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Implementing the Power of Blended Learning in the Era of AI War in Indonesia

Implementación del poder del Blended Learning en la era de la guerra de la IA en Indonesia

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ABSTRACT
This study investigates the factors that influence the implementation of blended learning and artificial intelligence (AI) in teaching and learning in Indonesia. Five factors are proposed: Structure and Support System, Schedule Blended learning, Pedagogy Support, Method in Blended Learning, and Assessment in Blended Learning. The study employed a questionnaire survey method to gather data from 625 lecturers who had implemented blended learning at universities in Indonesia. The structural equation model using the partial least square method (PLS-SEM) was employed to analyze the data. The findings of the study demonstrate that all five independent variables (Structure and Support System, Schedule Blended learning, Pedagogy Support, Method in Blended Learning, and Assessment in BL) exhibit a significant positive correlation with the dependent variable, Blended Learning-AI in teaching learning. The results of this study provide empirical evidence to support the proposed hypotheses. The study also provides insights into the factors that may influence the effectiveness of implementation of blended learning and AI in teaching and learning.

RESUMEN
Este estudio investiga los factores que influyen en la implementación del aprendizaje combinado y la inteligencia artificial (IA) en la enseñanza y el aprendizaje en Indonesia. Se proponen cinco factores: Estructura y Sistema de Apoyo, Horario de Aprendizaje Combinado, Apoyo Pedagógico, Método en el Aprendizaje Combinado y Evaluación en el Aprendizaje Combinado. El estudio empleó un método de encuesta por cuestionario para recopilar datos de 625 profesores que habían implementado el aprendizaje combinado en universidades de Indonesia. Para el análisis de los datos se empleó el modelo de ecuaciones estructurales mediante el método de mínimos cuadrados parciales (PLS-SEM). Los resultados del estudio demuestran que las cinco variables independientes (Estructura y Sistema de Apoyo, Horario de Aprendizaje Combinado, Apoyo Pedagógico, Método en Aprendizaje Combinado y Evaluación en BL) exhiben una correlación positiva significativa con la variable dependiente, Blended Learning-IA en la enseñanza del aprendizaje. Los resultados de este estudio aportan evidencia empírica para apoyar las hipótesis propuestas. El estudio también proporciona información sobre los factores que pueden influir en la eficacia de la implementación del aprendizaje combinado y la IA en la enseñanza y el aprendizaje.

KEYWORDS · PALABRAS CLAVES
Blended learning; artificial intelligence; teaching and learning, higher education; ICT
aprendizaje combinado; inteligencia artificial; enseñanza-aprendizaje; enseñanza universitaria; TIC

1. Introduction

The educational landscape has undergone a significant transformation due to rapid technological progress, leading to the emergence of innovative methods for teaching and learning (Delenko & Sholovii, 2023; Hernández et al., 2024; Kebir, 2023). Blended learning, a pedagogical approach that seamlessly combines traditional face-to-face instruction with online learning activities, has emerged as a promising alternative to conventional classroom-based education. This strategy creates a vibrant learning environment that caters to the diverse needs and preferences of students, promoting flexibility, customization, and increased involvement.

The integration of artificial intelligence (AI) into blended learning environments has further amplified its potential to transform teaching and learning (Dimitriadou & Lanitis, 2023; Ng et al., 2023; Stone, 2023). AI-powered tools, such as adaptive learning systems, intelligent tutoring systems, and data analytics dashboards, provide educators with valuable insights into student performance and preferences, enabling them to tailor instruction to individual needs and optimize learning outcomes. The fusion of traditional and online teaching methods presents a promising avenue for optimizing learning experiences (Goyal et al., 2023; Panova et al., 2023; Yc et al., 2023). As Indonesia's higher education sector witnesses increasing adoption of blended learning, it becomes imperative to delve into the foundational aspects that contribute to its effectiveness.

1.1. The Influencing Factors of the Blended Learning Model at the AI Era

1.1.1. Structure and Support System Related to Blended Learning

In the era of artificial intelligence (AI), blended learning frameworks have emerged as formidable tools for enhancing teaching and learning processes (Arul Raj et al., 2024; Ng et al., 2023; Park & Doo, 2024). These frameworks combine traditional face-to-face instruction with online activities, offering dynamic and tailored educational encounters. However, the efficacy of blended learning relies on a thoughtfully designed and supportive system that meets the needs of both students and instructors.

A well-structured and supportive system is essential for the effectiveness of blended learning models (Rahmi et al., 2024; Southern Federal University & Moskvin, 2023; TuğtekiN, 2023). This system should include clear expectations and guidelines, technical support, and pedagogical support, ensuring students and instructors have the resources they need to utilize technology successfully in the learning process. Accordingly, the present study posits the following hypotheses:

- **Hypothesis 1 (H1):** Structure and Support System Related to Blended Learning significantly influences Blended Learning and Artificial Intelligence in Teaching and Learning.

- **Hypothesis 2 (H2):** Pedagogical Support Related to Blended Learning mediates the relationship between Structure and Support System and Blended Learning-Artificial Intelligence in Teaching and Learning.

1.1.2. Class Schedule Related to Blended Learning

The class schedule plays a pivotal role in the effectiveness of blended learning models (Delenko & Sholovii, 2023; Henseruk et al., 2023). Educators can craft class schedules that foster student engagement, promote efficient time management, and optimize the use of AI-powered tools, potentially revolutionizing teaching and learning. Thus, the following hypotheses are proposed:

- **Hypothesis 3 (H3):** Class Schedule Related to Blended Learning significantly influences Blended Learning-Artificial Intelligence in Teaching and Learning.

- **Hypothesis 4 (H4):** Pedagogical Support Related to Blended Learning mediates the relationship between Class Schedule and Blended Learning-Artificial Intelligence in Teaching and Learning.

1.1.3. Method of Blended Learning and AI in Teaching and Learning

Blended learning and AI, though nascent, hold immense promise for revolutionizing the teaching and learning landscape (Zhang et al., 2024). As AI evolves, the emergence of more innovative AI applications in blended learning environments is anticipated. Thus, the following hypothesis is proposed:

- **Hypothesis 5 (H5):** Blended Learning Method significantly influences Blended Learning and Artificial Intelligence in Teaching and Learning.

- **Hypothesis 6 (H6):** Pedagogical Support mediates the relationship between Blended Learning Method and Blended Learning-Artificial Intelligence in Teaching and Learning.

1.1.4. Assessment of Blended Learning and AI in Teaching and Learning

Opportunities associated with AI in blended learning assessment include increased flexibility and the provision of real-time, personalized feedback, enhancing the effectiveness, fairness, and personalization of assessments (Camacho-Zuñiga et al., 2023; Inprasitha, 2023; Sallam et al., 2023). Therefore, the following hypothesis is made:

- **Hypothesis 7 (H7):** Assessment significantly influences Blended Learning and Artificial Intelligence in Teaching and Learning.

- **Hypothesis 8 (H8):** Pedagogical Support mediates the relationship between Assessment and Blended Learning-Artificial Intelligence in Teaching and Learning.

1.1.5. Pedagogical Support Mediates Blended Learning and AI in Teaching and Learning

Pedagogical support is crucial for the success of blended learning and AI in teaching and learning, helping instructors create effective and engaging courses (Casal-Otero et al., 2023; Li & Wong, 2023; Warner et al., 2023). Therefore, the following hypothesis is made:

- **Hypothesis 9 (H9):** Pedagogical Support significantly influences Blended Learning and Artificial Intelligence in Teaching and Learning.

1.2. Conceptual Framework

Figure 1

Conceptual Framework

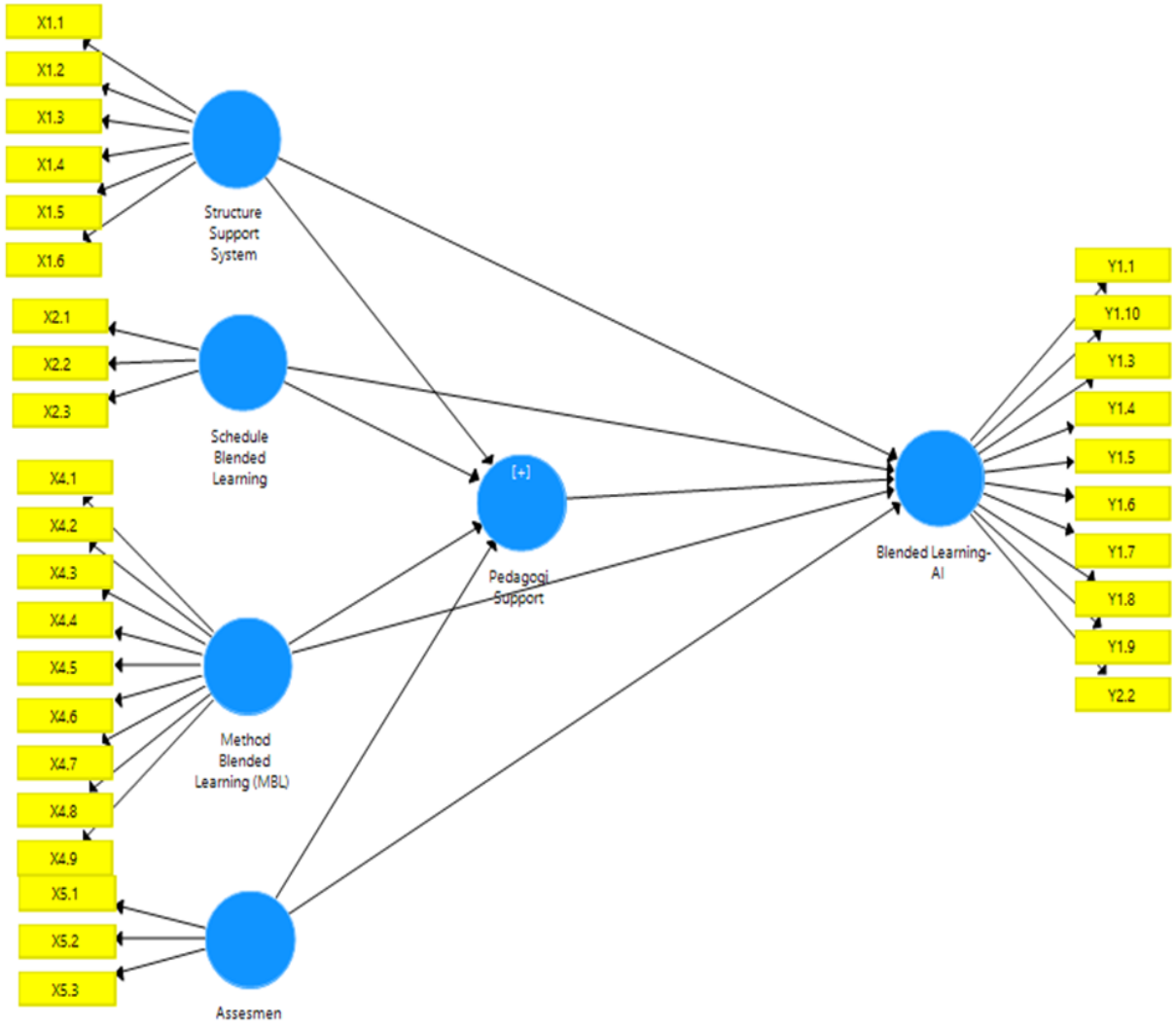

Figure 1 depicted in the succeeding section illustrates the derived conceptual framework as obtained from this particular study. This framework explores and analyzes five distinct direct relationships, namely Hypothesis 1 (H1), Hypothesis 3 (H3), Hypothesis 5 (H5), Hypothesis 7 (H7) and Hypothesis 9 (H9). Besides, this framework also examines the four mediating Hypothesis 2 (H2), Hypothesis 4 (H4), Hypothesis 6 (H6): and Hypothesis 8 (H8).

2. Methodology

In this research, a quantitative approach was embraced, utilizing an online survey targeted at lecturers across Indonesian public universities with experience in blended learning and Artificial Intelligence (AI). To strike a balance between the need for specific, experience-based insights and the statistical rigor of our study, we combined judgmental sampling with the Slovin formula for determining our sample size. This hybrid methodological approach allowed for the targeted collection of data from a pertinent subset of the academic population while ensuring the representativeness and reliability of our findings. Specifically, the Slovin formula, n=N1+N(e)2n=1+N(e)2N, where NN is the estimated population of lecturers and ee is a 5% margin of error, guided us to an appropriate sample size, enhancing the confidence in our study's conclusions. The survey commenced with a screening query to isolate lecturers with direct blended learning and AI teaching experience, thus ensuring the relevance and applicability of the collected data. By judiciously selecting our participants and carefully calculating our sample size, this study adeptly navigated the complexities of researching emerging educational technologies, providing valuable insights into the adoption and impact of blended learning and AI within the Indonesian higher education context.

The second section pertained to the demographic profile of the respondents. Lastly, the third section addressed multiple-item scales related to six constructs developed in this study. All items in the questionnaire were adapted from previous studies and measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Following this, a pre-testing phase was conducted to assess the questionnaire's reliability before the final data collection procedure. The results of the pre-test necessitated further descriptions of various variables, such as structure and support system, class schedule, method, assessment, pedagogical support, and blended learning. Subsequently, these descriptions were added, and the same respondents were asked to answer the revised questionnaire to confirm the reliability of the constructed items. Two expert panels specializing in research methodology and online learning were selected to review the items in the instrument, ensuring the content validity of the constructed items. Based on the comments provided by both experts, certain modifications were made.

3. Analysis and results

The instructor provided prior notice to the students before the commencement of the course, and subsequent to its implementation, the students were invited to willingly complete a questionnaire. This research questionnaire employs Likert's 5-point scale, encompassing choices such as "strongly disagree," "disagree," "neutral," "agree," and "strongly agree." For the first-year students from the Digital Content Design Department at Ling Tung University in Taiwan, a total of 173 valid questionnaires were disseminated and completed following a 9-week period of blended learning. Subsequently, SPSS 22.0 (IBM, USA) software was utilized to perform descriptive statistics and independent sample t-test methods to assess the differential analysis of various background variables on research variables. Smart-PLS 3.0 employs partial least squares structural equation modeling (PLS-SEM) to ascertain the correlation between observed variables and latent variables utilizing a reflective measurement model. Partial least squares structural equation modeling (PLS-SEM) is an analytical technique employed to establish or identify predictive models. Particularly for the analysis of causal models between latent variables, it surpasses the general linear structural relationship model, rendering it highly suitable for exploratory research. In contrast to covariance-based structural equation modeling (CB-SEM), which is evaluated based on covariance matrices, PLS-SEM is appropriate for conducting analyses on small samples (J. Hair & Alamer, 2022). (Kock & Hadaya, 2018) recommended that the sample size requirement for PLS should be at least 10 times the dimension of the majority of question items.

According to the principle of statistical conservativeness, it is imperative to employ a larger sample size. Consequently, the research necessitates a minimum sample size of no less than 80. Remarkably, the sample size for this particular study amounts to 625, satisfying the required minimum sample size. PLS-SEM is predominantly designed to identify whether the causal relationship possesses a statistically significant mutual linear association. Furthermore, it proves to be highly suitable for the establishment of theoretical models. In this study, PLS-SEM is utilized as a methodology to investigate the connection between the variables under scrutiny. Consequently, it predominantly utilizes the PLS Algorithm and Bootstrapping to repetitively sample 5000 times, thereby obtaining path coefficients and determining significance.It can discuss the correlation and influence between the dimensions.

Table 1

Questionnaire items and reference

Dimensions	No	Question	Relevant Literature
Structure and Support System	1	Does the institution regularly revisit and communicate the strategic purposes for engaging in BL?	Graham, C.R., Woodfield, W., & Harrison, J. B. (2013).
	2	Has your university published a uniform definition of BL?	
	3	Does the institution regularly revisit the definition to assure that it is addressing the needs of increased numbers of BL adopters?	

Dimensions	No	Question	Relevant Literature
Schedule	4	Does your technological infrastructure primarily focus on supporting traditional classroom instruction?	
	5	Is there an increased focus on providing technological infrastructure for BL faculty adopters?	
	6	Is there a well-established technological infrastructure in place for BL faculty and student adopters?	
	7	Does the registration/catalog system not distinguish between BL courses and traditional courses?	
	8	Is there an effort to designate BL and online courses in the registration/catalog system?	
	9	Are designations for traditional, BL, and online courses available in the registration/catalog system?	
Pedagogical Support	10	Does pedagogical support primarily focus on strategies for traditional classroom instruction?	
	11	Is there Professional Development available that focuses on strategies for blending online and on campus instruction?	
BL method	12	How many percentage portion in offline learning?	Henritius, E., Löfström, E., & Hannula, M. S. (2019).
	13	How many percentage portion in online learning?	Mcguinness, C., & Fulton, C. (2019).
	14	Face to face intensity in semester period?	
	15	Seminar method intensity in semester period?	
	16	Experiment method intensity in semester period?	
	17	Do you use video in face-to-face learning?	Putra, A. B. R. N., Mukhadis, A., Soraya, D. U., & Dzakiya, N. (2019)
	18	Do you use interactive website in learning?	
	19	Do you use flip learning method in class?	
	20	Have you ever used hybrid methods in classroom learning?	
	21	Have you ever used AI-based teaching materials	
	22	What kind of AI-based teaching materials have you ever used?	
Assessment	23	What kind of assessment method do you use in learning?	Davison, E.; Price, J. (2009)
	24	Have you ever used "quiziz" application to assess your class?	Walker, J.D., Brooks, D.C., Hammond, K., Fall, B.A., Peifer, R.W., Schnell, R., and Schottel, J.L. (2014).
	25	Have you ever made an evaluation question using Google Forms?	Hoffman, B. and Lowe, D. (2011)
Blended Learning-AI	26	Integration of Blended Learning Components:	Putra, A. B. R. N., Mukhadis, A., Soraya, D. U., & Dzakiya, N. (2019)
	27	Utilization of Artificial Intelligence:	
	28	Adaptability of Content Delivery	
	29	Student Engagement and Interaction	
	30	Assessment Alignment with Blended Learning and AI	

Dimensions	No	Question	Relevant Literature
	31	Feedback Mechanisms	
	32	Learning Analytics Utilization	
	33	Technological Infrastructure	
	34	Perceived Impact on Student Outcomes	
	35	Instructor Professional Development	

3.1. Demographic Profile

Drawing conclusions from the presented table, we can infer insights regarding the demographic profile of the respondents: The majority of the respondents are female (54.40%), with males accounting for 45.60%. The largest age group is 36-40 years old and above, with 57.50% of respondents falling into this category. The remaining 42.50% of respondents are 31-35 years old. All of the respondents are lecturers. Overall, the demographic profile of the respondents suggests that they are a relatively evenly split group of males and females, with the majority of them being in their late 30s and early 40s. Additionally, all of the respondents are employed as lecturers.

Table 2

Demographic Profile

Demographics	Respondents (n=625)	Percentage (%)
Gender	Male	45.60%
	Female	54.40%
Age	31-35 years old	42.50%
	36-40 years old and above	57.50%
Work	Lecturer	100%

3.2.Measurement Model

The evaluation of the measurement model comprises internal consistency (reliability), convergent validity (loading ≥ 0.708 and average variance extracted ≥ 0.5), composite reliability (CR) with a threshold of ≥ 0.7, and discriminant validity for the indicators, as outlined by (Hair & Alamer, 2022). Following this, the structural model reveals the outcomes of the research hypotheses. The findings of the measurement model are outlined in Table 2. Concerning cross loading, four items (STR4, PS1, ME5, and ME9) must be eliminated due to insufficient loading below 0.708. Regarding AVE and CR, all constructs demonstrated values exceeding 0.5 for AVE and 0.7 for CR, confirming the reliability of the measurement model at both the item and construct levels.

Table 3

Measurement model

Construct	Items	Loadings	CR (>0.7)	AVE (>0.5)
Structure and Support System	STR1	0.816	0.772	0.836
	STR2	0.706		
	STR3	0.72		
	STR4	**0.188**		
	STR5	0.766		
	STR6	0.766		
Schedule	SCH1	0.813	0.89	0.73
	SCH2	0.948		
	SCH3	0.794		
Pedagogical Support	PS1	**0.49**	0.715	0.978
	PS2	0.771		
	PS3	0.77		
	PS4	0.921		
Method	ME1	0.736	0.914	0.873
	ME2	0.703		
	ME3	0.698		
	ME4	0.652		
	ME5	**0.108**		
	ME6	0.605		
	ME7	0.721		
	ME8	0.633		
	ME9	**0.191**		
Assessment	ASS1	0.762	0.796	0.796
	ASS2	0.704		
	ASS3	0.872		
Blended Learning-AI	BLA1	0.657	0.708	0.843
	BLA2	0.711		
	BLA3	0.701		
	BLA4	0.848		
	BLA5	0.727		
	BLA6	0.866		
	BLA7	0.852		
	BLA8	0.757		
	BLA9	0.659		
	BLA10	0.332		

Subsequently, discriminant validity was evaluated using the HTMT criterion proposed by Henseler et al. (2015) and Franke and Sarstedt (2019). A more stringent criterion is represented by an HTMT value of ≤ 0.85, while a more lenient criterion is represented by ≤ 0.90. As depicted in Table 3, all HTMT values were below ≤ 0.85. Consequently, it can be

inferred that the five constructs are clearly distinguishable by the respondents and that the measurement items for all constructs possess both validity and reliability.

Table 4

Discriminant Validity

	Ass	BL-AI	Method	Pedagogi	Schedule	Structure
Assesmen						
Blended Learning-AI	0.782					
Method_Blended_Learning	0.719	0.757				
Pedagogi_Support	0.604	0.642	0.678			
Schedule_Blended_Learning	0.676	0.791	0.776	0.713		
Structure_Support_System	0.676	0.656	0.631	0.665	0.735	

3.3. Structural Model

The next step involved assessing the structural model to evaluate the accuracy of the research model's estimates and the significance of the hypothesized relationships between the variables. Following the recommendation of J. F. Hair et al. (2021), a bootstrapping procedure with 5,000 samples was employed to examine the path coefficients, standard errors, t-values, and effect sizes (f2) of the structural model. The analysis of Table 4, which examines the direct relationships between various factors and Blended Learning-Artificial Intelligence (BL-AI), reveals noteworthy insights. Each hypothesis (H1 to H5) demonstrates a significant positive relationship, as indicated by the positive beta coefficients (β) and the corresponding p-values below the conventional threshold of 0.05. Specifically, the structural support system (H1), schedule (H2), pedagogy support (H3), method in blended learning (H4), and assessment in blended learning (H5) all exhibit strong statistically supported connections with BL-AI.

The effect sizes (f2) further emphasize the practical significance of these relationships, ranging from 1.034 to 2.292. The decision to support each hypothesis is reinforced by the robust statistical evidence. Notably, the overall model fit, as measured by the coefficient of determination (R2), is substantial, with an impressive value of 0.541, signifying that the specified predictors collectively account for a significant proportion of the variance in BL-AI. This suggests that the proposed structural support system, schedule, pedagogy support, method in blended learning, and assessment in blended learning contribute meaningfully to the understanding and prediction of BL-AI, providing a comprehensive view of the direct relationships examined in this study.

Table 5

Direct Relationship

Hypothesis	β	SE	P-value	f^2	Decision	R^2
H1 : Structure Support System -> BL-AI	0.703	2.954	0.003	1.229	Supported	0.541
H2 : Schedule -> Blended Learning - AI	0.624	4.49	0.004	1.109	Supported	0.459
H3 : Pedagogical Support -> BL-AI	0.587	4.323	0.001	2.292	Supported	
H4 : Method in Blended Learning -> BL-AI	0.613	6.494	0.003	1.034	Supported	
H5 : Assesmen in Blended Learning-> BL-AI	0.786	3.975	0.001	1.057	Supported	

Table 5 explores the mediating relationships between key factors, namely Structure Support System, Schedule in Blended Learning, Method in Blended Learning, and Assessment in Blended Learning, with Pedagogy Support serving as the mediator, ultimately influencing Blended Learning-Artificial Intelligence (BL-AI). The beta coefficients (β) for all hypotheses are positive, ranging from 0.587 to 0.703, indicating a significant direct effect of the independent variables on the mediator. The p-values for each hypothesis fall below the conventional threshold of 0.05, affirming the statistical significance of these relationships. Consequently, all hypotheses are supported, suggesting that Pedagogy Support indeed acts as a mediator in the relationship between Structure Support System, Schedule, Method, and Assessment with BL-AI. This implies that the impact of the structural support system, schedule, method, and assessment on BL-AI is partially, if not wholly, explained by the mediation of pedagogy support. This intricate web of relationships underscores the importance of considering not only the direct effects of certain factors on BL-AI but also the indirect effects mediated through pedagogy support. In conclusion, the findings highlight the nuanced interplay between these variables and emphasize the pivotal role of pedagogy support in shaping the integration of Blended Learning and Artificial Intelligence in educational settings. The statistically supported mediating relationships contribute to a more comprehensive understanding of the mechanisms at play in the complex landscape of educational technology adoption.

Table 6

Mediating Relationship

Hypothesis	β	SE	P- value	Decision
Structure_Support_System -> Pedagogi_Support -> BL-AI	0.703	2.954	0.002	Supported
Schedule_Blended_Learning -> Pedagogi_Support -> BL-AI	0.624	4.49	0.001	Supported
Method_Blended_Learning -> Pedagogi_Support -> BL-AI	0.587	4.323	0.002	Supported
Assesmen -> Pedagogi_Support -> Blended Learning-AI	0.613	6.494	0.003	Supported

4. Discussion

This study demonstrates that all five independent variables—Structure and Support System, Schedule of Blended Learning, Pedagogical Support, Methodology in Blended Learning, and Assessment in Blended Learning—have a significant positive relationship with the dependent variable, Blended Learning-AI integration in teaching and learning. The effect sizes of these relationships range from small (f2 = 0.034) to large (f2 = 2.292), with Pedagogical Support showing the largest effect size, followed by Assessment in Blended Learning, Structure and Support System, Schedule of Blended Learning, and Methodology in Blended Learning. The overall model fit, as indicated by the coefficient of determination (R2), is significant at 0.541, suggesting a substantial explanatory power for the model.

Firstly, the research revealed that the Structure and Support System related to Blended Learning significantly impacts the integration of Blended Learning and AI in teaching and learning (H1), aligning with findings from existing research (Wan, 2023). The effectiveness of the Structure and Support System in facilitating Blended Learning-AI is determined by various factors, in order of impact: the institution's commitment to regularly revising and communicating the strategic purposes for engaging in Blended Learning, the existence of a well-established technological infrastructure for faculty and students, and an increased focus on technological support for faculty adopters. An indirect effect was observed in Hypothesis 2 (H2), where Pedagogical Support mediates the relationship between the Structure and Support System and Blended Learning-AI integration (consistent with Tayag, 2020; Zheng, 2020).

Secondly, it was found that the Class Schedule related to Blended Learning significantly influences Blended Learning-AI integration (H3), which is supported by existing research (Li et al., 2021; Wahid et al., 2022). The effectiveness of Class Schedule is influenced by efforts to designate Blended Learning and online courses in the registration/catalog system, the absence of distinctions between Blended Learning courses and traditional courses in the system, and the availability of designations for various course types. An indirect effect is noted in Hypothesis 4 (H4), where Pedagogical Support mediates the impact of Class Schedule on Blended Learning-AI integration, resonating with findings from Gosh & Anwar (2022) and Vásquez Astudillo (2020), highlighting the crucial role of Pedagogical Support in enhancing the effectiveness of Blended Learning-AI implementation, especially in managing class schedules.

Thirdly, the study identifies that the Methodology in Blended Learning significantly affects Blended Learning and AI in teaching and learning (H5), corroborating with the literature (Khalil et al., 2018). The impact of Blended Learning Methodology is shaped by various factors, such as the intensity of face-to-face interactions during the semester, the adoption of hybrid learning methods, and the use of AI-based teaching materials, among others. Hypothesis 6 (H6) reveals that Pedagogical Support acts as a mediator in this relationship (Hakim et al., 2023; Wan, 2023; Xiao & Jiang, 2023).

Fourthly, the research establishes that Assessment significantly affects Blended Learning and AI in teaching and learning (H7), in line with previous findings (Hooda et al., 2022; Liu et al., 2022). The influence of Assessment on Blended Learning-AI is driven by factors such as the utilization of the "quiziz" application for class assessments. An indirect effect is discovered in Hypothesis 8 (H8), where Pedagogical Support mediates the relationship between Assessment and Blended Learning-AI integration.

Lastly, the study shows that Pedagogical Support significantly contributes to Blended Learning and AI in teaching and learning, influenced by factors like the proportion of online learning and the availability of professional development focusing on blended teaching strategies (Alam, 2022; Brits et al., 2022).

In summary, this study's findings shed light on the multifaceted factors that facilitate the adoption of blended learning and AI in educational contexts, offering significant implications for educational policy, practice, and scholarly research.

5. Conclusions

This study investigated the factors that influence the implementation of blended learning based artificial intelligence (AI) in teaching and learning in Indonesia. The study found that all five independent variables (Structure and Support System, Schedule Blended learning, Pedagogy Support, Method in Blended Learning, and Assesmen in BL) have a significant positive relationship with the dependent variable, Blended Learning-AI in teaching learning. The study also found that Pedagogy Support mediates the relationship between Structure and Support System, Class Schedule, Blended Learning Method, and Assessment. The findings of this study provide valuable insights into the factors that influence the adoption of blended learning and AI in educational settings. The study has important implications for educational policy, practice, and research.

6. Study Limitations

- **Sample Diversity:** While our study successfully gathered data from 625 lecturers across various universities in Indonesia, the focus on higher education limits the generalizability of our findings to other educational levels. Future studies could explore the implementation of blended learning and AI in primary and secondary educational settings to provide a more comprehensive understanding.

- **Regional Representation:** The study predominantly represents the perspectives of lecturers in Indonesia, which may not fully encapsulate the challenges and opportunities of blended learning and AI integration in other cultural or regional contexts. Further research in diverse geographical areas would be beneficial.

- **Technological Infrastructure:** Our findings highlight the critical role of structural support systems; however, the variability in technological infrastructure across institutions may affect the applicability of our results. Studies that account for these disparities could offer more tailored recommendations.

- **Rapid Technological Advancements:** The fast-paced nature of AI and educational technology means that our study's insights might quickly become outdated. Continuous research is necessary to keep abreast of new developments and their implications for blended learning.

Future Research Directions:

- **Longitudinal Studies:** To better understand the long-term effects and sustainability of blended learning and AI in education, future research could employ longitudinal study designs.

- **Comparative Studies:** Comparing the effectiveness of blended learning and AI integration across different countries or educational systems could provide valuable insights into best practices and universal challenges.

- **Focus on Student Outcomes:** Further research could concentrate on the direct impact of blended learning and AI on student learning outcomes, engagement, and satisfaction to identify the most effective strategies and tools.

- **Technological Adoption Barriers:** Investigating the barriers to adopting blended learning and AI tools among educators and institutions could help in developing targeted interventions to facilitate smoother transitions to these innovative teaching models.

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Aplicaciones tecnológicas relacionadas con la edad temprana infantil

Technology applications related to early childhood

Coordinadora:

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Spain

Introducción

Decir que las aplicaciones tecnológicas están relacionadas con la primera infancia es quedarse corto.

La primera infancia es un estadio de desarrollo que mejora la vida escolar. Es la etapa más importante para cambiar la vida futura de un niño. La educación de un niño empieza en casa.

La tecnología determina la calidad de la educación temprana de un individuo. La educación infantil mejora los conocimientos, las habilidades y desarrolla la personalidad y la actitud de los niños. Sobre todo, la tecnología en la primera infancia afecta la familia del niño.

Un niño con un alto grado de ayudas tecnológicas aumenta su capacidad de desarrollo.

En este monográfico sobre la importancia de las aplicaciones tecnológicas relacionadas con la primera infancia, discutiremos su valor en la escuela y la familia.

To say that Technology applications related to early childhood is an understatement.

Early childhood is a weapon to improve school life. It is the most important stage for changing future lives. A child's education begins at home.

Technology certainly determines the quality of an individual's early education. Early childhood education improves knowledge, skills and develops personality and attitude of children. Most notably, early childhood technology affects a child's family.

A child with a high level of technological aids increases their developmental capacity.

This monograph on the importance of technology applications related to early childhood will tell you about its value in school and family.

Alcance

El monográfico **Aplicaciones tecnológicas relacionadas con la edad temprana infantil** abordará intervenciones tecnológicas tempranas para niños con necesidades especiales, modelos de atención integral que proporcionan servicios tecnológicos y apoyos de manera holística, abordando las necesidades del niño y su familia de manera coordinada, avances tecnológicos en el diagnóstico precoz con la colaboración de distintos profesionales (médicos, terapeutas, educadores y trabajadores sociales), e investigaciones tecnológicas recientes obre educación temprana

*The monograph **Technology applications related to early childhood** will address early technology interventions for children with special needs, integrated care models that provide technology services and supports holistically, addressing the needs of the child and family in a coordinated way, technology advances in early diagnosis with the collaboration of different professionals (doctors, therapists, educators and social workers), and recent technology research on early education.*

Descriptores/Líneas Temática

- Modelos tecnológicos para la educación temprana
- Guía para padres y madres sobre edad temprana
- Uso de tecnologías digitales para educación temprana
- Educación informática integrada en tecnología para la primera infancia
- Relación entre los antecedentes de los futuros maestros y el uso de la tecnología en la educación infantil: visión comparada
- Relación entre los antecedentes de los futuros maestros y el uso de la tecnología en la educación infantil: estudio de caso
- Comunicación educador-cuidador a través de la tecnología
- Aplicación tecnológica para la medición del desarrollo infantil: estudio comparado
- Aplicación tecnológica para la medición del desarrollo infantil: estudio de caso
- Revisión de la literatura de naturaleza empírica sobre el uso de la tecnología en la educación temprana
- Tecnología y sostenibilidad en el cuidado de la educación temprana

- El desarrollo artístico en la educación temprana con ayuda de dispositivos tecnológicos
- Los juegos y las actividades dramáticas en la educación temprana
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- De la gamificación a la IA en educación temprana
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