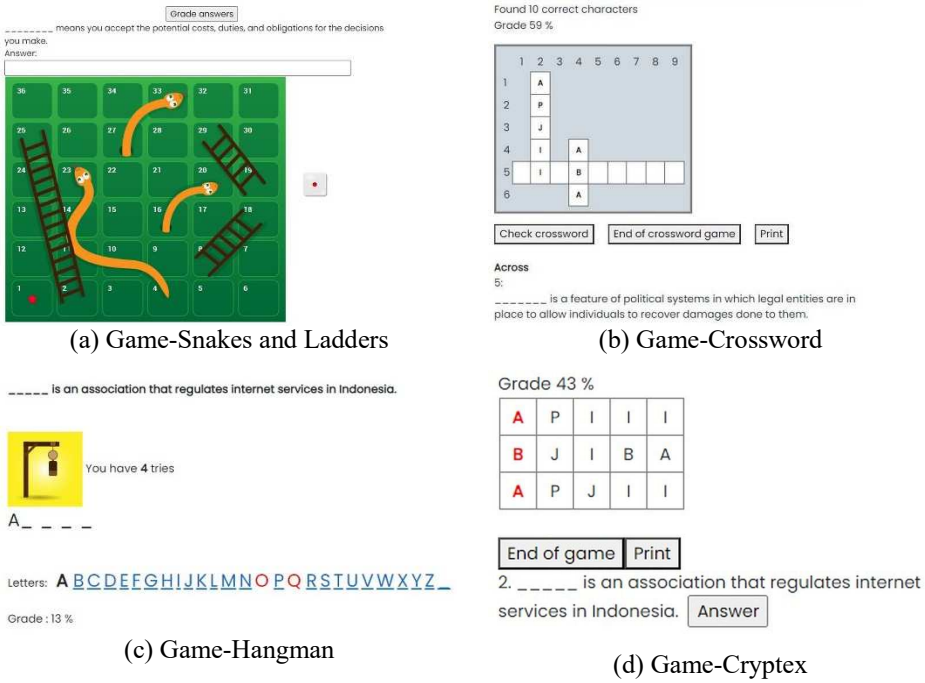
- **Crossword** [1,6,7,14]. This game generates a randomized Crossword puzzle by selecting words randomly from a glossary or quiz short answer questions. The teacher can specify the maximum number of columns, rows, or words in the puzzle. Students can verify the correctness of their answers by clicking the 'Check Crossword' button. Each Crossword is generated dynamically, ensuring a unique student experience.
- **Cryptex** [7]. This game functions similarly to a Crossword but with an added element of intrigue-the answers are concealed within a randomly generated Cryptex.
- **Hangman** [7,14,17]. This game randomly uses glossary or quiz short-answer questions to construct a Hangman puzzle. The teacher can customize the game by specifying the number of words included, deciding whether to reveal the first or last letter, and displaying the question or answer as the game progresses.
- **Snakes and Ladders** [7]. To navigate the traditional Snakes and Ladders board, students must randomly respond to questions drawn from either a glossary or quiz short answer questions. When a correct answer is provided, the dice are rolled, revealing a random number determining how many squares their game piece moves forward. If the game piece lands at the bottom of the ladder and the answer is correct, it climbs to the top. However, if the game piece lands at a snake's head and the answer is incorrect, it slides down to the tail.

III. Research Methodology

We conducted a study in the fourth semester of the Business Management program at MIS course. During the 2022/2023 Even Semester, 194 students enrolled in the MIS course were divided into five classes, approximately 39 students per class. Until now, the LMS has been used solely for sharing lecture materials and conducting traditional MIS exams without any gamification elements. However, this semester, we intend to explore active learning by incorporating gamified e-quizzes in LMS, which we call LMS gamification. Non randomly selected class, B1 MIS, participated in LMS gamification to achieve this. In contrast, the remaining four classes participated in traditional LMS without gamified e-quizzes, which we call LMS non-gamification. Implementing LMS gamification aims to enhance student engagement, active learning, and the performance of B1 MIS.

Research activities within sixteen weeks, including preparatory, intervention, and assessment activities. In the first week, we trained and introduced gamified platforms and gamification concepts to B1 MIS students. Intervention or teaching and learning activities occurred from the second to the fifteenth week. Each week, the class begins with a 120-minute onsite presentation of MIS material. Followed by online gamified e-quiz learning activities at LMS for 30 minutes. The gamification quiz platform is LMS because it is open-source and easy to use. The game activity randomly took questions from the question bank, and each test scored 100 points. All formative assessments aim to evaluate students' understanding of the topics they have studied. All MIS students took the midterm and final exams using the LMS quiz in the eighth and sixteenth weeks.

Quantitative methods design, i.e., independent samples t-test and regression, were conducted in this study. We collected quantitative MIS data from the midterm and final exams for all MIS students to calculate the final score of MIS as students' performance. Then, we conducted an independent samples t-test analysis on the student's performance for both LMS gamification and LMS non-gamification. For LMS gamification, we also collected activity completion as the student engagement and game activity scores as active learning. Then, we conducted a regression analysis. The independent variables in this analysis were student engagement and student engagement. Regarding gamified instructions, we used four LMS game activities, namely (a) Snakes and Ladders, (b) Crossword, (c) Hangman, and (d) Cryptex, as shown in Figure 1, respectively. The dependent variable studied was students' performance following LMS gamification.



(a) Game-Snakes and Ladders (b) Game-Crossword

(c) Game-Hangman (d) Game-Cryptex

Fig. 1. The selected LMS game activities for the project

In this study, we set the p-value to be smaller or equal to 0.05 on the independent sample t-test to conclude there is a significant difference between student performance at LMS gamification and LMS non-gamification. In addition, we also set the p-value smaller or equal to 0.05 in the regression to conclude there is a significant relationship between student engagement and active learning to student performance at LMS gamification.

IV. Results and Discussion

A. Results and Findings

Independent Samples Test for Means

The first data analysis conducted in this study was the test of the mean difference in students' performance between two student groups of LMS gamification and LMS non-gamification.

According to the independent samples test for means, 38 students who received the gamification treatment in class as part of their learning had a final exam score mean of 72.11. In comparison, the 156 students whose classes had no game activity had a score mean of 62.28, with a difference of 9.83. The independent samples t-test results in Table I show a significant difference in student performance between the two groups of segmented students, i.e., LMS gamification and LMS non-gamification (p-value <0.05).

TABLE I. Compared Means (Independent Samples T-Test)

Group	Mean	Std. Deviation	t-value	Mean difference	p-value
LMS gamification (**n 38**)	72.11	13.701	3.244	9.83	0.001
LMS non-gamificaation (**n 156**)	62.28	17.397			

Multiple Linear Regression

The second data analysis conducted in this study was the multiple linear regression test. The independent variables or predictors in this stage are engagement and game activity. At the same time, performance has a role as the dependent variable or target variable. The number of observations in this stage is 38 students from the LMS gamification. Figure 2

shows the model framework of this analysis.

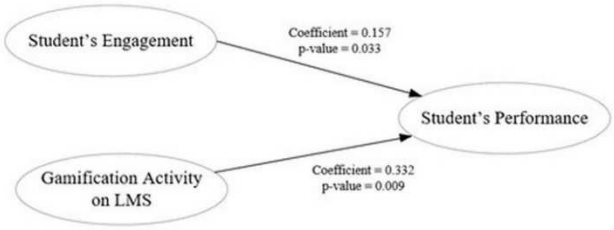


Fig. 2. Regression Model

We executed a data normality test before performing tests on the suggested regression model. Utilizing IBM SPSS 26 software and the Kolmogorov-Smirnov test, the result showed that the data distribution in the observations of this study followed a normal distribution. This finding is supported by the Asymptotic significance value of 0.2, which exceeds the threshold of 0.05 typically used for normality testing.

TABLE II. REGRESSION RESULTS

Influence Path	Coefficient	t-statistics	p-value	Pemark
Student's Engagement → Student's Performance	0.157	2.220	0.033	Proposed hypothesis supported
Game Activity on LMS → Student's Performance	0.332	2.760	0.009	Proposed hypothesis supported
Intercept (Constant)	31.857	3.548	0.001	-

Based on Table II, the regression analysis results in an equation in the following.

$$Performance=0.157\ engagement+0.332\ activity+31.857+\varepsilon$$

According to the findings in Table II and the formulated equation, students' engagement positively influences students' performance among the 38 students in LMS gamification. It reflects that the more active students are in accessing information and actively using the LMS, the better their performance will be. In addition, gamification activities embedded in the LMS can positively impact better student performance, as seen from the overall final score.

B. Discussion

One significant benefit of LMS is its ability to enhance the efficiency and effectiveness of educational processes. The first finding of this study is that students with LMS gamification have better score achievement on their final exam than LMS non-gamification. In other words, this research has consistently demonstrated a notable disparity in performance between students who receive gamification on LMS and those who do not. Incorporating gamified elements in the learning process creates a motivating environment that enhances student participation and knowledge retention. Gamification stimulates intrinsic motivation, encouraging students to pursue learning goals actively, persist through challenges, and seek mastery of the subject matter. The interactive and immersive nature of gamification fosters deeper engagement, promoting higher levels of cognitive processing and critical thinking skills. Additionally, gamification's immediate feedback and rewards provide continuous reinforcement, reinforcing positive learning behaviors and promoting a growth mindset. As a result, students exposed to gamified LMS experiences demonstrate improved performance, increased academic achievement, and a greater enthusiasm for their studies, setting them toward long-term success.

Secondly, according to our findings in this study, providing extra activities such as gamification can promote students' ability to catch the material through fun activities. The statistical calculation of regression analysis undertaken in this study found that gamification substantially impacts student performance over activity completion (engagement). In other words, implementing gamification in LMS can have a transformative effect on student performance. Gamification enhances student engagement and motivation by incorporating game-like elements such as Snakes and Ladders, Crosswords, Hangman, and Cryptex into the active learning process. Crosswords, Hangman, and Cryptex are suitable for weekly activities. However, Snakes and Ladders require more questions and are better suited for repeating exercises over several weeks. Game activities create a sense of challenge, competition, and achievement, which drives students to actively participate and excel in their studies. Gamification too cultivates a positive learning environment by making the learning encounter more agreeable and immersive. In expansion, gamification advances ceaseless input and rewards advance, ingrains a sense of achievement, and empowers understudies to endeavor for continuous change. As a result, understudies are more likely to remain centered, hold data superior, and perform at higher levels scholastically.

In addition to gamification, the student's engagement on the LMS platform profoundly impacts their overall academic performance. Even though the student's engagement indicates a lower coefficient of impact on the student's academic performance, it still has a significant effect. When students actively participate and interact with the LMS platform, they benefit from increased access to course materials and interactive learning resources for communication and discussion. Engaging with these features promotes a deeper understanding of the subject, encourages critical thinking, and fosters active learning. Finally, the LMS allows for personalized learning experiences, as students can track their progress on LevelUp, receive immediate feedback, and access supplementary materials tailored to their needs. Through active engagement in the LMS, students are more likely to stay motivated, develop a sense of ownership over their learning, and ultimately achieve higher performance levels in their academic endeavors.

V. CONCLUSION

To sum up, this study consistently demonstrates a notable difference in performance between students' LMS gamification and LMS non-gamification. The interactive and immersive nature of gamification promotes deeper engagement. It enhances the critical thinking skills of students who are assigned game activities as part of their learning process in the class. The immediate feedback and rewards associated with gamification reinforce positive learning behaviors and cultivate a growth mindset. Consequently, students exposed to gamified LMS

experiences exhibit improved performance, achieve higher academic results, and display tremendous enthusiasm for their studies.

Finally, the findings of this study underscore the significant impact of active learning in gamification and student engagement on LMS on student performance. Incorporating gamified elements in the learning process has consistently demonstrated a notable disparity in achievement between students' LMS gamification and LMS non-gamification. Additionally, while the coefficient of effects may be lower, student engagement on the LMS platform still significantly impacts academic performance. Active participation and interaction with the LMS provide students with increased access to resources, personalized learning experiences, and opportunities for collaboration, leading to a deeper understanding of the subject matter and higher levels of achievement. The combination of gamification and student engagement within LMS holds immense potential for transforming the educational landscape and facilitating students' long-term success.

Regarding the limitations, this study did not employ all plugins game activities in active learning. For advanced investigations, Hidden Picture, Millionaire, and Sudoku could be incorporated as game variations to enhance student engagement and motivation. In addition, during the analysis and writing of this paper, we did not distribute questionnaires to explore further student interest and involvement in LMS Gamification. Conducting mixed-method research would be beneficial in examining the impact of engagement and game activity on student performance.

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