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EFFECTIVENESS OF BLENDED LEARNING STAGE ROTATION ON DIGITAL LITERACY AND CRITICAL THINKING

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ABSTRACT

This study examines the effectiveness of the Blended Learning Stage Rotation model on digital literacy and critical thinking skills among Mathematics Education students of the 2022 cohort at Sembilanbelas November University, Kolaka. With the increasing need for digital literacy and critical thinking skills in modern education, blended learning models such as Stage Rotation offer potential solutions to meet these demands in the technological era. A quasi-experimental method with a One Group Pretest-Posttest design was employed, involving a total sample of 15 students. Digital literacy and critical thinking skills were assessed using a likert scale questionnaire and essay test, respectively. The research instruments were validated to ensure reliability, and statistical analysis was conducted using a paired sample T-test to evaluate the effectiveness of the learning model. The results revealed a significant improvement in digital literacy and critical thinking skills following the intervention. These findings suggest that the blended learning model is an effective pedagogical strategy and has the potential to be implemented in curriculum courses. Further research is recommended to explore the impact of this model in other educational contexts to enhance the generalisability of the findings.

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1. INTRODUCTION

Amid the rapid advancements and transformations in education toward an era of hyper-digitalization and hyper-globalization, education must be capable of preparing individuals to meet the demands of the emerging workforce. The labor market requires graduates to possess competencies that are aligned with the needs of global industry (Lase, 2019). Between 2030 and 2040, the productive-age population in Indonesia is projected to reach 64% (approximately 297 million people). This demographic condition necessitates an improvement in the quality of human resources to ensure competitiveness in the global job market (Ghufron, 2018).

In this era, many aspects of life including employment and education rely heavily on digital technology. This condition underscores the critical role of higher education institutions as providers of education in producing graduates who are able to adapt and remain competitive in the global market. There are essential competencies that need to be developed to enable graduates to compete globally, such as fundamental literacies and 21st-century productive skills (Arsanti et al., 2021). Digital literacy, as one of the core literacies, refers to the ability to use digital technology effectively and productively (Sugiarto & Farid, 2023). Students with a high level of digital literacy tend to adapt more easily to technological changes and are better able to utilize technology to their advantag.

In essence, digital literacy can be introduced at an early age; however, the outcomes of literacy development during this stage serve as a key reason why literacy must remain a priority throughout higher levels of education (Sulianta, 2020). Therefore, efforts to cultivate literate students must begin with the development of prospective teachers who will be responsible for teaching literacy. This culture of literacy should not only serve as academic preparation, but also as a form of habituation that must be instilled and passed on to future learners.

In addition to digital literacy, critical thinking skills also need to be fostered from the university level. Critical thinking is a higher-order thinking skill that can be developed and strengthened through both offline and online learning processes (Hasnawati & Widodo, 2023). As one of the essential 21st-century skills, critical thinking involves the ability to analyze, evaluate, and synthesize information in order to make sound decisions and solve problems (Khamdanah et al., 2023). The 21st-century skill set includes Communication, Collaboration, Critical Thinking and Problem Solving, Creative Thinking, Compassion, and Computational Logic (Kemdikbud, 2020). Students with well-developed critical thinking skills tend to be more proficient in identifying problems, analyzing their root causes, and making decisions based on evidence and thorough analysis (Sihotang, 2019). These characteristics demonstrate that critical thinking is not only vital in academic settings, but also in everyday life, as it enables students to become more independent, analytical, and wise thinkers.

The *Merdeka Curriculum* has been introduced as an effort to address various existing challenges in the education system (Supriadi et al., 2025). Within the framework of the *Merdeka Curriculum*, the government encourages all higher education institutions specifically study programs to formulate graduate learning outcomes that incorporate the cultivation of literacy and competencies essential for the future. In response, the Mathematics Education Study Program at Universitas Sembilanbelas November Kolaka

is striving to produce graduates who are competitive in the 21st century. However, in practice, the study program has not yet fully optimized the delivery of learning that enhances digital literacy and critical thinking skills. Based on classroom observations, instruction is still largely dominated by one-way lectures with limited use of technology, such as merely displaying Power Point slides without digital interaction or the use of collaborative platforms. Interviews with several students revealed similar concerns; one student stated, “We are more often asked to memorize material for exams rather than being invited to analyze or discuss using technology”. These findings indicate that the current instructional focus remains centered on achieving lower-order cognitive outcomes, rather than fostering critical thinking and digital literacy development.

The *Merdeka Belajar* policy within the *Merdeka Curriculum* promotes flexibility, which carries significant implications for instructional practices. Lecturers are required to design adaptive, differentiated, and student-centered learning processes, as well as to create environments that support active participation, collaboration, and the holistic development of competencies. Differentiated instruction has been proven to foster the development of skills in Communication, Collaboration, Critical Thinking, and Creative Thinking (Sapan, 2023). Differentiated instruction is an effective teaching model to address the diversity of students within the classroom, enabling lecturers to adapt learning activities according to the individual needs of each student. These needs pertain to learning readiness, interests, and learning styles, all of which are mapped to achieve improved learning outcomes (Khristiani et al, 2021) Consequently, students' learning needs are met in a more comprehensive manner.

One strategy that can be integrated with differentiated instruction is blended learning. Various studies have demonstrated that blended learning can enhance digital literacy (Rahmasiwi et al., 2023). One type of blended learning is Blended Learning Stage Rotation (BLSR), also known as the station rotation model, which involves rotating through different learning stations, with at least one station dedicated to online learning (Rezaini et al., 2024). The station rotation model engages students in moving between multiple learning stations, each focusing on different topics or skills. This method provides flexibility in learning activities, as instruction is tailored to student needs, allowing both individual and group tasks to be conducted effectively using this approach (Salim, 2023).

Blended Learning Stage Rotation (BLSR) provides students with the opportunity to engage in flexible and active learning tailored to their individual needs through the integration of face-to-face instruction, online learning, and station-based activities. Aligned with the principles of differentiated instruction, BLSR promotes active and collaborative engagement in the learning process. Therefore, this study aims to examine the effectiveness of the Blended Learning Stage Rotation model in enhancing digital literacy and critical thinking skills among Mathematics Education students.

2. METHOD

This study is a quantitative research employing a pre-experimental approach with a one-group pretest-posttest design. The design model is as follows:

Table 1. *One Group Pretest-Posttes Design*.

O_1 (Pretest)	⟶	X (Treatment)	⟶	O_2 (Posttest)

Explanation:

O_1 = Before the treatment

X = Implementation of the treatment

O_2 = After the treatment

The instruments used in this study included a diagnostic test, an observation sheet, a digital literacy skills questionnaire, and a critical thinking skills test. The diagnostic test took the form of an interview aimed at identifying students' readiness, interests, and learning styles. The diagnostic interview served solely as a reference for grouping students according to their learning readiness, interests, and learning styles. Based on the results of this diagnostic test, three groups were formed, each consisting of five students. The observation sheet was used to document the implementation of the Blended Learning Stage Rotation (BLSR) model.

The digital literacy skills questionnaire consisted of 18 items answered by students based on specific indicators and had been validated and tested for reliability by experts. Each statement included four response options based on a Likert scale: Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1. This questionnaire was administered both before and after the treatment**.**

The critical thinking skills test consisted of three essay questions, which in this study were developed based on Ennis's indicators of critical thinking. The scoring of the critical thinking responses employed a specialized rubric for essay-type questions adapted from Finken and Ennis (1993) by Zubaidah et al (2015) the rubric included the following components: (1) focus, (2) reasoning, (3) organization, (4) conventions, and (5) integration.

The data in this study were analyzed using both descriptive and inferential statistics. Prior to conducting inferential analysis, prerequisite tests were administered, including normality and homogeneity tests. The Shapiro–Wilk test was used to assess normality, as the sample size in this study was relatively small. Homogeneity was tested using the homogeneity of variance feature in SPSS version 24. Subsequently, inferential statistical analysis was conducted to determine whether the treatment had a significant effect, using a t-test at a 5% level of significance. Additionally, the N-Gain test was employed to measure the effectiveness level of the treatment.

3. RESULTS AND DISCUSSION

3.1. Results

The results of the descriptive analysis of the two main variables in this study digital literacy and students' critical thinking skills both before and after the implementation of the Blended Learning Stage Rotation (BLSR), are presented in Table 2.

Table 2. Descriptive analysis results

Value	Digital Literacy		Critikal Thingking	
	Pre	Post	Pre	Post
Min	28	33	32	60
Max	38	54	87	99
Mean	32.4	45.47	55.53	79.01
Std. Dev	2.98	5.96	17.83	14.89
Category	Low	Med	Med	High

Based on the results of the descriptive analysis presented in Table 2, the mean pretest score for digital literacy skills was 32.4, while the mean posttest score was 45.47. The mean pretest score for critical thinking skills was 55.53, whereas the mean posttest score was 79.01.

Following the descriptive analysis, inferential analysis was conducted to test the research hypothesis. A prerequisite for conducting inferential analysis is that the data must be normally distributed. The Shapiro-Wilk test was used to assess normality. The results of the normality test are shown in Table 3.

Table 3. Normality Test

	Shapiro-Wilk		
	Statistic	df	Sig.
Digital literacy pretest	0.954	15	0.583
Digital literacy posttest	0.962	15	0.723
Critical thinking pretest	0.954	15	0.586
Critical thinking posttest	0.854	15	0.807

Based on the results of the Shapiro-Wilk normality test, it was found that the significance values for the pretest and posttest of digital literacy skills were 0.583 and 0.723, respectively, both exceeding the 0.05 significance level. Similarly, the pretest and posttest of critical thinking skills showed significance values of 0.586 and 0.807, respectively, which are also greater than 0.05. Therefore, all four tests can be classified as normally distributed data. The results of the homogeneity test are presented in Table 4 as follows:

Table 4. Uji Homogeneity Test

Levene statistic	*df1*	*df2*	*Sig.*
.164	2	28	0.689

Table 4 shows a significance value of 0.689, which is greater than 0.05, indicating that the data are homogeneous. Subsequently, a paired sample t-test and N-Gain test were conducted because the prerequisite tests were met, confirming that the data were both normally distributed and homogeneous. The results of the t-test and N-Gain hypothesis tests are presented in Table 5 as follows:

Tabel 5. *t-test* and *N-gain*

Variable	Data Group	Normality test (Shapiro Wilk)	Paired sample t-test	N-Gain
Digital Literacy	Pretest	0.583	Sig. 0.000	56.29 %
	Posttest	0.723		
Critical Thinking	Pretest	0.586	Sig. 0.000	58.37 %
	Posttest	0.807		

The data analysis from the t-test showed a significance value of less than 0.05, indicating that the Blended Learning Stage Rotation (BLSR) had a significant effect on digital literacy and critical thinking skills. Given the presence of this effect, an N-Gain test was conducted to determine the extent of the treatment's effectiveness. The results of the N-Gain test for digital literacy and critical thinking skills indicated a percentage that falls within the category of quite effective based on the N-Gain criteria. In other words, the Blended Learning Stage Rotation (BLSR) model is effective in enhancing the digital literacy and critical thinking skills of mathematics education students

3.2. Discussion

Blended Learning Stage Rotation (BLSR) is a learning model that combines online learning activities, face-to-face sessions, and collaborative tasks through a station rotation system. In this model, students move between stations designed for technology-based independent learning, group discussions, and direct interaction with the instructor (Nugraha, 2021). The aim of this approach is to create a varied, engaging, and challenging learning environment that addresses the challenges of modern education, such as low learning motivation, lack of meaningful interaction, and limited utilization of educational technology (Wokas et al., 2024).

The implementation of Blended Learning Stage Rotation (BLSR) in this study proved effective in enhancing students' digital literacy and critical thinking skills. This is evidenced by the increase in the average digital literacy score from 32.4 to 45.47, as well as the improvement in the average critical thinking skills score from 55.53 to 79.01. Furthermore, the t-test results showed a significance value of 0.000 (< 0.05), indicating a significant difference before and after the application of the BLSR model. These improvements reflect the effectiveness of BLSR in helping students comprehend the

material through an approach that aligns with their learning needs.

The implications of these findings indicate that the use of Blended Learning Stage Rotation (BLSR) can encourage students to develop digital literacy and critical thinking skills. In terms of digital literacy, students are able to enhance their abilities to access, evaluate, and utilize technology-based information effectively. Meanwhile, regarding critical thinking skills, students demonstrate improved capabilities in analyzing information, evaluating arguments, and solving problems logically and systematically.

The findings of this study align with Nugraha (2021) who demonstrated that the station rotation model is effective in enhancing students' critical thinking skills. Additionally, found that BLSR not only improves learning outcomes but also strengthens students' motivation and character (Muthmainnah & Suswandari, 2020). Therefore, BLSR can serve as a relevant and adaptive alternative learning strategy to meet the demands of contemporary education, particularly in the context of higher education.

4. CONCLUSION

Based on the results of the t-test, the significance values were found to be less than 0.05 for both digital literacy and critical thinking skills, indicating a significant difference after the implementation of the BLSR model. This demonstrates that BLSR is effective in improving these two skills among mathematics education students. Furthermore, the N-Gain test results for digital literacy and critical thinking skills showed a percentage categorized as moderately effective.

The BLSR model is capable of creating an interactive, innovative, and relevant learning environment that aligns with the demands of 21st-century education. The improvements achieved include enhanced digital collaboration skills and strengthened technological literacy, which are crucial for students' readiness to face challenges in the digital era. These findings can serve as a basis for adopting the BLSR model in other learning contexts that require reinforcement of 21st-century skills. However, further research is needed to examine the effectiveness of BLSR in other courses or educational levels, so that this model can be adapted more broadly by considering the diverse contexts and characteristics of learners.

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