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The Effect of Skul.id-Based Blended Learning with the Station Rotation Model on Students' Perceptions, Activities, and Science Learning Outcomes at the Junior High School

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Abstract: The Skul.id platform is a local Learning Management System (LMS) designed to support blended learning through features such as access to learning materials, assignment submission, and online evaluation. This study aimed to examine the effectiveness of Skul.id-based blended learning with the station rotation model on students' perceptions, learning activities, and science learning outcomes. A quasi-experimental method with a nonequivalent control group design was employed, involving 54 eighth-grade students. The experimental group received blended learning with station rotation, while the control group received blended learning without station rotation. Data were collected using questionnaires, observation sheets, and learning achievement tests. The results showed significant differences between the two groups. The experimental group demonstrated very positive perceptions (96.30%), very high learning activity (100%), and higher learning outcomes with a mean posttest score of 77.78 and an N-gain of 0.56. In contrast, the control group showed positive perceptions (77.78%), active learning activity (92.59%), and lower learning outcomes with a mean posttest score of 65.48 and an N-gain of 0.36. Although both N-gain values were categorized as moderate, the experimental group achieved a substantially higher improvement. Independent sample t-test results confirmed statistically significant differences in perceptions, learning activities, and learning outcomes ($p < 0.05$). These findings indicate that Skul.id-based blended learning with station rotation is more effective in improving students' perceptions, learning activities, and science learning outcomes.

Keywords: Blended learning; Learning activity; Learning perception; Science learning outcomes; Skul.id; Station rotation

Introduction

The development of information and communication technology has brought significant changes to the world of education, including in the teaching of Natural Sciences (Science) (Oise et al., 2025). Science learning requires students not only to understand theoretical concepts but also to be able to apply knowledge through active and meaningful learning experiences (Huang et al., 2025; Guo et al., 2020; Sudarmono et al., 2025). However, conventional science learning, which is still teacher-centered, often fails to encourage active student engagement, resulting in low learning outcomes and minimal learning activities (Muhamad Dah et al., 2024; Morris, 2025; Ngoc Tuong Nguyen & Thi Kim Oanh, 2025). Blended learnings is an alternative solution that combines face-to-face and online learning to create a more flexible and personalized learning experience. Umam et al., (2025); Zakariya et al., (2024); Cannaos et al., (2024), states that

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blended learning provides students with the opportunity to learn at their own pace and according to their individual needs. Furthermore, Bekele et al., (2025); Wong, (2024); Alammary, (2024), emphasizes that blended learning can increase positive student perceptions because it provides learning flexibility and a more personalized learning experience. One widely implemented blended learning model is station rotation.

Uludağ, (2023); Da Silva et al., (2022); Dominguez, (2024), explains that station rotation is designed to enhance students' learning experiences through planned and varied activity arrangements. In this model, students move between different learning stations, such as direct instruction with a teacher, online learning through a digital platform, and collaborative activities. This variety of activities is expected to optimally enhance student engagement. The Skul.id platform, a local Learning Management System (LMS) Irhamni & Ashari, (2023); Duarte et al., (2025); Simon et al., (2025), provides various features that support the implementation of blended learning, such as access to learning materials, assignment submission, and online evaluation. Integrating Skul.id with the station rotation model is expected to create more effective science learning, increasing positive student perceptions, learning activities, and learning outcomes.

Based on this background, this study aims to determine the effectiveness of Skul.id-based blended learning with station rotation on the perceptions, learning activities, and science learning outcomes of eighth-grade students. This research is expected to provide theoretical and practical contributions to the development of more innovative and student-centered science learning models.

Method

This study was a quasi-experimental study with a nonequivalent control group design. The study was conducted in two eighth-grade classes with a total of 54 students: 27 in the experimental class and 27 in the control class. The experimental class implemented Skul.id-based blended learning with station rotation, while the control class implemented Skul.id-based blended learning without station rotation. The variables in this study included student perceptions, learning activities, and science learning outcomes. Perception data were collected using a Likert-scale questionnaire consisting of 28 statements. Learning activity data were collected through observation sheets covering aspects of student participation, engagement, and activeness during learning.

Learning outcome data were collected through pretest and posttest achievement tests covering cognitive aspects of science material. Data analysis techniques used included descriptive analysis to describe data distribution and inferential analysis to test the research hypotheses. Prerequisite analysis tests, including the Shapiro-Wilk normality test and the Levene homogeneity test, were conducted first. Next, the hypothesis was tested using an Independent Sample t-test to determine differences in perception, learning activities, and learning outcomes between the experimental and control classes. Improvements in learning outcomes were analyzed using the N-Gain test.

Result and Discussion

Description of Student Perceptions

The descriptive analysis results indicate that experimental class students' perceptions of Skul.id-based blended learning with station rotation were very positive, with an average score of 123.33 (SD = 5.74). The frequency distribution indicates that 96.30% of students (26 students) were very positive, and only 3.70% (1 student) were positive.

Table 1. Descriptive Statistics of Experimental Class Student Perceptions

N	Minimum	Maximum	Mean	Standard Deviation
27	113	138	129.44	5,740

(Maximum score for the perception questionnaire = 28 x 5 = 140)

Table 2. Frequency Distribution of Perceptions of Experimental Class Students

Interval Score	Category Perception	Frequency (f)	Percentage (%)
118 – 140	Very Positive	26	96.30
95 – 117	Positive	1	3.70
73 – 94	Moderately Positive	0	0.00
20 – 72	Negative	0	0.00
28 - 49	Very Negative	0	0.00
Total		27	100.00

Meanwhile, control class students' perceptions of blended learning without station rotation were positive, with an average score of 88.00 (SD = 4.54). A total of 77.78% of students (21 students) were in the positive category, and 22.22% (6 students) were in the somewhat positive category.

Table 3. Descriptive Statistics of Control Class Student Perceptions

N	Minimum	Maximum	Mean	Standard Deviation
27	77	96	88.00	4.54

Table 4. Frequency Distribution of Perceptions of Control Class Students

Interval	Category	Frequency	Percentage
118 – 140	Very Positive	0	0.00
95 – 117	Positive	1	3.70
73 – 94	Moderately Positive	26	96,30
50 – 72	Negative	0	0.00
28 - 49	Very Negative	0	0.00
113 – 140	Very Positive	0	0.00
Total		27	100.00

Description of Student Learning Activities

The analysis results show that the learning activities of students in the experimental class were very high, with an average score of 47.86 (SD = 1.17). All students in the experimental class (100%) were in the very active category. In the control class, the average learning activity score was 42.55 (SD = 1.44), with 92.59% of students in the active category and 7.41% in the very active category.

Table 5. Descriptive Statistics of Student Activities in the Control Class

N	Minimum	Maximum	Mean	Standard Deviation
27	39	45	42.55	1.44

Table 6. Frequency Distribution of Student Activities in the Control Class

Interval	Category	Frequency	Percentage
40 – 60	Activity	2	7.41
31 – 45	Very Active	25	92.59
16 – 30	Active	0	0.00
0 – 15	Moderately Active	0	0.00
76 – 100	Less Active	2	7.41
Total		27	100.00

Description of Student Learning Outcomes

The science learning outcomes of students in the experimental class showed a significant increase, from a pretest average of 49.63 to a posttest average of 77.78, a 28.15-point increase. On the posttest, 74.07% of students were in the good category, 22.23% in the fair category, and 3.70% in the very good category. In the control class, learning outcomes increased from a pretest average of 46.22 to a posttest average of 65.48, a 19.26-point increase. The posttest distribution showed that 48.15% of students were in the fair category, 40.74% in the poor category, and 11.11% in the good category.

Table 7. Descriptive Statistics of Student Learning Outcomes in the Experimental Class

Test	N	Min	Max	Mean	Std. Deviation
Pretest	27	43	57	49.63	3.61
Posttest	27	68	85	77.78	4.64

Table 8. Descriptive Statistics of Learning Outcomes of Control Class Students

Test	N	Min	Max	Mean	Std. Deviation
Pretest	27	38	58	46.22	4.63
Posttest	27	55	80	65.48	6.06

Results of the Prerequisite Analysis Test

A normality test using the Shapiro-Wilk test showed that all data on perception, learning activities, and learning outcomes were normally distributed ($p > 0.05$).

Table 9. Summary of Normality Test Results for all Data

Variable	Group	Sig. Shapiro-Wilk	Conclusion
Perception	Experiment	0.98	Normal
	Control	0.93	Normal
Learning Activities	Experiment	0.33	Normal
	Control	0.16	Normal
Posttest	Experiment	0.18	Normal
	Control	0.60	Normal

The homogeneity test using Levene's Test also showed that the data variance was homogeneous ($p>0.05$), thus meeting the requirements for hypothesis testing using the Independent Sample t-test.

Table 10. Results of the Student Perception Homogeneity Test

Variables	Levene Stasc	df1	df2	Sig.	Description
Students' Perceptions	1.17	1	52	0.28	Homogeneous
Learning Activities	0.02	1	52	0.88	Homogeneous
Learning Outcomes	1.01	1	52	0.31	Homogeneous

Hypothesis Test Results

The t-test results showed significant differences between the experimental and control classes across all variables. For student perception, the sig. (2-tailed) value was 0.00 ($p < 0.05$) with a mean difference of -35.33. For learning activities, the sig. (2-tailed) value was 0.000 ($p < 0.05$) with a mean difference of 5.31. For posttest learning outcomes, the sig. (2-tailed) value was 0.000 ($p < 0.05$) with a mean difference of 12.29.

N-Gain Test Results

The N-Gain test results showed that the experimental class had an N-Gain of 0.56 (medium category), while the control class had an N-Gain of 0.36 (medium category). Although both classes were in the medium category, the experimental class showed greater improvement than the control class.

N-Gain Formula

$$N - Gain = \frac{\text{Score Posttest} - \text{Score Pretest}}{\text{Score Maximum} - \text{Score Pretest}} \quad (1)$$

Table 11. N-Gain Interpretation Criteria

N-Gain Range	Category
g ≥ 0.70	High
0.30 ≤ g < 0.70	Medium
g < 0.30	Low

Discussion

The findings of this study indicate that Skul.id-based blended learning with station rotation is more effective in improving perceptions, learning activities, and science learning outcomes than blended learning without station rotation. The very positive perceptions in the experimental class indicate that the station rotation model is able to create a non-monotonous learning experience through a variety of learning activities. This aligns with Luthfi Oktarianto et al., (2023); Aloizou et al., (2025); Pho et al., (2021) opinion, which states that station rotation is designed to enhance students' learning experiences through planned and varied activity arrangements. The very high learning activity in the experimental class indicates that station rotation provides opportunities for students to directly engage in various learning activities (Xiangze & Abdullah, 2023; Zhong et al., 2025; Adel & Dayan, 2021). This finding aligns with active learning theory, which emphasizes the importance of direct student involvement in constructing knowledge (Slavin, 2019). Research by Tong et al., (2022); Dari et al., (2022); Hadiprayitno et al., (2021) also reports that the implementation of station rotation in blended learning can significantly increase student engagement.

The higher learning outcomes in the experimental class indicate that station rotation allows students to gain conceptual reinforcement through various learning resources and activities. Awidi et al., (2025); Capone, (2022); Mujallid, (2024), stated that blended learning can improve learning outcomes if supported by appropriate learning design and active learning strategies. This finding is further supported by research by De Bruijn-Smolders & Prinsen, (2024); Zhu et al., (2021); Hidayah & Rahmawan, (2023), which reported that blended learning can significantly improve student learning outcomes. Overall, this research confirms that the success of blended learning is determined not only by the use of technology but also by learning design that encourages active student engagement (Mohammadi et al., 2025; Yang & Tan, 2025; Müller & Mildenberger, 2021). The integration of the Skul.id platform with the station rotation model has been proven to create more effective, meaningful, and student-centered science learning (Van Berk et al., 2024; Zamiri & Esmaeili, 2024; Sajja et al., 2024).

The findings indicate that integrating station rotation into Skul.id–based blended learning leads to more positive student perceptions of science compared to blended learning without rotation. *First*, varied and structured learning experiences across stations make science more engaging and meaningful. This supports Walgito (2010), who states that perception is shaped by direct experience, and Robbins and Judge (2013), who argue that positive perceptions arise when learning aligns with students' needs and expectations. *Second*, multimodal activities strengthen students' self-efficacy. According to Bandura (1997), mastery experiences build confidence. Success in different stations enhances students' belief in their ability to understand science, fostering more positive perceptions. Third, direct guidance in the Concept Support Station encourages positive internal attributions. Based on Weiner's (1985) attribution theory, students who receive timely support tend to attribute success to their own effort and ability, reinforcing motivation and positive perceptions toward science learning.

From the perspective of students' learning activities, station rotation significantly enhances active engagement compared to non-rotational blended learning. *First*, station rotation structurally promotes active participation. In line with constructivist theory by Piaget (1972), knowledge must be actively constructed through direct experience. Each station requires different outputs—digital tasks, peer discussions, and guided problem-solving—ensuring that all students actively build their understanding. In contrast, non-rotational settings tend to be more uniform and allow some students to remain passive. Second, rotating activities helps maintain attention and prevent boredom. According to Sweller's (1988) Cognitive Load Theory, effective instructional design manages extraneous load so that students can process information meaningfully. Periodic changes in learning tasks optimize cognitive capacity. Similarly, the attention theory of Posner and Petersen (1990) explains that varying stimuli helps sustain focus during learning. Third, station rotation balances cognitive, affective, and psychomotor domains, consistent with the revised Bloom's Taxonomy by Anderson and Krathwohl (2001). Online stations develop higher-order thinking skills, collaborative stations strengthen social and affective skills, and concept support stations reinforce conceptual understanding and science process skills. Finally, collaborative learning improves the quality of engagement. Based on Vygotsky's (1978) Zone of Proximal Development, peer interaction enables students to achieve higher understanding through scaffolding. Structured collaboration within station rotation fosters meaningful peer support, a condition less optimally achieved in non-rotational blended learning environments.

From the perspective of science learning outcomes, station rotation integrated into Skul.id–based blended learning leads to deeper conceptual understanding and higher achievement. First, repeated exposure through multiple modalities strengthens concept mastery. According to Paivio's (1991) Dual Coding Theory, information processed through both verbal and visual channels is more strongly retained in long-term memory. In station rotation, science concepts are delivered digitally (text, animation, video), discussed verbally in collaborative groups, and reinforced through guided instruction. This repeated dual processing enhances memory traces. Similarly, the Information Processing Theory of Atkinson and Shiffrin (1968) explains that information is more effectively transferred to long-term memory when processed deeply and meaningfully. *Second*, dual feedback accelerates conceptual improvement. Students receive immediate automated feedback from Skul.id and direct teacher feedback in the Concept Support Station. This aligns with Hattie and Timperley (2007), who emphasize that specific and timely feedback significantly influences learning achievement, especially when it supports feed-forward improvement. Third, station rotation allows responsive differentiation. Based on Gardner's (1983) Multiple Intelligences theory, students have diverse learning profiles. The variety of activities across stations accommodates these differences, ensuring proportional improvement for students with different strengths, unlike one-size-fits-all instruction. Fourth, the model strengthens scientific literacy. The OECD (2018) framework defines scientific literacy as the ability to explain phenomena scientifically, evaluate investigations, and interpret evidence. These competencies are trained across online, collaborative, and guided stations. This is supported by Ausubel (1968), who argues that meaningful learning occurs when new knowledge is explicitly connected to prior cognitive structures. Finally, the approach aligns with Keller's (1987) ARCS motivational model—Attention, Relevance, Confidence, and Satisfaction. Station rotation sustains attention through varied activities, builds relevance through contextual tasks, strengthens confidence through repeated success, and promotes satisfaction through structured feedback.

Overall, the superiority of Skul.id–based blended learning with station rotation is not incidental but reflects a synergistic instructional ecosystem grounded in strong theoretical foundations. It systematically enhances students' perceptions, engagement, and science learning outcomes through a holistic, adaptive, and meaningful learning design.

Conclusion

Based on the research results and discussion, it can be concluded that Skul.id-based blended learning with station rotation is more effective than blended learning without station rotation in improving the perception, learning activities, and science learning outcomes of eighth-grade students. Students in the experimental class showed very positive perceptions, very high learning activities, and significantly better learning outcomes. The station rotation model has been proven to be able to create varied learning experiences, encourage active student involvement, and facilitate optimal understanding of science concepts. This study recommends the implementation of blended learning with station rotation as an alternative, innovative, student-centered science learning model.

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Author Contributions

Conceptualization, A.H. and F.D.; methodology, A.H.; software, A.H.; validation, F., F.D. and O.J.; formal analysis, A.H.; investigation, A.H.; resources, O.J. and Y.H.; data curation, A.H.; writing—original draft preparation, F and A.H.; writing—review and editing, F.D. and O.J.; visualization, A.H.; supervision, F.D. and Y.H.; project administration, F and A.H.; funding acquisition, Y.H. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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