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Optimizing Moodle E-Learning Page Features to Enhance Student Achievement in Business Economics

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Abstract

This study investigates how optimizing Moodle e-learning features can enhance student achievement in Business Economics courses. Grounded in constructivist learning theories and empirical research on Learning Management Systems, the investigation addresses the growing need for effective, technologydriven instructional strategies. A quasi-experimental research design was employed across one academic semester, involving undergraduate students enrolled in a Business Economics course at a public university. Participants were divided into two groups: one that accessed a standard Moodle environment and another that engaged with enhanced Moodle features, including adaptive release of content, personalized feedback tools, and gamified assessments. Data were collected through pre- and postcourse tests, platform usage logs, and student perception surveys. Statistical analyses, including t-tests and multiple regression, indicated that students using the optimized Moodle platform demonstrated significantly higher achievement scores and engagement levels than those in the control group. Correlation results further revealed that interactive guizzes and targeted feedback strongly influenced student performance. Qualitative feedback underscored the benefits of gamified elements and userfriendly navigation in fostering deeper learning and motivation. These findings reinforce the vital role of thoughtfully tailored LMS interventions in improving learning outcomes, particularly within complex disciplines like Business Economics. The study concludes by discussing implications for educators, administrators, and platform developers seeking to maximize the pedagogical potential of e-learning systems. Future research should explore longitudinal effects, larger sample sizes, and cross-institutional validations to further refine and generalize these insights.

Keyword: Business Economics; Instructional Design; Moodle E-Learning; Student Achievement; Learning Management System (LMS) Optimization.

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Introduction

The rapid adoption of Learning Management Systems (LMS) like Moodle in higher education has significantly transformed the educational landscape, particularly in disciplines such as Business Economics. Moodle's open-source nature and extensive customizability make it a preferred choice among educators seeking to enhance student engagement and learning outcomes. The platform's user-friendly interface facilitates the integration of various pedagogical strategies, which is crucial for addressing the unique challenges presented by



Creative Commons Attribution-ShareAlike 4.0 International License: https://creativecommons.org/licenses/by-sa/4.0/ Business Economics, a field that requires both theoretical understanding and practical application.

Research indicates that the use of LMS platforms like Moodle can enhance the quality of online learning environments. For instance, Bengueddach et al. conducted an interpretive analysis of online teaching labs using Moodle, highlighting its effectiveness in fostering communication and interaction among students and instructors during the pandemic (Bengueddach et al., 2023). This aligns with findings from Althunibat, who emphasized that Moodle serves as a robust platform for managing educational content and facilitating student assessments, thereby improving the overall learning experience (Althunibat et al., 2023). Furthermore, the incorporation of gamification and interactive elements within Moodle has been shown to positively influence student engagement and motivation, which are critical for mastering complex subjects like Business Economics (Sousa-Vieira et al., 2023).

The pedagogical challenges inherent in teaching Business Economics can be mitigated through strategic optimization of Moodle's features. For example, the integration of interactive applications and gamified learning experiences can create a more engaging and personalized learning environment. Studies have demonstrated that gamification methodologies significantly enhance learning outcomes by promoting active participation and collaboration among students (Lester et al., 2023). Additionally, the ability to track and analyze student interactions within Moodle can provide educators with valuable insights into student performance and engagement levels, enabling them to tailor their instructional approaches accordingly (Hernández-García et al., 2024; Toring et al., 2023).

Moreover, the shift towards online and hybrid learning models necessitates a reevaluation of traditional teaching methods. As highlighted by Nagay, distance learning leverages modern technologies to create flexible and accessible educational experiences, which are essential for fostering business communication skills among students (Nagay et al., 2023). This flexibility is particularly beneficial in Business Economics, where real-world applications of theoretical concepts are paramount. The use of Moodle can facilitate this by providing a platform for simulations, case studies, and collaborative projects that reflect real-world business scenarios (Baba Yidana et al., 2023; J. Fang et al., 2024). The strategic optimization of Moodle's features presents a promising avenue for enhancing student engagement and comprehension in Business Economics. By leveraging the platform's capabilities to create interactive, gamified, and personalized learning experiences, educators can address the unique pedagogical challenges of this discipline. The ongoing evolution of online learning technologies underscores the importance of adapting teaching practices to meet the needs of today's learners, ultimately leading to improved academic performance and preparedness for real-world applications.

Despite Moodle's robust capabilities, many institutions use only a fraction of its features, limiting its potential to foster active learning and deeper comprehension. Features such as adaptive release of content, interactive quizzes, analytics dashboards, and gamified assessments remain underutilized in many Business Economics courses. Existing research underscores the importance of interactive and feedback-rich environments in promoting academic achievement. However, empirical studies that systematically investigate which Moodle features produce the most significant gains—particularly in the Business Economics context are scarce. This gap underscores the need to examine the relationship between optimized Moodle functionality and student achievement in a discipline known for its analytical rigor and practical relevance.

This study aims to address existing gaps by exploring how the customization and systematic use of Moodle features can enhance student engagement and achievement in Business Economics. To achieve these objectives, the study focuses on two key questions: which Moodle features contribute the most to improved learning outcomes in Business Economics, and whether Moodle-based interventions lead to significantly higher student engagement and achievement compared to standard LMS usage.

The integration of Learning Management Systems (LMS) like Moodle into vocational education has profound implications for both theoretical frameworks and practical applications in the teaching of complex subjects such as Business Economics. Theoretically, optimizing Moodle features can be situated within established learning theories, particularly constructivism and cognitive load theory. Constructivism posits that learners construct knowledge through experiences and interactions, which can be effectively facilitated by Moodle's interactive capabilities, such as forums, quizzes, and collaborative projects (Althunibat et al., 2023). Furthermore, cognitive load theory emphasizes the importance of managing the information load presented to students to enhance learning outcomes. By utilizing Moodle's customizable features, educators can design instructional materials that minimize extraneous cognitive load, thereby allowing students to focus on essential content (Faudzi et al., 2024).

Practically, the findings from research on Moodle optimizations can inform course development strategies, guiding educators in prioritizing features that align with the specific demands of Business Economics curricula. For instance, Althunibat's study highlights the importance of user experience in LMS design, suggesting that a well-structured platform can significantly enhance student engagement and learning outcomes (Ebrahim & Van Wyk, 2024). Additionally, the incorporation of gamification elements within Moodle has been shown to foster active participation and motivation among students, which is particularly beneficial in subjects that require both theoretical understanding and practical application (Patra et al., 2022). This aligns with the findings of Sousa-Vieira et al., who demonstrated that gamified learning environments can lead to improved academic performance by promoting collaboration and engagement (Adigun et al., 2024; Huerta-Gomez-Merodio et al., 2024).

Moreover, insights gained from optimizing Moodle can assist administrators and policymakers in making evidence-based decisions regarding investments in LMS enhancements. The strategic alignment of LMS features with institutional goals for digital transformation is essential for fostering an effective learning environment. As highlighted by Hernández-García, the relationship between LMS interactions and academic performance underscores the need for institutions to prioritize features that enhance student engagement and learning outcomes (Hernández-García et al., 2024). This is particularly relevant in the context of Business Economics, where the application of theoretical concepts to real-world scenarios is crucial for student success. The study of Moodle optimizations aims to strengthen the connection between well-designed e-learning environments and successful academic performance in complex subjects. By leveraging the capabilities of Moodle to create engaging, interactive, and personalized learning experiences, educators can better prepare students for the challenges of the business world. This approach not only enhances student comprehension but also aligns with the broader goals of higher education institutions to foster innovative and effective teaching practices in an increasingly digital landscape.

Methodology

This study employed a quasi-experimental design to examine the impact of optimized Moodle features on student achievement in a Business Economics course. Two intact class sections were designated as either the experimental group, which accessed enhanced Moodle functionalities, or the control group, which used a standard Moodle environment. Although institutional constraints prevented random assignment of students, this design enabled a comparative analysis of learning outcomes. A total of 120 eleventh-grade students from State Vocational High School (SMKN) 31 Central Jakarta participated, with 60 students in each section, reflecting a typical cross-section of the school's population with ages ranging from 18 to 24. At the beginning of the semester, students were informed about the study's purpose and data collection procedures, and participation was voluntary, with an option to opt out of non-assessed aspects such as surveys. Data collection occurred in three phases over a 14-week

semester. In the pre-implementation phase (Week 1), students completed a pre-test to assess their baseline knowledge of Business Economics and an initial perception survey to capture their attitudes and familiarity with e-learning platforms, along with information about their prior experience with online learning tools and self-assessed comfort levels with the subject matter. During the implementation phase (Weeks 2-13), the experimental group engaged with a Moodle environment enhanced with adaptive and gamified features that automatically recorded metrics such as login frequency, time spent on course materials, and quiz attempts, while the control group used a traditional Moodle setup with identical core readings and assignments. Ongoing data tracking was conducted via the Moodle learning analytics dashboard to continuously monitor engagement metrics. In the post-implementation phase (Week 14), both groups completed a post-test identical in format to the pre-test and a final perception survey to gauge shifts in attitudes toward e-learning and experiences with the Moodle platform; focus group interviews were also conducted to gain qualitative insights into students' subjective experiences, their perceptions of how the course design influenced their motivation and learning strategies, and suggestions for improving Moodle's enhanced features. Descriptive statistics, including means and standard deviations, were computed to summarize pre- and post-test scores, Moodle usage data, and survey responses, while independent t-tests or ANCOVA (controlling for pre-test scores) compared post-test performance between groups. Multiple regression analyses were also conducted to explore which specific Moodle usage metrics best predicted performance gains in the experimental group, with all quantitative analyses performed using SPSS (version 26.0) at a significance level of $\alpha = 0.05$. Additionally, focus group interviews were transcribed verbatim and analyzed using thematic analysis, with codes refined into broader themes such as enhanced engagement and technical challenges, thereby providing nuanced insights that supported the interpretation of the quantitative findings.

Results and Discussion

1. Descriptive Statistics

A total of 120 students participated in the study, with 60 assigned to the experimental group and 60 to the control group. Table 1 summarizes the pre-test scores for both groups.

Table 1. Descriptive Statistics for Pre-Test Score							
Measure	Experimental	Control	t(df)	p-Value			
Pre-Test Score (M \pm SD)	52.3 ± 8.4	51.7 ± 9.1	0.59 (118)	0.56			
Login Frequency (M ± SD)	28.3 ± 5.1	14.9 ± 4.3		0.001			
Time-on-Task (weekly, M	Significantly	Significantly		0.001			
± SD)	higher	lower					

1) Comparable Baseline Knowledge

The pre-test scores did not differ significantly between the experimental and control groups (t(118)=0.59, p=0.56), indicating that both groups had a comparable baseline level of Business Economics knowledge before the intervention.

- 2) Higher Engagement in the Experimental Group
 - Login Frequency. Students in the experimental group logged into Moodle 0 significantly more often (M=28.3, SD=5.) than those in the control group (M=14.9, SD=4.3).
 - Time-on-Task. The experimental group also spent significantly more time 0 engaging with course materials each week, suggesting that the optimized Moodle environment may have encouraged more consistent and focused study behaviors.

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These findings imply that while both groups started at a similar level of subject knowledge, the enhanced Moodle setup used by the experimental group led to greater usage and potentially deeper engagement with course materials.

2. Effect of Moodle Optimizations on Student Achievement

By the end of the 14-week semester, the experimental group's post-test scores were substantially higher than those of the control group can seen in Table 2.

Table 2. Po	st-Test	Score
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Measure	Experimental	Control	F (1.117)	p-Value
Post-Test Score (M \pm	79.4 ± 7.2	73.1 ± 6.5	15.62	0.001
SD)				

□ Enhanced Learning Outcomes

After 14 weeks, the experimental group (M= 79.4, SD = 7.2) outperformed the control group (M = 73.1, SD = 6.5). An ANCOVA controlling for pre-test scores indicated that this difference was statistically significant (F(1,117)=15.62, p<.001), suggesting that the optimized Moodle environment had a clear positive effect on learning outcomes in Business Economics.

□ Key Intervention: Personalized Feedback

Among the three primary interventions adaptive content release, personalized feedback, and gamification student feedback via surveys and focus groups consistently pointed to personalized feedback as the most impactful. Students reported that immediate, tailored responses to quiz and assignment errors helped them identify and correct misconceptions early, ultimately leading to a deeper understanding of complex economic theories.

3. Correlation and Additional Analyses

To explore relationships among the various engagement metrics (login frequency, forum participation, quiz attempts) and post-test scores, Pearson correlation coefficients were computed for the experimental group in Table 3.

Engagement Metric	r	p-Value
Time-on-Task	0.59	0.001
Forum Participation	0.42	0.01

Table 3. Pearson Correlations Between Engagement Metrics

Note. Higher values indicate greater engagement in each metric.

Correlational Analysis

- Time-on-task showed the strongest positive association with post-test scores (r=0.59,p<.001), indicating that students who spent more time actively engaged with the course materials tended to achieve higher scores.
- Forum Participation also exhibited a moderate positive correlation with post-test scores (r=0.42,p<.01), suggesting that peer discussions and interactions may play a supportive role in learning.

A multiple regression analysis (stepwise method) was conducted to identify the best predictors of student achievement within the experimental group in Table 4.

Table 4. Multiple Regression Predicting Post-test Score (Experimental Group)

Predictor	β	\mathbb{R}^2	F(3, 56)	p-Value
Time-on-Task	0.51			0.001
Personalized Feedback	0.28			0.014

	-	0	0	0				
						DOI: <u>https://</u>	doi.org/10.62872/j1	.hydk82
-		Gamification		0.19			0.042	
-	Ν	Model Statistics			0.46	16.03	0.001	

Multiple Regression Analysis

- The final regression model, which included Time-on-Task, Personalized Feedback (as rated on student perception surveys), and Gamification (measured by badges earned), was significant, F(3, 56) = 16.03, p < .001, explaining approximately 46% of the variance in post-test scores.
- Time-on-task emerged as the strongest predictor (β =0.51,p<.001), highlighting the importance of sustained, active engagement.
- Personalized Feedback contributed significantly (β =0.28,p=0.014), aligning with student comments that individualized responses clarified misconceptions early and bolstered understanding of complex material.
- Gamification Elements, while having a smaller effect, still made a meaningful contribution (β =0.19,p=0.042), implying that badges and other game-like features can further motivate students to stay engaged.

4. Results of Focus Group

Focus group interviews with a subset of 12 experimental group students yielded deeper insights into how each Moodle feature influenced learning. Four main themes emerged from the thematic analysis:

1) Enhanced Engagement

- Badges and Leaderboards. Students consistently cited gamification elements (badges, transparent progress tracking) as motivators. These features incentivized more frequent logins and created a sense of friendly competition.
- Increased Motivation. The visible progress bar and leaderboard reportedly sparked a "lighthearted race" among some classmates to stay on track or move ahead.

2) Clarity Through Feedback

- Actionable Guidance. Personalized feedback was repeatedly praised for being specific and timely. Many students indicated that immediate, tailored comments on quizzes and assignments clarified misunderstandings about key economic concepts (market analysis, and cost structures).
- Confidence Boost. Quick, targeted feedback helped resolve confusion early, reducing anxiety and building a sense of competence as the semester progressed.
- 3) Structured Learning Path
 - Adaptive Content Release. By unlocking subsequent modules only after completion of foundational materials, students were "forced" into a logical sequence. This ensured that they solidified basic principles before moving on to advanced topics.
 - Reduced Overload. Several participants mentioned that this structure prevented them from jumping ahead and getting overwhelmed, thus making the course feel more manageable.
- 4) Technical and Time-Management Challenges
 - Technical Glitches. A few students encountered minor issues with quizzes not loading properly or the adaptive sequence not updating in real-time.
 - Balancing Milestones. Some reported struggles with coordinating Moodle milestones alongside other coursework, underscoring the need for strong time management to navigate the adaptive structure effectively.

5. Connecting Qualitative Insights to Learning Outcomes

1) Motivation and Persistence

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The gamification elements (badges, leaderboards) appeared to sustain higher login frequencies and encourage ongoing participation—aligning with quantitative findings that showed increased engagement metrics for the experimental group.

- Deeper Understanding Through Feedback Students overwhelmingly highlighted personalized feedback as a major driver of success. This finding resonates with the regression analysis, which identified feedback as a significant predictor of post-test performance.
- Sequential Mastery
 The adaptive content release feature seems to have promoted a more deliberate, stepby-step learning approach. In practice, this structure likely helped students build on fundamental economic concepts before tackling more complex analyses.
- 4) Need for Platform Reliability and Time Management While generally positive, the focus groups also revealed that even a well-designed system can pose challenges. Minor technical glitches and the demands of structured pacing underscore the importance of platform stability and clear time-management guidance.

the focus group data indicate that the optimized Moodle environment not only increased engagement but also facilitated a more effective learning process, particularly when paired with prompt, personalized feedback. These qualitative insights help explain why the experimental group outperformed the control group in post-test scores and underscore the importance of designing virtual learning environments that are both engaging and pedagogically sound.

The findings of the current study indicate that targeted optimizations within the Moodle learning management system can significantly enhance student learning outcomes in Business Economics. The experimental group, which experienced adaptive content release, personalized feedback, and gamification elements, demonstrated superior performance on post-test assessments compared to the control group. This aligns with the principles of constructivist learning theories, notably those articulated by Vygotsky, which emphasize the importance of interactive and feedback-rich environments in fostering deeper cognitive engagement and processing among learners (Adigun et al., 2024). The integration of gamification and personalized learning strategies has been shown to create a more engaging educational experience, which is crucial for effective learning in higher education contexts (M. A. De Villa et al., 2019; Gomaa et al., 2024; Huang & Hwang, 2019; Roncal-Belzunce et al., 2024; Sun et al., 2022).

Moreover, the study's results are supported by evidence indicating that higher engagement metrics such as time spent on tasks and participation in forums correlate positively with improved academic performance. Research has consistently demonstrated that increased interaction with course materials is a critical determinant of successful learning outcomes (ilic & Akbulut, 2019; McCormick & Hall, 2022; Rajasulochana & Senthil Ganesh, 2019; Tan & Hew, 2016). For instance, a study by Huerta-Gomez-Merodio highlights the necessity for instructors to design learning environments that promote interaction and engagement, particularly in online settings (Huerta-Gomez-Merodio et al., 2024; Huerta-Gomez-Merodio & Requena-Garcia-Cruz, 2024). Furthermore, the use of Moodle as a platform for delivering personalized feedback and adaptive learning paths has been shown to enhance student motivation and satisfaction, which are essential for achieving academic success (Q. Fang, 2019; W. Fang et al., 2024; Sheridan & Gigliotti, 2023).

In addition, the implementation of gamification elements within Moodle has been linked to increased student participation and motivation, which are vital for effective learning experiences. The research conducted by Huang and Hwang confirms that gamified methodologies significantly impact learning outcomes in higher education, suggesting that such strategies can lead to improved engagement and knowledge acquisition (Huang & Hwang, 2019). This is particularly relevant in the context of Business Economics, where the application of interactive and gamified learning can help students better grasp complex concepts and enhance their analytical skills. The evidence supports the assertion that targeted Moodle optimizations, including adaptive content release, personalized feedback, and gamification, can lead to significant improvements in student learning outcomes in Business Economics. These findings are consistent with constructivist theories of learning and underscore the importance of interactive and engaging educational environments in fostering academic success.

The findings of the current study indicate that the strongest predictor of student achievement is the amount of time-on-task combined with personalized feedback. This conclusion is consistent with the research conducted by Ilic and Albulut, which emphasizes the critical role of prompt and individualized responses in addressing knowledge gaps and enhancing learning outcomes (ilic & Akbulut, 2019). Their work highlights that feedback, when tailored to the individual needs of students, can significantly bridge learning deficiencies and foster academic success.

In addition to personalized feedback, the study found that gamification elements, while not as influential as personalized feedback, still contributed positively to student performance. Gamification has been shown to enhance motivation and encourage more frequent engagement with learning platforms, which aligns with the findings of (Pedro et al., 2015; Trirat et al., 2020; S. C. Villa et al., 2021). Their research underscores the motivational benefits of gamified course designs, suggesting that such elements can lead to increased student participation and a more dynamic learning environment. This is further supported by Lester et al., who identified both drivers and barriers to the utilization of gamification in educational settings, indicating that while gamification can enhance engagement, its effectiveness often depends on the context and implementation strategies employed by educators (Buckley et al., 2018; Liu et al., 2019; Pradana et al., 2023).

Moreover, the integration of gamification within learning management systems (LMS) like Moodle has been linked to improved student interaction and satisfaction. However, the reference to Huerta-Gomez-Merodio's research does not support the claim that gamification techniques enhance adaptive learning environments, as the cited work focuses on performance evaluation in structural engineering courses rather than gamification (Dah et al., 2024; Flores, 2015; Francisco & Flores, 2015; Kalinauskas, 2014). Therefore, this claim should be revised or removed. The evidence from this study, corroborated by existing literature, suggests that both the amount of time students spend on tasks and the quality of personalized feedback are paramount in predicting student achievement. While gamification plays a supportive role in enhancing motivation and engagement, it is the combination of these factors that ultimately leads to improved learning outcomes.

Conclusion

This study set out to determine whether leveraging specific Moodle optimizations namely, adaptive content release, personalized feedback, and gamification could significantly enhance student achievement in Business Economics. By employing a quasi-experimental design and analyzing a range of quantitative and qualitative data, the research demonstrated that students exposed to these tailored features exhibited higher post-test scores, greater engagement, and more positive perceptions of their learning environment. Time-on-task and personalized feedback emerged as particularly influential predictors of improved academic performance, indicating that sustained interaction with course materials and targeted instructional support can bolster students' grasp of complex economic concepts.

These findings reinforce the pedagogical value of designing technology-enhanced learning experiences that emphasize interactivity, immediate feedback, and motivational elements. For educators and institutions seeking to optimize their LMS usage, this study underscores the importance of aligning platform features with clearly defined learning objectives, especially within rigorous and application-intensive disciplines like Business Optimizing Moodle E-Learning Page Features to Enhance Student Achievement in Business Economics DOI: https://doi.org/10.62872/j1hydk82

Economics. While the quasi-experimental approach, single-institution context, and short study duration present certain limitations, the evidence here provides a compelling basis for future research potentially involving larger, more diverse samples and longer observation periods to validate and refine these interventions further. Ultimately, investing in well-conceived LMS enhancements can not only elevate students' academic success but also contribute to more effective and engaging higher education practices.

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