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Development of a Moodle LMS-Assisted Blended Learning Model in the Information Systems Study Program at Institut Hasan Sulur

Noer Ekafitri Sam, Sirwan, Indra Sukma
Universitas Negeri Makassar, Indonesia
noer.ekafitri@unm.ac.id; sirwan@unm.ac.id

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Abstract

Integrating face-to-face and online learning in higher education requires coherent instructional design and appropriate digital support. This study evaluated the feasibility, practicality, and effectiveness of a Moodle-assisted blended learning model in the Information Systems Study Program. A research and development (R&D) approach was employed, with data collected through expert validation, student responses, classroom activity observations, and pretest and posttest assessments. Evaluation scores were 90% for learning materials, 91% for media presentation, 90% for practicality, 88% for pedagogical aspects, 93% for instructional devices, and 89% for the user guidebook. Individual, small-group, and field trials yielded scores of 84.76%, 89%, and approximately 96%, respectively. The student learning activity assessment yielded 87%. Mean test scores increased from 31.53 before implementation to 45.93 afterward, out of a maximum of 54. These descriptive findings support the model's feasibility and practicality, while the observed score increase provides preliminary evidence of potential learning benefits. The study contributes a technology-supported instructional model for systematically integrating face-to-face and online activities in higher education, with practical implications for lecturers and institutions implementing blended learning. Further evaluation involving a control group and inferential statistical analysis is recommended to establish the model's effectiveness more rigorously.

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Keywords: Blended Learning; Moodle; Higher Education; Student Engagement; Learning Outcomes

INTRODUCTION

The rapid development of information and communication technology has significantly transformed the delivery of higher education. Digital technology is no longer merely a supporting tool for academic administration but has become an essential component of teaching and learning processes (Haleem et al., 2022). Higher education institutions are increasingly expected to develop learning environments that provide flexible access to educational resources, facilitate academic interaction, and promote students' digital competencies(Bruijn-Smolders & Prinsen, 2024). This transformation requires a shift from conventional instructional practices toward more adaptive, interactive, and technology-integrated learning approaches. In this regard, digital learning platforms offer opportunities to improve the accessibility, organization, and management of educational activities (N. E. Sam & Idrus, 2021).

One instructional approach that has gained increasing attention in response to digital transformation is blended learning. Blended learning integrates face-to-face instruction with online learning activities to provide students with more flexible and diverse learning experiences (Dwi & Sofalina, 2026). Thomas et al. (2025) argue that blended learning has transformative potential in higher education because it combines the advantages of direct interaction with the flexibility of online learning environments. More recently, Dania & Amna (2025); Supriatna et al., (2026); Ridayanti et al., (2023) emphasized that blended learning should not be understood merely as the combination of face-to-face and online instructional modes. Instead, its implementation requires careful consideration of learning objectives, instructional activities, interaction patterns, and the pedagogical rationale underlying the integration of different learning environments. Therefore, the quality of blended learning depends not only on technological availability but also on the instructional design that guides its implementation.

In the context of higher education, blended learning is particularly relevant to Information Systems study programs. Information Systems is a field of study closely associated with information technology, digital applications, information management, and

technology-based problem-solving (Hidayah et al., 2024). Consequently, the learning process should extend beyond the delivery of theoretical concepts and provide opportunities for students to develop practical skills, independent learning abilities, and digital competencies. The integration of online learning activities with face-to-face instruction can support these objectives by enabling students to access learning materials, participate in discussions, complete assignments, and engage in learning activities beyond conventional classroom settings. in their research on LMS-based e-learning, demonstrated that technology-supported learning can contribute to student learning activities and learning outcomes in the Information Systems study program (Perrmann-graham et al., 2025).

Despite these opportunities, the implementation of technology-supported learning continues to present several pedagogical and practical challenges. Conventional face-to-face instruction may limit students' flexibility in accessing learning materials and managing independent learning activities (Ahmed & Opoku, 2022); (Khairani et al., 2025); (Dave et al., 2025). On the other hand, fully online learning may reduce opportunities for direct academic interaction between lecturers and students when instructional activities are not adequately designed (Yenti et al., 2026). These challenges indicate the need for an integrated learning model that combines the strengths of face-to-face interaction with the flexibility of digital learning environments. From the researcher's perspective, the availability of digital technology alone is insufficient to ensure meaningful learning experiences. Technology must be integrated into a structured instructional model that clearly defines learning activities, interaction mechanisms, assessment procedures, and the roles of lecturers and students (Ekafitri, 2025).

One technology platform that can support this integration is the Learning Management System (LMS) Moodle. Moodle provides various instructional features, including learning material management, discussion forums, assignment submission, quizzes, assessments, and student activity monitoring. These facilities allow lecturers to organize learning activities systematically while providing students with continuous access to learning resources. Previous research by Sam et al. (2021), entitled Pengembangan Media E-Learning Berbasis Learning Management System (LMS) di Era Pandemi Covid-19, developed Moodle-based learning media and examined its validity, practicality, and effectiveness. Their subsequent study, Efektivitas Media E-Learning Berbasis Learning Management System (LMS) di Era Pandemi Covid-19, investigated the implementation of LMS-based e-learning in the Information Systems study program and reported improvements in student learning

outcomes and learning activities. These studies provide an empirical foundation for the integration of LMS technology into higher education learning processes.

Further contributions by Nurmayanti & Sam (2023) through the development of a Flipped Blended Learning Model based on LMS demonstrated the importance of integrating instructional strategies, digital platforms, and structured learning resources. Subsequently, Ekafitri (2024) developed a flipped-blended learning model for Computer and Network Engineering education using a Research and Development approach. Their findings indicated that the developed model could support learning management, student motivation, and learning outcomes. Ekafitri (2025) also examined the effectiveness of the flipped-blended learning model in vocational education, providing further empirical evidence of the potential of LMS-supported instructional models. Collectively, these studies demonstrate the researcher's continuing contribution to the development of technology-supported learning models. However, the previous studies primarily focused on e-learning media development and flipped-blended learning in vocational education contexts, rather than developing and evaluating a Moodle-assisted blended learning model specifically for the Information Systems study program in the present institutional context.

This distinction identifies an important research gap. Although previous studies have examined the development of LMS-based learning media and flipped-blended learning models, further investigation is needed into the systematic development of a blended learning model that integrates face-to-face instruction and Moodle-supported online activities within an Information Systems higher education context. In particular, the feasibility of the instructional components, practicality of implementation, student engagement, and changes in learning outcomes need to be examined together. Addressing this gap is important because a successful blended learning implementation requires more than the provision of digital learning materials; it requires a coherent instructional structure that connects learning objectives, teaching activities, student participation, learning resources, and assessment.

The novelty of the present study lies in the development and evaluation of a Moodle-assisted blended learning model designed for the Information Systems Study Program at Institut Hasan Sulur. Unlike previous studies that primarily examined LMS-based learning media or flipped-blended learning in vocational secondary education, this study focuses on integrating face-to-face and online learning activities into a structured instructional model for higher education. The theoretical foundation of the study draws on the blended learning

concept proposed by Garrison & Kanuka (2004), which emphasizes the transformative integration of face-to-face and online learning, and the conceptual perspective of Hrastinski (2019), which highlights the importance of pedagogically meaningful integration between different learning modes. These perspectives are complemented by the research and development framework, particularly the evaluation of product feasibility, practicality, and learning outcomes.

Accordingly, this study aims to develop and evaluate a Moodle-assisted blended learning model for the Information Systems Study Program at Institut Hasan Sulur. Specifically, the study examines the feasibility of the model through expert validation of learning materials, instructional media, learning devices, and user guidelines; evaluates its practicality through individual, small-group, and field trials; and investigates its implementation through student learning activity observations and pretest–posttest score comparisons. Through these stages, the study is expected to contribute to the development of instructional models in higher education, particularly by providing an empirically evaluated framework for integrating face-to-face instruction with Moodle-supported digital learning activities.

METHODS

1. Type of Research

This study employed a Research and Development (R&D) approach aimed at developing and evaluating an instructional product. The product developed was a Moodle-assisted blended learning model that integrates face-to-face instructional activities with online learning through a Learning Management System (LMS). The development process focused on producing an instructional model that meets established criteria of content feasibility, media quality, pedagogical suitability, and ease of use for students.

The R&D approach was selected because the study not only examined the implementation of technology-supported learning but also involved the development, validation, and evaluation of an instructional product. The evaluation focused on three main aspects: feasibility, practicality, and the potential effectiveness of the developed blended learning model.

2. Research Design

The research design consisted of a series of systematic development and evaluation procedures. These procedures included identifying learning needs, developing the Moodle-assisted learning media and instructional materials, conducting expert validation, implementing product trials, and evaluating student learning activities and outcomes.

The development and evaluation procedures were organized into the following stages:

a. Needs identification: Identifying the learning requirements and the need to integrate face-to-face instruction with online learning activities.

b. Product development: Developing the blended learning model, digital learning materials, instructional devices, and Moodle user guidelines.

c. Expert validation: Evaluating the developed product through material expert validation, media expert validation, instructional device validation, and user guideline validation.

d. Individual trial: Conducting an initial product trial involving three students to identify aspects requiring improvement.

e. Small-group trial: Implementing the revised product with five students to evaluate its practicality and instructional suitability.

f. Field trial: Implementing the developed model with 15 students to examine student responses and learning activities.

g. Learning outcome evaluation: Administering pretest and posttest assessments to 15 students to describe changes in learning achievement following the implementation of the model.

This design enabled the researchers to examine the quality of the developed product from expert evaluations, student responses, classroom observations, and learning assessment results.

3. Participants and Sampling Technique

The study was conducted in the Information Systems Study Program at Institut Hasan Sulur, as specified in the adapted research title. The participants consisted of students involved in the learning activities and experts who evaluated the developed instructional product.

The student participants were involved in three stages of product testing. The individual trial involved three students, the small-group trial involved five students (Iriani et al., 2024), and the field trial involved 15 students. The pretest and posttest assessments were also administered to 15 students.

The participants were selected based on their involvement in the learning activities and their suitability for evaluating the developed blended learning model. The selection followed the participant distribution documented in the research appendices. The expert validators assessed the instructional materials, learning media, pedagogical aspects, instructional devices, and user guidelines.

The available research documentation does not specify the detailed demographic characteristics of the participants or the exact sampling procedure. Therefore, these details should be confirmed from the original research records before the manuscript is submitted for publication.

4. Instruments and Data Collection

Several instruments were used to collect data on the feasibility, practicality, and learning outcomes of the developed model.

First, expert validation instruments were used to assess the quality of the developed product. The validation covered instructional material suitability, media presentation, ease of use, pedagogical aspects, instructional devices, and the Moodle user guidebook. The assessments were conducted by experts to determine whether the developed product met the required instructional and technical criteria.

Second, student response questionnaires were used to evaluate the practicality and quality of the developed model during the product trials. The questionnaires employed a four-point rating scale: 1 = poor, 2 = fair, 3 = good, and 4 = very good. The assessed dimensions included media presentation, practicality, pedagogical suitability, and learning material quality.

Third, learning achievement tests were administered to measure students' knowledge before and after the implementation of the blended learning model. The assessment instrument consisted of 54 questions covering software and applications as well as Microsoft Excel. The same assessment framework was used for the pretest and posttest to describe changes in students' learning achievement.

Fourth, student learning activity observation sheets were used to document student participation during the learning process. The observation instrument consisted of nine indicators covering various aspects of student engagement in learning activities.

Data collection was conducted sequentially through product development, expert validation, individual testing, small-group testing, field implementation, learning activity observations, and pretest and posttest assessments. The results from these instruments were subsequently analyzed to evaluate the developed model.

5. Data Analysis Technique

The collected data were analyzed using descriptive quantitative analysis. Expert validation, student responses, and learning activity observations were calculated as percentages.

Student learning outcomes were analyzed by comparing the mean pretest and posttest scores. The results were used to describe changes in student learning achievement following the implementation of the Moodle-assisted blended learning model. The analysis was limited to descriptive statistics.

RESULTS

Main Findings

The results of this study are presented based on the evaluation stages of the developed Moodle-assisted blended learning model, including expert validation, product trials, student learning activity observations, and learning outcome assessments.

a. Expert Validation Results

Expert validation was conducted to assess the feasibility of the developed model in terms of instructional materials, media presentation, practicality, pedagogical aspects, instructional devices, and the user guidebook. The validation results are presented in Table1.

Table 1. Expert Validation Results of the Blended Learning Model

Validation aspects	Percentage (%)
Material validation	90
Media presentation	91
Media practicality	90
Pedagogical aspects	88
Instructional devices	93
User guidebook	89

As presented in Table 1, the validation results ranged from 88% to 93%. Instructional devices obtained the highest validation score (93%), whereas pedagogical aspects recorded the lowest score (88%).

b. Product Trial Results

The product trials consisted of individual, small-group, and field trials. These stages involved 3, 5, and 15 students, respectively. The overall results of each trial are presented in Table 2.

Table 2. Student Response Results Across Product Trial Stages

Trial stages	Number of students	Percentage (%)
Individual trial	3	84.76
Small-group trial	5	89.00
Field trial	15	95.97

As shown in Table 2, the individual trial achieved 84.76%, followed by 89.00% in the small-group trial and 95.97% in the field trial. The detailed results of the field trial based on four assessment dimensions are presented in Table 3.

Table 3. Detailed Field Trial Results

Assessment dimensions	Obtained score	Maximum score	Percentage (%)
Media presentation	978	1,020	95.88
Practicality	521	540	96.48
Pedagogical aspects	687	720	95.42
Learning materials	693	720	96.25
Total	2,879	3,000	95.97

Table 3 shows that the overall field trial percentage was 95.97%. The practicality dimension recorded the highest percentage (96.48%), while the pedagogical dimension obtained the lowest percentage (95.42%).

c. Student Learning Activity Results

Student learning activities were assessed using nine observation indicators during four observation sessions conducted on May 12, May 19, June 2, and June 9, 2018. The observation results are summarized in Table 4.

Table 4. Student Learning Activity Observation Results

Observation indicators	Percentage (%)
Indicator 1	86
Indicator 7	90
Indicator 9	86
Overall average	87

As presented in Table 4, the overall student learning activity percentage reached 87%. Indicator 7 recorded the highest percentage (90%), whereas indicators 1 and 9 each obtained 86%. The individual percentages for the remaining indicators were not available in the summarized observation data.

d. Student Learning Outcomes

Student learning outcomes were evaluated through pretest and posttest assessments involving 15 students. The assessment consisted of 54 questions covering software and applications as well as Microsoft Excel. The results are presented in Table 5.

Table 5. Comparison of Pretest and Posttest Results

Assessment	Number of students	Total score	Mean score	Percentage (%)
Pretest	15	473	31.53	58.40
Posttest	15	689	45.93	85.06
Difference	15	216	14.40	26.66

As shown in Table 5, the mean score increased from 31.53 in the pretest to 45.93 in the posttest. The difference between the two mean scores was 14.40 points, representing an increase of approximately 26.66 percentage points relative to the maximum possible score.

The research findings are presented through five tables covering expert validation, product trial responses, detailed field trial results, student learning activities, and learning outcomes.

The tables provide a structured presentation of the quantitative findings at each evaluation stage. Table 1 presents the expert validation results, Table 2 summarizes student responses across product trials, Table 3 details the field trial scores, Table 4 reports student learning activities, and Table 5 presents the comparison of pretest and posttest results. Figure 1 may be used to visualize the comparison of student learning outcomes before and after the implementation of the blended learning model.

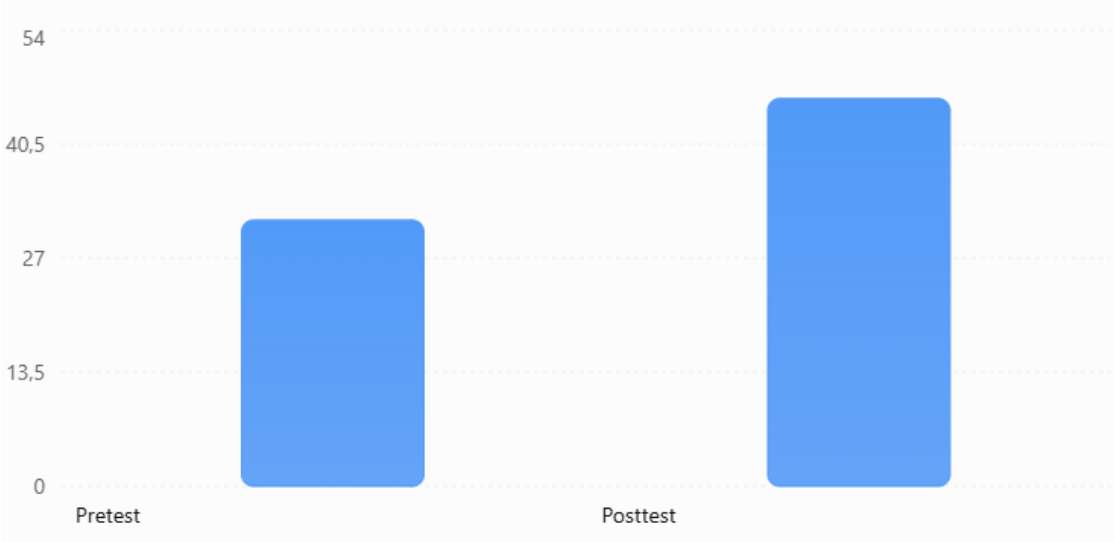


Figure 1. Comparison of Student Pretest and Posttest Mean Scores

The overall findings showed positive assessment percentages across the validation and product trial stages. However, several differences and limitations were identified in the available research data.

First, the pedagogical validation score (88%) was lower than the other expert validation components. Similarly, the pedagogical dimension in the field trial (95.42%) recorded the lowest percentage among the four assessed dimensions.

Second, the individual trial percentage of 84.76% was retained from the original research summary. The detailed underlying scores were not sufficiently available to independently recalculate this percentage.

Third, the student learning activity data provided the overall percentage of 87%, together with selected indicator results. Individual percentages for all nine indicators were not available in the summarized data.

Fourth, the field trial percentages presented in Table 3 were recalculated from the reported obtained scores and maximum scores. The total score was 2,879 out of 3,000, resulting in an overall percentage of 95.97%.

Finally, the pretest and posttest results were analyzed descriptively. No inferential statistical testing, control-group comparison, or normalized gain analysis was reported in the available research documentation.

The percentage of expert validation, student responses, and learning activity observations was calculated using Equation (1).

$$P = \frac{S_o}{S_m} \times 100\%$$

Sumber : Interest (2025)

Where *P* represents the assessment percentage, *So* the obtained score, and *Sm* the maximum score. Student learning outcomes were analyzed by comparing the mean pretest and posttest scores. The difference was calculated using (2).

$$\Delta X = \bar{X}_{posttest} - \bar{X}_{pretest}$$

Sumber : Sari et al. (2026)

DISCUSSION

1. Analysis and Interpretation of Findings

The findings of this study demonstrate that the Moodle-assisted blended learning model achieved positive evaluations in terms of feasibility, practicality, student engagement, and changes in learning outcomes. The expert validation results ranged from 88% to 93%, indicating that the developed model received favorable assessments across instructional materials, media presentation, pedagogical aspects, instructional devices, and user guidelines. These results suggest that the model was developed with consideration of both technological requirements and instructional components.

The relatively high validation score for instructional devices (93%) indicates that the supporting learning components were considered appropriate for implementation. Meanwhile, the pedagogical aspect obtained the lowest score (88%), suggesting that instructional design remains an important area for further refinement. This distinction is important because the quality of a blended learning model is determined not only by the availability of digital facilities but also by the alignment between learning objectives, instructional activities, learning resources, and assessment procedures.

Regarding practicality, student responses increased from 84.76% in the individual trial to 89% in the small-group trial and 95.97% in the field trial. This pattern indicates increasingly positive responses across the product evaluation stages. The field trial also showed that the practicality dimension reached 96.48%, representing the highest score

among the four assessed dimensions. These findings indicate that students responded positively to the organization and use of the Moodle-assisted learning environment.

Student learning activity reached 87%, demonstrating participation across the nine observed indicators. This finding is relevant to the objective of developing a learning model that integrates classroom instruction with online learning activities. The combination allows students to access digital materials while maintaining opportunities for direct interaction during face-to-face sessions.

Furthermore, the comparison of learning outcomes showed an increase in the mean score from 31.53 in the pretest to 45.93 in the posttest, representing a difference of 14.40 points. This result indicates that students achieved higher assessment scores after participating in the learning activities. Taken together, the findings address the research objectives by providing evidence concerning product feasibility, practicality, student participation, and observed changes in learning achievement.

2. Comparison with Theories and Previous Literature

The findings regarding model feasibility are consistent with the theoretical perspective of Garrison & Kanuka (2004), who explain that blended learning has the potential to transform higher education through the meaningful integration of face-to-face and online learning environments. Hrastinsk, (2019) further emphasizes that blended learning should be designed according to pedagogical objectives rather than simply combining different instructional delivery modes. In the present study, the integration of Moodle into face-to-face instruction demonstrates how digital technology can become part of a structured instructional process.

The findings also correspond with previous research conducted by Sam & Idrus (2021), which examined the development and effectiveness of LMS-based e-learning media in higher education. Their research demonstrated the relevance of LMS-supported learning in the Information Systems study context. The present study extends this research direction by focusing on the development and evaluation of an integrated blended learning model rather than solely examining the use of digital learning media.

Similarly, Sam et al. (2023) developed a Flipped Blended Learning Model based on a Learning Management System, while N. Sam et al., (2024) investigated the development of a flipped-blended learning model in Computer and Network Engineering education. Ekafitri (2025) further examined the effectiveness of this instructional approach in vocational

education. These studies provide a foundation for understanding the role of LMS-supported instructional models in organizing learning activities and supporting student participation.

The student activity findings are also consistent with Bruijn-Smolders & Prinsen, (2024), whose systematic review identified the contribution of blended learning design to student engagement and learning outcomes. Argyriou, (2022) likewise reported an association between student engagement in online blended learning activities and academic achievement. These findings suggest that structured online activities can complement classroom instruction by providing additional opportunities for student participation.

Regarding learning outcomes, the increase in posttest scores is consistent with the broader evidence reported in blended learning research. Bruijn-Smolders & Prinsen (2024) identified positive effects of blended learning interventions on several dimensions of student engagement and learning outcomes. However, the present study differs methodologically from studies employing experimental or comparative designs because its learning outcome analysis was limited to descriptive pretest and posttest comparisons. Therefore, the findings demonstrate an observed improvement in student scores but do not establish a statistically significant causal relationship.

Overall, the present study extends previous research by examining the feasibility and practicality of a Moodle-assisted blended learning model in an Information Systems higher education context. Its contribution is particularly relevant to the integration of instructional design, digital learning resources, and student learning activities within one structured model.

3. Research Implications

The findings have theoretical and practical implications for the development of technology-supported learning in higher education.

From a theoretical perspective, this study reinforces the importance of integrating pedagogical design and digital technology in blended learning implementation. The results indicate that the development of a blended learning model should consider not only the technical functionality of the LMS but also the organization of instructional materials, learning activities, student interaction, and assessment. This perspective supports the blended learning framework proposed by Garrison & Kanuka (2004) and the conceptual explanation provided by Hrastinski (2019).

The study also extends the research trajectory of Noer Ekafitri Sam in developing LMS-based learning media and blended learning models (Sam & Idrus, 2021; Sam et al., 2023; Sam et al., 2024; Sam, 2025). The current research contributes additional evidence from the Information Systems higher education context, particularly concerning expert validation, student responses, learning activities, and descriptive changes in learning outcomes.

From a practical perspective, the developed model provides a reference for lecturers in organizing face-to-face and online learning activities through Moodle. Learning materials, assignments, discussion forums, and assessments can be managed within an integrated digital environment. This arrangement may assist lecturers in providing more flexible access to learning resources while maintaining direct academic interaction with students.

For higher education institutions, the findings provide an empirical basis for considering LMS-supported blended learning as an alternative instructional approach. Implementation should be accompanied by adequate lecturer preparation, accessible learning resources, clear instructional guidelines, and continuous evaluation of student learning activities.

4. Research Limitations and Directions for Future Research

Despite its contributions, this study has several limitations. First, the field trial involved only 15 students, limiting the generalizability of the findings to other student populations and higher education institutions. Second, the evaluation of learning outcomes relied on descriptive comparisons between pretest and posttest scores without a control group or inferential statistical testing. Consequently, the observed increase in scores cannot be interpreted as definitive evidence that the developed model caused the improvement.

Third, the student activity data were summarized using an overall percentage and selected observation indicators. Complete individual results for all nine indicators were not available for more detailed analysis. Fourth, the available research documentation requires further confirmation regarding participant characteristics and institutional affiliation to ensure consistency between the original research records and the adapted institutional context.

Future research should involve larger and more diverse participant groups to examine the applicability of the model across different higher education contexts. Experimental or quasi-experimental designs could also be employed to compare the developed model with conventional instructional approaches and determine its effectiveness using appropriate

statistical tests. Furthermore, future studies could investigate additional variables, including student learning independence, digital literacy, learning motivation, satisfaction, and academic engagement.

Longitudinal research may also provide a more comprehensive understanding of the sustainability of blended learning implementation and its contribution to student competency development. These directions would strengthen the empirical evidence concerning Moodle-assisted blended learning and support further refinement of the instructional model.

CONCLUSION

The findings indicate that the Moodle-assisted blended learning model is a feasible and practical instructional alternative for supporting learning activities in the Information Systems Study Program. The integration of face-to-face instruction and online learning through Moodle received positive evaluations from experts and students, while its implementation encouraged active student participation. The comparison of pretest and posttest performance also showed an improvement in students' learning achievement, suggesting the potential of this model to support a more flexible and interactive learning process.

This study contributes to the development of technology-supported learning in higher education by demonstrating how Moodle can be integrated systematically into a blended learning model. Its contribution lies not merely in the use of an LMS as a digital platform, but in its integration with learning materials, instructional activities, student interaction, and assessment. Practically, the developed model provides lecturers, particularly in Information Systems programs, with an alternative framework for organizing face-to-face and online learning in a more structured and flexible manner.

Further research should involve a larger number of participants and different higher education contexts to examine the applicability of the model more broadly. Experimental or quasi-experimental designs involving control groups and appropriate statistical analyses are also recommended to establish stronger evidence of its effectiveness. Future studies may additionally investigate the influence of Moodle-assisted blended learning on student engagement, learning independence, motivation, and digital learning experiences over a longer implementation period.

REFERENCES

Ahmed, V., & Opoku, A. (2022). Technology supported learning and pedagogy in times of crisis: The case of COVID-19 pandemic. *Education and Information Technologies, 27*(1), 365–405. https://doi.org/10.1007/s10639-021-10706-w

Argyriou, P., Benamar, K., & Nikolajeva, M. (2022). What to blend? Exploring the relationship between student engagement and academic achievement via a blended learning approach. *Psychology Learning & Teaching, 21*(2), 126–137. https://doi.org/10.1177/14757257221091512

Dania, R., & Amna, S. (2025). A critical review of the blended learning implementation in Indonesia. *International Journal of Foreign Language Studies, 1*(1), 34–42. https://ijofls.ppj.unp.ac.id/index.php/ijofls/article/view/5

De Bruijn-Smolders, M., & Prinsen, F. R. (2024). Effective student engagement with blended learning: A systematic review. *Heliyon, 10*(23), Article e39439. https://doi.org/10.1016/j.heliyon.2024.e39439

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education, 7*(2), 95–105. https://doi.org/10.1016/j.iheduc.2004.02.001

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers, 3*, 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Hidayah, N. A., Aini, Q., & Ghania, P. (2024). Implementation of blended learning system in higher education to explore the interaction of technology, organization, environment, and technology acceptance model. *Journal of Applied Data Sciences, 5*(2), 491–507. https://doi.org/10.47738/jads.v5i2.204

Hrastinski, S. (2019). What do we mean by blended learning? *TechTrends, 63*(5), 564–569. https://doi.org/10.1007/s11528-019-00375-5

Khairani, M., Burhanudin, Febriani, A., & Az-Zahra, D. W. (2025). 21st century teachers' problems: Teachers' difficulties in implementing technology in the learning process. *Khalaqa: Journal of Education and Learning, 3*(2), 77–84. https://jurnal.staiyastispadang.ac.id/index.php/Khalaqa/article/view/181

Layyinah, R., Muhtadi, A., & Asad, M. (2025). Juz 'Amma memorization board game: An educational media to enhance students' interest and ability in Qur'an memorization. *Profesi Pendidikan Dasar, 12*(3), 231–253. https://doi.org/10.23917/ppd.v12i3.12730

Nurmayanti, Sam, N. E., Khaerani, Faiqah, N. Z., & Tamrin, N. A. (2023). Pemanfaatan Software Simulator Berbasis Android pada Pembelajaran Tatap Muka Terbatas Era New Normal. *Jurnal INSTEK (Informatika Sains dan Teknologi), 8*(1), 142–151. https://journal.uin-alauddin.ac.id/index.php/instek/article/view/37259

Perrmann-Graham, J., Peat, D. M., Christensen-Salem, A., & Walumbwa, F. O. (2025). The evolution of online learning and engagement in management education during disruption: A paradoxical view. *The International Journal of Management Education, 23*(2), Article 101190. https://doi.org/10.1016/j.ijme.2025.101190

Ridayanti, I., Halim, A., & Amin, F. H. (2023). The implementation of blended learning in EFL classroom at SMA Negeri 4 Selayar. *International Journal of Business English and Communication, 1*(2), 68–76. https://journal.unm.ac.id/index.php/ijobec/article/view/118

Salgado, J. D. A., & Paglinawan, J. L. (2025). Teacher's challenges and opportunities in integrating digital technology in the classroom. *International Journal of Scientific and Management Research, 8*(10), 282–292. https://doi.org/10.37502/IJSMR.2025.81022

Sam, N. E. (2025). Effectiveness of the flipped-blended learning model in computer and network engineering education. *Information Technology Education Journal, 4*(3), 536–542. https://doi.org/10.59562/intec.v4i3.10590

Sam, N. E., & Idrus, R. (2021). Pengembangan Media E-Learning Berbasis Learning Management System (LMS) di Era Pandemi Covid-19. *Jurnal Basicedu, 5*(5), 4271–4280. https://doi.org/10.31004/basicedu.v5i5.1503

Sam, N. E., Nurmayanti, Basri, & Linda. (2023). Pengembangan Model Flipped Blended Learning (MFBL) Berbasis Learning Management System Post Pandemi COVID-19. *Jurnal INSTEK (Informatika Sains dan Teknologi), 8*(1), 76–85. https://journal.uin-alauddin.ac.id/index.php/instek/article/view/37095

Sam, N. E., Nurmayanti, & Nurjanna. (2021). Pengembangan Media Pembelajaran Elektronika Dasar Berbasis Komik dengan Adobe Illustrator CS5. *Indonesian Journal of Educational Science (IJES), 3*(2), 138–145. https://doi.org/10.31605/ijes.v3i2.1013

Sam, N. E., Purnamawati, & Mappalotteng, A. M. (2024). Development of learning models computer and network engineering expertise concentration based on flipped-blended learning. *Asian Journal of Education and Social Studies, 50*(4), 302–313. https://doi.org/10.9734/ajess/2024/v50i41332

Sari, K. S., S, A. E., & Fitriyana, N. (2026). Mathematics learning outcomes before and after the implementation of LKPD-assisted discovery learning among Grade VII students. *Jurnal Didactical Mathematics, 8*(2), 515–526. https://ejournal.unma.ac.id/index.php/dm/article/view/19753

Sofalina, F. D. J., Priadi, R., & Faiz, M. I. (2026). Determinants of learning effectiveness in digital STEM higher education: A cross-sectional study using hierarchical regression. *Information Technology Education Journal, 5*(1), 41–56. https://doi.org/10.59562/intec.v5i1.263

Supriatna, A., Nurdin, E. S., Warlim, Hidayat, M., & Nugraha, R. A. (2026). Blended learning as a pedagogical ecology: Relational-regulatory functions in the internalization of Pancasila values and the strengthening of good character. *Pedagogy Review, 5*(4), 585–604. https://doi.org/10.61436/pedrev/v5i4.pp585-604

Syahmani, Iriani, R., Kusasi, M., Prasetyo, Y. D., Norhasanah, H., & Rahman, N. F. A. (2024). Culturally wetland responsive teaching to improve science literacy and Wasaka character. *Journal of Innovation in Educational and Cultural Research, 5*(2), 196–206. https://doi.org/10.46843/jiecr.v5i2.1075

Thomas, S., Joshi, M., Anjana, C., Dolly, & Chavan, A. V. (2025). Blended learning in education: The future of digital pedagogy. *Journal of Marketing & Social Research, 2*(5), 329–335. https://jmsr-online.com/article/blended-learning-in-education-the-future-of-digital-pedagogy-279/

Yenti, Y., Septiani, L. S., Ramadia, Z., & Muzakki, M. A. (2026). The impact of online learning on students' level of understanding of material. *Al-Manar: Jurnal Komunikasi dan Pendidikan Islam, 15*(1), 440–451. https://journal.staimsyk.ac.id/index.php/almanar/article/view/1857