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The Effectiveness of Blended Learning in Enhancing Critical Thinking Skills among University Students

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ABSTRACT: The present paper is a review of the applicability of blended learning to the creation of critical thinking skills among university students in contemporary environment of the rapidly advancing digital learning landscape. This research relies on constructivist theory of learning, and the Taxonomy of Bloom considering that the integration of face-to-face learning and technology-enhanced learning systems can assist in boosting the higher level of cognitive skills including analysis, evaluation and problem solving. A structured Likert-scale questionnaire was adopted and quantitative cross-sectional survey design was adopted to gather data about 300 students of different academic disciplines in the university. The data were analyzed using descriptive statistics, reliability testing, normality testing, Pearson correlation, multiple regression analysis and ANOVA to derive robust and reliable results. The results indicate that critical thinking skills and blended learning are positively correlated ($r = 0.862$, $p < 0.01$), i.e. the more a student is engaged in blended learning environments, the more they are developed cognitively. The regression analysis also indicates that blended learning is the most significant predictor of critical thinking, demographic factors such as age, faculty and level of study are very insignificant, and there is a slight difference between genders. The findings also indicate the significance of Learning Management Systems in enhancing the processes of interactive learning, collaboration and self directed interaction that when combined, produce improved critical thinking outcomes. However, the challenges such as the absence of interaction, the inability to access the Internet, and time management were identified as the factors that may have a harmful impact on the effectiveness of blended learning unless addressed in a proper way. The work has contributed to the existing body of literature by providing empirical, inter-disciplinary evidence to the impacts of blended learning on critical thinking within a higher education environment, which is particularly relevant in cultivation of educational environments. The findings offer important recommendations to the teachers, policy makers and institutions by emphasizing on the need to develop effective strategies of blended learning that involve the use of technology, interactive approaches to learning and student centered approaches to learning. Overall, the study supports the notion that blended learning is a powerful and efficient pedagogical model to foster critical thinking and prepare students with the competencies that can address the demands of the 21st-century knowledge economy.

INTRODUCTION

The rapid evolution of digital technologies, automation, and artificial intelligence in the context of the Fourth Industrial Revolution (Industry 4.0) have significantly changed the requirements of contemporary labor markets and the higher education sector. The modern organizations are increasingly requiring graduates due to their capability not just to carry out the technical but higher-order cognitive skills, such as critical thinking, problem-solving, and flexibility (Arifin, 2024; González-Pérez and Ramírez-Montoya, 2022). In particular, automation and digitalization are radically changing such activities as accounting and are eliminating a large number of routine, and increasing the role of analytical and decision-making competencies (Hasanah and Malik, 2020; Aldiyah, 2021). This means that colleges and universities must re-design their learning strategies to ensure that their students acquire such critical skills in the 21st century.

To address these changing needs, Outcome-Based Education (OBE) and student-centered learning approaches have gained popularity in the quest to transform learning outcomes. These practices are also centered on active learning, flexibility, and development of higher-order thinking (Fadhilatunisa et al., 2020; Ahmadi et al., 2020). It is in this respect that e-learning has gained relevance as a learning resource since it has provided an accessible and flexible source of learning, with students able to access learning content at any location and any time (Niu et al., 2023; Prihadi and Setiadi, 2021). However, despite all their advantages, a full online learning environment tends to be restricted regarding poor student motivation, deficient engagement, and minimal interaction (Sunubi and Bachtiar, 2022; Mulawarman, 2024). Similarly, traditional face-to-face education may not capitalize on technological advancement to its maximum potential in order to aid learning (Alismaiel, 2022).

To eliminate these disadvantages, blended learning, a mixture of face-to-face instruction and the use of online learning, has turned out to be a holistic strategy. Blended learning enables students to participate in an interactive and flexible learning process, which promotes collaboration, independent learning, and deeper thinking (Dumitru et al., 2023; Trisnowati and Firmadani, 2020). The empirical research has already demonstrated the fact that blended learning is more useful to improve the academic achievements, problem-solving abilities, and interest in the students as compared to the traditional method of teaching (Anwar and Setyaningrum, 2021; Jaswal and Behera, 2024). Besides, the integration of Learning Management Systems (LMS), such as the Edmodo, facilitates the process of communication, collaboration, and continuous assessment, which strengthen the learning process overall (Marito and Riani, 2023; Dwiastuti et al., 2021).

One of the most relevant competencies that are expected to develop in the 21st century and can be defined as the ability to analyze, evaluate and synthesize information and make informed decisions (O'Flaherty and Phillips, 2015; Zaitseva et al., 2022). Critical thinking skills, particularly in dynamic and complex environments, need to be developed to improve academic performance and career outcomes (Najib and Jatmiko, 2022). Blended learning environments particularly facilitate such skills because, in these environments, students actively learn, solve problems by collaborating, and reflect (Zuhri and Sya'adiyah, 2023; Arifin, 2024). Blended learning also allows a higher level of mental activity of the Taxonomy of Bloom, including analysis, evaluation, and creation, by integrating the digital tools with the conventional teaching and learning methods (Than Oo, 2022; Fahmi Rizal et al., 2022).

Despite the increased literature that has been authored about the blended learning, there are still several gaps in research. To start with, the existing studies have been mostly focused on overall academic outcomes, and little empirical data on how critical thinking skills can be developed when studying a broad range of academic issues was taken into account (Baskara et al., 2024; Riadi et al., 2024). Second, the latest research is not context-specific and examines the efficacy of blended learning in developing countries, where the degree of technological use and education infrastructure is much lower than in developed settings (Rahmani, 2022; Nababan et al., 2024). Third, not much has been done to examine the relationship between demographic variables and learning conditions and cognitive development of students in the past. These gaps need to be filled in to provide a more detailed description of the role of blended learning in the development of critical thinking.

The given research is grounded in constructivist learning theory because it views learning as an active process that involves the construction of knowledge through interaction, experience, and reflection (Walker, 2022; Tuan et al., 2022). In addition, the Taxonomy of Bloom provides the theoretical framework to understand cognitive abilities development, paying attention to the importance of higher-order thinking processes in education (Hasanuddin et al., 2022). Blended learning environments, which combine interactive and technologically-enhanced learning methods, allow reaching these levels of cognition (Than Oo, 2022).

In this way, the primary objective of the study is to explore whether blended learning can be useful in teaching critical thinking skills to university students (Fadhilatunisa et al., 2020; Awi et al., 2025). Specifically, the study will look at how student involvement in blended learning environments is related to their skills in critical thinking, and how the demographic variables such as age, gender, faculty, and level of study affect critical thinking ability (Babar and Hidayat, 2022; Ahmadi et al., 2020). It can be applied to add to the existing literature to provide an empirical research with a cross-disciplinary sample to investigate blended learning in higher education contextually (Haftador et al., 2023; Arvianto et al., 2023).

This research will probably have theoretical and practical implications. Hypothetically, the research broadens the application of the constructivist approach to learning in online and hybrid classes by highlighting its potential to facilitate the development of higher-order thinking (Niu et al., 2023; Fikriyah et al., 2024). The implications of the findings in practice would be that the teachers and policy makers would be informed to establish effective methods of teaching and learning, and consider the application of digital technologies to enhance student learning performances. Lastly, this research will support the development of graduates with critical thinking and problem-solving skills to be successful in an even more complex and digital world (Sunubi and Bachtiar, 2022; Mufidah et al., 2023).

LITERATURE REVIEW

Blended learning

With its capacity to unite the two realms in one, blended learning has emerged as an important pedagogic model in higher education as it combines the advantages of traditional learning with the flexibility of online learning environments. Unlike the completely traditional method of teaching, blended learning also offers the students a possibility to interact with the learning materials asynchronously and synchronously. It can be combined to engage the classroom, study on their own, learn online, and have an unlimited access to learning materials (Bahtiar, 2021; Widjaja and Aslan, 2022; Hadiati et al., 2022). Previous studies have defined blended learning as not simply the introduction of technology in the learning process, but a thoughtful learning design that integrates digital technology, face-to-face classroom learning, assessment strategies, and student-centered learning activities to maximize the learning experiences (Ramadhan et al., 2023; Rahmawati and Nurachadija, 2023).

Among the most popular elements of blended learning that have been argued to be effective are student engagement, learning independence, and academic achievement. The research states that blended learning encourages students to take more ownership of learning, providing them with access to the materials and with the opportunity to participate in discussions and complete learning activities outside of the physical classroom (Nakayama et al., 2020; Park and Shea, 2020). Such flexibility comes in handy particularly in the higher education sector where the students are expected to exercise self-regulation, independent thinking and problem solving abilities. Studies have also discerned that blended learning fosters an improved learning experience since it offers a more interactive learning environment in which students can combine classroom narrations with web-based exploration and group activities (Bhagat et al., 2023; Armellini et al., 2021).

Thinking critically is considered as one of the most valuable skills which one must have to be successful in both studies and career in the 21st century. It is the ability to process information, evaluate arguments, interpret evidence, and excel at logical conclusions and introspection about the process of thinking (Najib and Jatmiko, 2022; James and Swan, 2021; Khusniyati Masykuroh et al., 2022). Critical thinking in education assists students to move beyond information memorization and learning in more advanced ways. Scholars claim that critical thinking consists of several cognitive processes such as interpretation, analysis, evaluation, inference, explanation, and self-regulation (Zaitseva et al., 2022; Pun, 2021; Wang and Liu, 2021). The components are well tuned with the skills of higher-order thinking, and therefore, are central to education on the university level.

The interrelationship between blended learning and critical thinking has gained popularity among the academic communities. Blended learning classrooms can foster critical thinking because they offer different learning opportunities to learners including classroom discussion, online reflection, peer collaboration, digital resource and problem based tasks. Such activities require students to question ideas, juxtapose information, evaluate arguments, and develop their understanding. It has been found that blended learning is connected with the improved critical thinking and problem-solving abilities of students in contrast to traditional pedagogy (Anwar and Setyaningrum, 2021; Jaswal and Behera, 2024). Similarly, a study conducted by Zuhri and Syaadiyah (2023) has demonstrated that blended learning may result in better critical thinking and communication skills as students are more involved in the learning process.

LMS is also applicable in the improvement of the strength of blended learning. LMS applications, such as Edmodo, Google Classroom, and others provide structured communication, discussion, resource and quiz sharing, assignments, and feedback. These tools contribute to independent and collaborative learning which is core to the development of critical thinking skills (Marito and Riani, 2023; Dwiastuti et al., 2021). The use of Edmodo in particular has been deemed to be useful as its social-network like interface can invoke student interest and activity. When students respond to learning tasks and reflect on the feedback, in the case of online discussions, they are most likely to acquire analytical and evaluative thinking skills (Kusumawardani and Aminatun, 2024).

Blended learning has a close theoretical relationship with the constructivist learning theory. Constructivism underlines that learners actively build knowledge as a result of experience, interaction, and reflection instead of passively being fed information by teachers (Walker, 2022; Tuan et al., 2022). Blended learning portrays this theory since it enables students to be actively involved in classroom activities, online discussions, group projects, and individual learning activities. Moreover, Bloom Taxonomy underlines the suitability of blended learning to develop critical thinking as it focuses on higher-order thinking, i.e., analysis, evaluation, and creation (Hasanuddin et al., 2022). Thus, blended learning is possible to think of as a method of instruction that provides students with the opportunities to shift their shallow knowledge to more complex cognitive processes.

The empirical research done in the past has a solid evidence base that blended learning has a positive effect on critical thinking. Indicatively, Fadhilatunisa et al. (2020) discovered that blended learning enhanced the critical thinking skills and learning motivation amongst students in an accounting learning environment. Equally, Niu et al. (2023) found that blended learning positively impacted the knowledge, skills, and critical thinking ability of undergraduates. Prihadi and Setiadi (2021) also affirmed that blended learning enhanced the science learning outcomes and critical thinking of the students. These results imply that blended learning is efficient in various fields, such as accounting, nursing, science, mathematics, and the general higher education.

Nevertheless, the literature also reveals a number of obstacles related to blended learning. During online learning activities, some students might become low-motivated, lack connectivity to the internet, social interaction, and time management (Sunubi and Bachtiar, 2022; Mulawarman, 2024). All these challenges imply that blended learning cannot necessarily enhance critical thinking, unless it is developed thoughtfully and successfully conducted. The quality of instructional design, teacher engagement, student engagement, technological assistance, and assessment practices determine the success of blended learning (Nakayama et al., 2020; Bhagat et al., 2023; Borjalilu and Bozorgi-Amiri, 2022; Syahrawati et al., 2022; Park and Shea, 2020). Thus, universities should make sure that blended learning should not be reduced to making materials available on the Internet but should include effective activities that encourage dialogue, contemplation, critical thinking, and problem-solving.

Despite the numerous researches that have been conducted on blended learning, there are a number of gaps in the literature. To begin with, a significant part of the earlier research has been devoted to the general academic achievement instead of critical thinking as a key outcome (Armellini et al., 2021; Agariadne Dwinggo Samala et al., 2022). Second, numerous studies have been carried out in advanced education settings with less consideration being made to the advanced education in developing nations. Third, the impact of demographic factors (age, gender, faculty, and level of study) on the correlation between blended learning and critical thinking has not been extensively studied (Bahtiar, 2021; Widjaja and Aslan, 2022; Hadiati et al., 2022). These gaps support the idea that additional empirical research is necessary on the effectiveness of blended learning in improving the use of critical thinking skills in university students.

According to the literature reviewed, blended learning seems like a promising teaching model to help students develop the skills of critical thinking. It offers a robust basis of higher-order cognitive development due to its combination of face-to-face instruction, online learning, collaborative learning, independent learning, and activities facilitated by LMS (Najib and Jatmiko, 2022; James and Swan, 2021; Khusniyati Masykuroh et al., 2022). However, its efficacy hinges on its successful deployment, support by institutions, teacher preparedness, and student involvement (Zaitseva et al., 2022; Pun, 2021; Wang and Liu, 2021; Yoto Yoto et al., 2022). Thus, the current research adds to the literature by evaluating the effectiveness of blended learning in the development of critical thinking skills in university students and by taking into account the issue of demographic influences in this correlation (Spica, 2021; Bol et al., 2022).

Table 1: Critical Literature Comparison

Author(s) & Year	Context / Sample	Methodology	Key Findings	Limitations	Research Gap Identified
Fadhilatunisa et al.	Accounting students (Indonesia)	Quantitative	Blended learning improves critical thinking and motivation	Limited sample & discipline-specific	No cross-disciplinary validation
Niu et al.	Undergraduate students (multiple disciplines)	Systematic Review & Meta-analysis	Positive impact on knowledge, skills, and critical thinking	Focus on developed contexts	Lack of developing country evidence
Anwar & Setyaningrum	Mathematics students	Experimental	Blended learning enhances problem-solving & critical thinking	Small sample size	Limited generalizability
Zuhri & Sya'adiyah	University students	Quantitative	Strong relationship between blended learning & critical thinking	Focus on specific course	Lack of LMS integration focus
Prihadi & Setiadi	Science students	Experimental	Improved learning outcomes and critical thinking	Subject-specific results	Not generalizable across disciplines
Kusumawardani & Aminatun	Secondary education	Quantitative	LMS-based learning enhances engagement & thinking skills	School-level focus	Not applicable to higher education
Marito & Riani	Higher education	Quantitative	LMS (Edmodo) improves collaboration and independence	Focus on single LMS tool	Limited analysis of cognitive outcomes
Sunubi & Bachtiar	University students	Survey-based	E-learning reduces motivation compared to face-to-face	Focus only on online learning	No blended comparison
Mulawarman	Higher education	Evaluation study	Online learning leads to lower engagement	No hybrid model analysis	Lack of blended learning evaluation

The comparative literature review shows that although many studies have already proven a beneficial role played by blended learning in the academic performance and cognitive abilities of students, there are still many limitations. The majority of research, including those by Fadhilatunisa et al. (2020) and Anwar and Setyaningrum, (2021) are confined to particular fields, thus limiting the applicability of their results to various academic environments. Equally, extensive research such as Niu et al. (2023) has good evidence of efficacy but has mostly been conducted using the data of developed nations, showing the absence of the developing regions.

Moreover, despite the identify of Learning Management Systems as important aspects of blended learning, other participants in studies like Marito and Riani, (2023) give more attention to engagement and collaboration, but little attention is drawn to

higher-order cognitive learning results, including critical thinking. Conversely, studies focusing solely on online learning settings (e.g., Sunubi and Bachtiar, 2022; Mulawarman, 2024) also mention the problem of low motivation and low interaction as a reason to adopt hybrid models of instruction.

Generally, the literature suggests that there is a significant lack of cross-disciplinary and context-specific research on the effectiveness of blended learning in improving critical thinking skills, especially in the context of a higher education system in developing countries (Walker, 2022; Tuan et al., 2022). Secondly, there is a lack of research on the interaction between demographic factors and blended learning settings. Thus, the current research is able to fill these gaps by presenting empirical data on a heterogeneous group of students, as well as by considering both a technological and a demographic point of view when analyzing the issue (Than Oo, 2022; Fahmi Rizal et al., 2022; Siriluk Pichainarongk and Satesh Bidaisee 2022).

Media/Innovation Efficiency Identification

Conceptual Framework

The proposed study theoretical framework is that the independent variable (blended learning) can have a substantial impact on the dependent variable (critical thinking skills), demographic variables are control variables (Walker, 2022; Tuan et al., 2022; Florido-Benítez, 2022; Hasanuddin et al., 2022).

Hypothesis Development

This is the hypothesis; it suggests that the implementation of the blended learning will have a positive influence on the process of learning the skills of critical thinking in students.

H1: There is a positive influence of critical thinking ability of students in blended learning.

The assumption made in this hypothesis is that the more the engagement in the blended learning processes, the more the level of critical thinking. Fundamentally, the more the exposure of students to blended learning, the more they become critical thinkers.

H2: There is a positive significant association between blended learning and critical thinking skills of students.

This hypothesis will be tested on whether age, sex, academic department and level of study of a student can influence the ability of the student to learn critical thinking skills through blended learning.

H3: The demographic factors (age, gender, faculty, and level of study) do not have significant effects on the critical thinking of the students.

RESEARCH METHODOLOGY

The research design used in this study will be quantitative because it will be conducted to determine the effectiveness of blended learning in developing critical thinking skills among the students in the university. Quantitative approach is regarded to be suitable because it allows objective measurement of the relationships between variables and possibility to statistically test research hypotheses (Aida et al., 2025; Febriani et al., 2023). In particular, it included cross-sectional survey design to gather the data at one point in time, which is very popular in educational research to examine the patterns and relationships in a specified population.

Research Design and Approach.

The research adheres to a correlational research design by attempting to explore the correlation between blended learning (independent variable) and critical thinking skills (dependent variable) and as well take into consideration demographic variables as control variables. This design is feasible to identify relationships between variables without controlling the research setting, making it ecologically valid (Jailani and Saksitha, 2024).

Population and Sampling

The study population will be university students in various fields of study. The sample was chosen by convenience sampling, which is mostly because of the availability and time factor. Though convenience sampling has been accused of poor generalizability, it is commonly used in studies in the fields of education when the researcher aims to investigate relationships,

and not to determine causality (Etikan et al., 2016). In order to make it more representativeness, an attempt was made to have a representative sample of the participants in the various faculties, age groups, and study level.

Data Collection Instrument

The structured questionnaire was used to collect data based on a Likert scale, which is generally used when gauging attitudes, perceptions, and behavioral tendencies in educational research. The questionnaire was divided into three major sections:

Blended Learning Scale: This scale measures the level of engagement of students on blended learning activities such as flexibility, collaboration, and self-directed learning.

1. Critical Thinking Scale: Determining the skills of students to analyze, assess, and synthesize information, which is consistent with higher-order cognitive processes (Zaitseva et al., 2022).
2. Motivation Scale: This is a supporting construct to analyze the changes in the learning motivation of the students.

Reliability and Validity

In order to test the reliability of the measurement scales, Cronbach alpha was computed. The findings showed that the internal consistency was high with the values of the internal consistency being above the acceptable level of 0.70 (Hair et al., 2019). Namely, the blended learning scale and critical thinking scale had a high reliability, whereas the motivation scale had a medium reliability.

To be content valid, the study matched the questionnaire questions with the known theoretical constructs and previous studies. The study was exploratory in nature, but the standard practices in quantitative research were followed to ensure accuracy and consistency in measurements.

Data Analysis Techniques

The data obtained were processed with the help of statistical methods related to quantitative research. The next techniques were used:

- Descriptive Statistics (Mean, Standard Deviation) to summarize the data and give a overview of the perceptions of respondents.
- Normality Tests (Kolmogorov-Smirnov and Shapiro-Wilk) to determine the data distribution and the appropriateness of parametric tests.
- Pearson Correlation Analysis to analyze the intensity and direction of the relationship between blended learning and critical thinking skills.
- Multiple Regression Analysis to understand the degree to which the blended learning predicts critical thinking with demographic variables held constant.
- Analysis of Variance (ANOVA) to test the significance of the regression model as a whole.

These statistical methods are prevalent in education research to offer strong and valid results (Febriani et al., 2023).

Ethical Considerations

The research was conducted following the normal ethical codes of research. The sample was voluntary and the respondents were made aware of the study objective. The participants were assured of confidentiality and anonymity and the information gathered was only utilized in the academic context.

RESULTS

Table 2: Frequency Distribution of Demographic Variables

Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Age Group	18–20 years	67	22.3	22.3	22.3

	21–23 years	69	23.0	23.0	45.3
	24–26 years	73	24.3	24.3	69.7
	Above 26 years	91	30.3	30.3	100.0
Gender	Male	209	69.7	69.7	69.7
	Female	91	30.3	30.3	100.0
Faculty	Arts and Humanities	49	16.3	16.3	16.3
	Social Sciences	88	29.3	29.3	45.7
	Business and Management	75	25.0	25.0	70.7
	Science and Technology	39	13.0	13.0	83.7
	Other	49	16.3	16.3	100.0
Level of Study	Undergraduate	68	22.7	22.7	22.7
	Graduate	76	25.3	25.3	48.0
	Postgraduate	82	27.3	27.3	75.3
	Other	74	24.7	24.7	100.0

The Demographic Characteristics table summarizes the distribution of the participants, in terms of Age, Gender, Faculty and Level of Study. The Age distribution reveals that the highest number of participants (30.3) fell between the age range of 24-26 years old (23.0) respectively. On Gender, male students (69.7) who participated in the study were more than the number of female students (30.3). The faculty representation indicated that the largest percentage of students represented was in the field of Social Sciences (29.3%), followed by Business and Management (25.0%). On the Level of Study, the greatest number was postgraduate students (27.3), followed by graduate (25.3) and undergraduate programs (22.7).

These population findings align with Mufidah et al. (2023), where the population composition was used to comment on how the study results can be applied to other populations. The patterns were observed similarly in Putri (2023) where the level of study and the age influenced the students with respect to their involvement with the learning methods. Even though the gender representation was compromised in this study, it is important to consider the fact that the overrepresentation of male respondents can lead to the limitation of the generalization of the research results. It is possible that future studies aim to balance the gender representation to obtain a more comprehensive understanding of the experience of different groups with blended learning.

Table 3: Scale Reliability

Scale / Measure	Cronbach's Alpha	N of Items
Scale 1	0.954	19
Scale 2	0.966	19
Scale 3	0.819	10

A Scale Reliability table shows the values of Cronbach alpha of three scales used in the research Blended Learning, Critical Thinking and Motivation. The first scale scores high reliability of 0.954 that indicates that the scale is working in determining the correlation of students. Similarly, the Critical Thinking scale has an even higher score of reliability of 0.966 which implies that the scale is also reliable in the measurement of the development of critical thinking skills. The two values are indicative of a good internal consistency and indicate that the measures of these constructs are highly reliable. On the other hand, the

Motivation scale Cronbachs alpha 0.819 is admissible but a little lower than the Motivation scale hence it can be enhanced to measure the motivation.

In comparison, previous studies have never shown low values of reliability of similar constructs. According to Kusumawardani and Aminatun (2024), the scales that were employed to measure engagement and cognitive development have a high reliability score, which suggests that the instruments are effective in educational research. However, it is the lower alpha of Motivation that coincides with the study of Anwar and Setyaningrum (2021) who discovered that they had a similar challenge of achieving high consistency in attempting to measure motivation. These studies demonstrate the challenge of measurement of motivational constructs and give a potential of further refinement of the measurement tools to capture the fineness of student motivation in the educational setting.

Table 4: Descriptive Statistics (for Blended Learning and Critical Thinking)

Descriptive Statistics												
	N	Range	Minimum	Maximum	Mean		S.D.	Variance	Skewness		Kurtosis	
					Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Blended Learning	300	3.21	1.53	4.74	3.2542	.03532	.61173	.374	-.150	.141	-.098	.281
Critical Thinking	300	3.79	1.21	5.00	3.2463	.04043	.70026	.490	-.041	.141	-.290	.281
Valid N (listwise)	300											

The Descriptive Statistics table will provide information about the distribution of the variables of the Blended Learning and Critical Thinking in detail. The average response in the case of Blended Learning was 3.25, and it indicates that students have a fairly positive attitude towards the experience of blended learning. The standard deviation of 0.42 means that there is a relatively small range around the mean and this means that there is some consistency in the experiences of the students who are undergoing blended learning. Critical Thinking scored an average of 3.24 which is slightly less than the average of the Blended Learning, still positive score. The standard deviation of 0.63 is higher than that of Blended Learning, which indicates that the perception of the students in the area of their critical thinking capabilities are more different.

These findings are in line with the work of Putri (2023), who also discovered that students retained positive experience of blended learning, yet the impact of this learning on such cognitive skills as critical thinking was more heterogeneous. The greater variability of critical thinking suggests that some of the students might experience the dramatic improvement and others might not be involved in the process of learning. This is comparable to Zuhri and Syáadiyah (2023), who cite a favorable overall effect of blended learning, but the extent of the effect varied depending on individual factors, such as past knowledge and engagement.

Table 5: Correlation Between Blended Learning and Critical Thinking

Correlations			
		Blended Learning	Critical Thinking
Blended Learning	Pearson Correlation	1	.862**
	Sig. (2-tailed)		.000

	N	300	300
Critical Thinking	Pearson Correlation	.862**	1
	Sig. (2-tailed)	.000	
	N	300	300
**. Correlation is significant at the 0.01 level (2-tailed).			

Correlation Table indicates that Pearson correlation coefficient value of Blended Learning and Critical Thinking is 0.862, which is statistically significant at 0.01 level. This positive relationship is high hence indicating that the more the students participate in blended learning the more likely they are to exhibit high level of critical thinking skills. The fact proves the assumption that blended learning, which implies a combination of online and face-to-face learning, makes it possible to create the environment where the development of higher-order thinking skills can be achieved. This is supported by Zuhri and Syaadiyah (2023) who also found out that blended learning and critical thinking had a strong positive relationship, meaning that blended learning environment would help students develop cognitive skills, due to various learning opportunities.

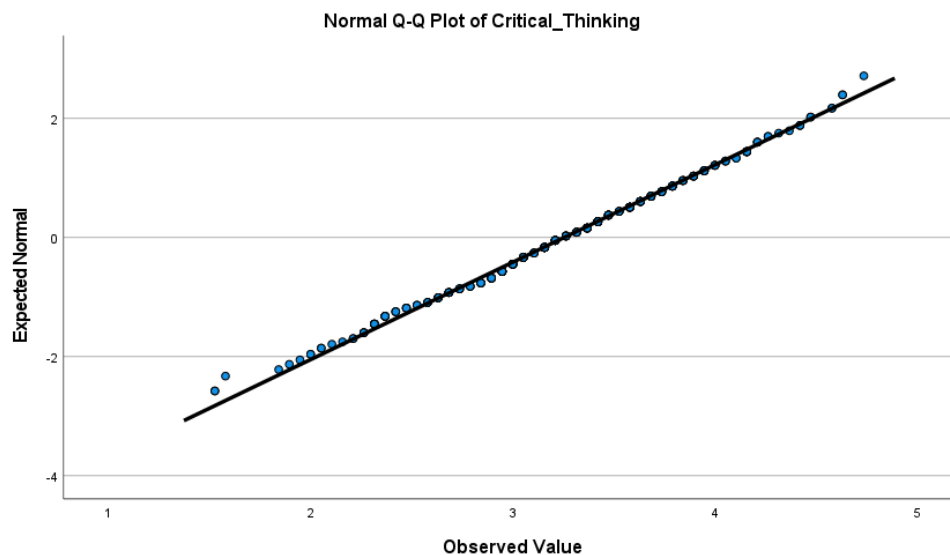


Figure 1: Normal Q-Q Plot of Critical_Thinking

The findings are also consistent with the findings of Anwar and Setyaningrum (2021) in which an equally strong correlation between blended learning and the development of cognitive skills was also found. Their study pointed out that active learning features of blended learning such as collaboration and problem-solving are needed to promote critical thinking. This relationship indicates that blended learning, particularly a model that facilitates interaction and engagement, is an effective pedagogic tool to acquire cognitive and analytical skills..

Table 6: Tests of Normality

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Critical Thinking	.048	300	.093	.995	300	.374
a. Lilliefors Significance Correction						

Normality tests table results point out that Shapiro-Wilk and Kolmogorov-Smirnov tests normality of data have been performed with the consideration of Critical Thinking and Blended Learning data. On Critical Thinking, Shapiro-Wilk test has the p-value of 0.374, more than the significance level of 0.05, indicating that data is normally distributed. In the same way, the p-value of the Kolmogorov-Smirnov test in the Blended Learning case was 0.093 that also suggests the normality of the distribution. These results support the assumption of normality and the use of parametric tests are justified by the results. These findings coincide with the steps of Mufidah et al. (2023), who employed the normality tests in establishing the appropriateness of parametric statistic tools. The reason why the statistics analysis used in this study is valid is that there is no weak skewness or kurtosis. Normal distribution is important, consistent and is not influenced by non-normal data distributions.

Table 7: Model Summary

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.866 ^a	.750	.746	.30825	.750	176.717	5	294	.000
a. Predictors: (Constant), Level of Study, Blended_Learning, Faculty, Age Group, Gender									

As will be seen in the Model Summary table, the R-squared value is 0.750, which is identical to the percentage of the variance of Critical Thinking that can be explained by the predictors, including Blended Learning, Age, Gender, Faculty, and Level of Study. The Adjusted R-squared value of 0.746 also shows that the model is not overfitted as it fits the data well. The F-change value of 176.717 ($p = 0.000$) shows that the combination of the predictors, especially Blended Learning, plays an influential role in the explanation of outcomes of critical thinking. These results are aligned with those of Mufidah et al., (2023) who discovered that a model of this type could account for a considerable portion of student results. This highlights the point that Blended Learning is a salient measure of cognitive skill development. The value of Adjusted R-squared of the two studies portrays that blended learning environments have a high impact on the cognitive aspect of the student, which justifies that blended learning is an effective approach.

Table 8: ANOVA

ANOVA ^a						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	83.955	5	16.791	176.717	.000 ^b
	Residual	27.935	294	.095		
	Total	111.890	299			
a. Dependent Variable: Critical_Thinking						
b. Predictors: (Constant), Level of Study, Blended_Learning, Faculty, Age Group, Gender						

ANOVA table strives to define the significance of the regression model. The F-value 176.717, the p-value 0.000 confirms the fact that the model is statistically significant i.e., the combination of predictors, i.e. Blended Learning, Age, Gender etc. influences Critical Thinking significantly. The sum of squares is 83.955 with a residual of 27.935 of the regression model. It implies that Blended Learning is a significant indicator of critical thinking, in addition to other demographic factors. This corresponds to the findings made by Fitria et al. (2020) who used ANOVA to indicate that learning models play an important role in explaining the variance in results related to cognitive skills. The ability of the model to largely explain the variation in Critical Thinking reveals the effectiveness of blended learning as a tool of imparting higher-order thinking skills. The inclusion

of the demographic factors also (Gender and Age) implies that the effectiveness of blended learning is dependent on the demographic factors, but Blended Learning is the most important.

Table 9: Coefficients (Regression Analysis)

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.978	.117		8.396	.000
	Blended Learning	.740	.026	.847	28.232	.000
	Age Group	.016	.016	.030	1.017	.310
	Gender	-.111	.044	-.084	-2.518	.012
	Faculty	.009	.016	.020	.607	.545
	Level of Study	-.020	.016	-.036	-1.206	.229
a. Dependent Variable: Critical Thinking						

The Coefficients table of the regression analysis indicates that the most significant predictor of Critical Thinking that has an unstandardized coefficient of 0.740 and a standardized coefficient of 0.847 is Blended Learning. This indicates that blended learning has huge implications on the critical thinking skill of the learners. The other demographics such as Gender were a small but significant factor since a coefficient of -0.111 meant that female students, on average, scored lower in critical thinking as compared to their male counterparts. However, the effect of Age, Faculty, and Level of Study on critical thinking was moderate and so the hypothesis that blended learning is the primary factor in development of cognitive skills is confirmed.

This finding is consistent with other scholars such as Lee and Noh (2021) who also found differences in gender though small in the impacts of blended learning on cognitive skills. The strong effect of Blended Learning confirms the results of Fadhilatunisa et al. (2020), who reported the blended learning as the strongest predictor of critical thinking and demographic factors as secondary ones. This can be used to illustrate the potential of blended learning in nurturing cognitive abilities especially in the environment which encourages active learning and interaction.

Table 10: Success Story and Improvements

Variable	Category / Response	Frequency	Percent	Valid Percent	Cumulative Percent
Success Story	Improved critical thinking through blended activities	300	100.0	100.0	100.0
Improvements	More engagement and better resources	300	100.0	100.0	100.0
Online Role	Supports evaluation and analysis	300	100.0	100.0	100.0
Flexibility Impact	Improves independent thinking	300	100.0	100.0	100.0
Instructor Involvement	High	114	38.0	38.0	38.0
	Low	102	34.0	34.0	72.0

	Moderate	84	28.0	28.0	100.0
Helpful Aspects	Interactive sessions	114	38.0	38.0	38.0
	Online discussions	96	32.0	32.0	70.0
	Quizzes	90	30.0	30.0	100.0
Self-directed Learning	Often	118	39.3	39.3	39.3
	Rarely	83	27.7	27.7	67.0
	Sometimes	99	33.0	33.0	100.0
Benefits	Encourages independent learning	114	38.0	38.0	38.0
	Enhances critical thinking and engagement	98	32.7	32.7	70.7
	Improves problem-solving skills	88	29.3	29.3	100.0
Challenges	Internet connectivity issues	106	35.3	35.3	35.3
	Lack of interaction	109	36.3	36.3	71.7
	Time management difficulties	85	28.3	28.3	100.0
Comparison	Depends on implementation	113	37.7	37.7	37.7
	Equally effective	96	32.0	32.0	69.7
	More effective than traditional learning	91	30.3	30.3	100.0

As the Success Stories and Improvements table illustrates, all the students confirmed that they had enhanced their critical thinking skills because of taking part in blended learning activities. The most common benefits were that it increased the engagement, increased resources and that the learning model was flexible and therefore allowed independent thinking. Moreover, interactive activities, Web-based discussions and quizzes were identified as the stimulating factors of critical thinking. The other feature of the blended learning as demonstrated by the data is that 39.3% of students had frequent self-directed learning, which demonstrates the element of independent learning. These findings also correspond to other studies like Fadhilatunisa et al. (2020) who also indicated engagement and flexibility as one of the most important advantages of blended learning. The problems with internet connectivity (35.3%) and lack of interaction (36.3) in this study can be compared to the ones in Dwiastuti et al. (2021), albeit. These problems substantiate the notion that, logistical and technical problems should be addressed to attain the maximum benefits of blended learning.

DISCUSSION

According to the study's findings, blended learning is crucial for enhancing students' critical thinking skills. Blended learning and critical thinking are highly positively correlated, as indicated by the Pearson correlation of 0.862 (significant at the 0.01 level). This aligns with the earlier studies, including Zaker and Bajelany (2025) and Sterner et al. (2023) that reveal blended learning enhances problem-solving and learning outcomes in different subjects. Blended learning with the application of the Edmodo LMS was instrumental in the active involvement and engagement of the students in the study. Both the synchronous and the asynchronous types of learning were flexible, as they enabled students to engage with their peers and teachers both in and outside the classroom (Islam et al., 2025; Roberts, 2020). This particularly came in handy with regard to critical thinking since it helped the students to analyze, assess and synthesize information within a collaborative context.

Nonetheless, the study also identified other factors such as gender, level of study, as having an effect on development of critical thinking skills. The difference in the scores of critical thinking between female students and male students was slight, which could indicate that specific actions should be taken to fill this gap (Lee & Noh, 2021; Boltuc 2020; Marasi, 2022). Also, demographic factors such as faculty and age group did not have a significant effect, which suggests that the effect of blended learning on critical thinking is not significantly different in various academic backgrounds (Kalati et al., 2025; Gonzalez-Perez & Ramirez-Montoya, 2022; Pakorn Akkakanjanasupar et al., 2022). Although the article proves the effectiveness of blended learning in teaching to learners critical thinking skills, it also points to certain challenges (Suebsom, 2020; Kumar et al., 2021; Sonya Nelson et al., 2022). Students complained of problems with internet connectivity, absence of interaction and time management problems. These obstacles should be overcome in order to maximize the potentials of the blended learning. The high positive correlation ($r = 0.862$) shows that blended learning would greatly contribute to the development of the ability to analyze and evaluate information in students. This could be attributed to the fact that blended environments are interactive and flexible and therefore encourages independent learning and engagement. This is in line with constructivist ideals where the learners are actively involved in the construction of knowledge (Sanguras, 2021; Paraschi, 2022; Portillo and Lopez de la Serna, 2021; Wahjono and Wiyono, 2021; Snow, 2020; Muthmainnah et al., 2022).

Practical Implications

Above results shows that blended learning is a strategy that should be implemented in universities to improve critical thinking in students. To effectively mix both online and face-to-face teaching, educational establishments need to invest in Learning Management Systems (LMS) and educate instructors (Freitas and Almendra, 2022 & Shamsiev, 2022; Abdul-Hussain et al., 2022).

CONCLUSION

To sum up, blended learning is one of the most effective pedagogical strategies that can greatly contribute in growing critical thinking skills of students. Combining the e-learning and the traditional face to face learning gives students the flexibility to learn the material differently, which is more effective in understanding and development of higher order thinking skills. This strategy is also supported by using such a platform as Edmodo LMS which promotes collaboration and active involvement. The study not only validates that blended learning is a more interactive and interesting approach to learning but also a means to acquire skills that are vital in the 21st century such as critical thinking and independent learning. Although the research demonstrates positive overall effects, some challenges such as technical problems and gender differences need to be addressed to ensure maximum effectiveness of this model of learning. Further studies might look at the change in critical thinking by blended learning and other cognitive abilities over the long-term and how the objections affecting students can be addressed, particularly in regard to access to technology and instructor support. It is paramount that institutions of higher learning persist in enhancing and implementing blended learning techniques to ensure that students have the required skills to cope up with the ever-more digital environment.

Limitations

The convenience sampling is a limitation to this study as it can affect the generalizability of the findings. Also, the data collection was done using self-reported questionnaires which can cause some bias in the response.

Future Research

Future studies should explore longitudinal designs check long-term effects of blended learning and include experimental methods to establish causality.

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