Salud, Ciencia y Tecnología. 2025; 5:2287
doi: 10.56294/saludcyt20252287

ORIGINAL

Exploring Students' Perceptions and Experiences of the Station Rotation Model in Blended Mathematics Learning

Exploración de las percepciones y experiencias de los estudiantes en el modelo de rotación por estaciones en el aprendizaje matemático híbrido

Alexis Michael B. Oledan[1]

[1]Integrated Developmental School, College of Education, Mindanao State University-Iligan Institute of Technology. Iligan City, Philippines.

Cite as: Oledan AMB. Exploring Students' Perceptions and Experiences of the Station Rotation Model in Blended Mathematics Learning. Salud, Ciencia y Tecnología. 2025; 5:2287. https://doi.org/10.56294/saludcyt20252287

Submitted: 19-05-2025 **Revised:** 14-07-2025 **Accepted:** 06-10-2025 **Published:** 07-10-2025

Editor: Prof. Dr. William Castillo-González

Corresponding Author: Alexis Michael B. Oledan

ABSTRACT

Introduction: the station rotation model of blended learning has gained increasing attention for its potential to enhance student engagement, motivation, and performance. However, little is known about how students actually perceive and experience this model, particularly in relation to its effectiveness, compatibility with individual learning preferences, and support for higher-order skills such as critical thinking. Addressing this gap, the present study explores students' perceptions of the station rotation model and examines how these perceptions of effectiveness shape their engagement and satisfaction, while also developing a thematic framework to explain key elements of their experiences.
Method: a descriptive-correlational mixed-method design was employed, using surveys and reflections from 126 Grade 10 students. The data were collected during the third quarter of the academic year 2024-2025 at a laboratory high school in Iligan City, Philippines. Descriptive statistics were used to interpret students' perceptions, while simple linear regression examined the relationship between 'Learning Effectiveness and Outcomes' and 'Engagement, Motivation, and Satisfaction.' Thematic analysis further identified and contrasted emerging themes from students' reflections on their experiences with the station rotation blended learning model.
Results: findings indicate that students rated both learning effectiveness ($M = 3,55$, $SD = 0,96$) and engagement, motivation, and satisfaction ($M = 3,76$, $SD = 0,99$) at moderately high levels. Regression analysis further revealed that perceptions of learning effectiveness significantly predicted engagement and satisfaction ($B = 0,89$, $t = 20,62$, $p < 0,001$), suggesting that when students perceive the station rotation model as effective for their learning, they are more likely to feel motivated, engaged, and satisfied with the experience. Furthermore, thematic analysis revealed a progression in students' experiences: the use of multiple learning resources and the sequencing of station activities shaped their 1) strategies and verification processes, 2) fostered peer support and collaboration, and 3) independent problem-solving, ultimately leading to enhanced understanding and skill mastery.
Conclusions: the study concludes that the station rotation model is an effective blended learning approach that promotes engagement, motivation, collaboration, critical thinking, and independent problem-solving, highlighting its potential for differentiated instruction and wider application across learning contexts.

Keywords: Blended Learning; Station Rotation Model; Student Engagement; Learning Effectiveness.

RESUMEN

Introducción: el modelo de rotación en estaciones del aprendizaje híbrido ha recibido una atención creciente debido a su potencial para mejorar el compromiso, la motivación y el rendimiento de los estudiantes. No obstante, se dispone de escasa información sobre la percepción y experiencia de los estudiantes respecto

a este modelo, especialmente en lo que concierne a su efectividad, compatibilidad con las preferencias de aprendizaje individuales y su capacidad para fomentar habilidades de orden superior, como el pensamiento crítico. Con el objetivo de abordar esta laguna en la literatura, el presente estudio explora las percepciones de los estudiantes sobre el modelo de rotación en estaciones y examina de qué manera estas percepciones de efectividad influyen en su compromiso y satisfacción. Además, se desarrolla un marco temático que permite explicar los elementos clave de sus experiencias.
Método: se empleó un diseño mixto descriptivo-correlacional, utilizando encuestas y reflexiones de 126 estudiantes de décimo grado. Los datos fueron recopilados durante el tercer trimestre del año académico 2024-2025 en una escuela secundaria de laboratorio ubicada en la ciudad de Iligan, Filipinas. Se emplearon estadísticas descriptivas para interpretar las percepciones de los estudiantes, mientras que se utilizó la regresión lineal simple para analizar la relación entre la 'Efectividad y Resultados del Aprendizaje' y los factores de 'Compromiso, Motivación y Satisfacción'. El análisis temático identificó y contrastó de manera adicional los temas emergentes a partir de las reflexiones de los estudiantes sobre sus experiencias con el modelo de aprendizaje combinado de rotación por estaciones.
Resultados: los hallazgos indican que los estudiantes evaluaron tanto la efectividad del aprendizaje ($M = 3,55$, $SD = 0,96$) como el compromiso, la motivación y la satisfacción ($M = 3,76$, $SD = 0,99$) en niveles moderadamente altos. El análisis de regresión reveló que las percepciones sobre la efectividad del aprendizaje predicen de manera significativa el compromiso y la satisfacción ($B = 0,89$, $t = 20,62$, $p < 0,001$). Esto sugiere que, cuando los estudiantes consideran que el modelo de rotación por estaciones es efectivo para su aprendizaje, es más probable que experimenten un mayor nivel de motivación, compromiso y satisfacción con la experiencia. El análisis temático reveló una progresión en las experiencias de los estudiantes. La utilización de múltiples recursos de aprendizaje y la secuenciación de las actividades en las estaciones influyeron en: 1) las estrategias y procesos de verificación, 2) el fomento del apoyo y la colaboración entre pares, y 3) la resolución independiente de problemas, lo que, en última instancia, condujo a una comprensión más profunda y a la adquisición de habilidades.
Conclusiones: el estudio concluye que el modelo de rotación por estaciones es un enfoque de aprendizaje combinado eficaz que fomenta la participación, la motivación, la colaboración, el pensamiento crítico y la resolución independiente de problemas. Se destaca su potencial para la instrucción diferenciada y su aplicación en diversos contextos de aprendizaje.

Palabras clave: Aprendizaje Combinado; Modelo de Rotación de Estaciones; Participación Estudiantil; Efectividad del Aprendizaje.

INTRODUCTION

Mathematics education has long relied on the memorization of strategies and the application of algorithmic techniques. This dependency often diminishes students' accountability for developing problem-solving approaches grounded in conceptual understanding, reducing mathematics to the execution of formal procedures.(1) While such strategies provide structure and familiarity, they frequently fail to support more profound learning, particularly in offering reinforcement and differentiated pathways for diverse learners. Capone(1) argues that effective teaching transcends knowledge transmission, fostering autonomy, problem-solving, and discovery. However, traditional pedagogies that fail to adequately address accessibility and equity continue to constrain many classroom practices. Recent studies suggest that integrating online learning stations into face-to-face instruction may provide a more personalized and flexible environment; however, empirical evidence regarding their effectiveness in mathematics education remains limited.(2)

These constant challenges have prompted scholars and practitioners to look into pedagogical models that combine structure with flexibility, personalization, and collaboration. Blended learning (BL) has emerged as one such model, combining in-person engagement with online activities and digital tools.(2) Initially adopted during the COVID-19 pandemic, BL has since been recognized as a sustainable pedagogical model that integrates technology with conventional instruction to enhance learning outcomes.(2) Scholars describe BL as a flexible methodology that merges conventional instruction with digital resources to expand access, promote collaborative and independent learning, and tailor instruction to individual student needs.(3,4) Research demonstrates that BL can improve motivation, engagement, higher-order thinking, and learning outcomes(5,6,7,8,9) though results remain inconsistent. Persistent challenges include the digital divide, the need for teacher training, and quality assurance across platforms,(3) while some studies report no significant differences in performance or engagement compared to traditional approaches.(9) These inconsistencies suggest that BL is not universally effective and must be adapted to subject, context, and learner needs.

Among various BL models, the rotation model has been particularly effective in balancing structured guidance with flexibility. This model includes station rotation, lab rotation, flipped classroom, and individual rotation.[10] Among these, the rotation model balances structure and flexibility, enabling educators to adapt instruction to student needs while organizing learning around scheduled stations.[11] The station rotation model (SRM) is particularly prominent, involving students rotating among multiple stations within a subject period, often in non-linear sequences.[12] The integration of multiple modalities in SRM creates opportunities for both procedural fluency and conceptual understanding. In mathematics, where abstract concepts often require repeated exposure, visualization, and discussion, SRM is uniquely positioned to address the discipline's challenges.

Empirical evidence supports SRM's potential. Each station reinforces prior knowledge and exposes students to diverse instructional strategies and collaborative experiences, promoting more profound understanding. Studies report improvements in student performance using SRM[13], with particular promise in mathematics, where multiple modalities support practice, reinforcement, and immediate feedback. Fulbeck et al.[14] identify key SRM requirements, including collaborative initiatives, at least two rotations per week, and at least one digitally mediated station, all conducted within a single classroom. SRM operationalizes the principles of BL by integrating teacher-led instruction with digital and independent stations, fostering autonomy and motivation while maintaining structured guidance.[15,16] Beyond performance, SRM fosters important mathematical practices: teacher-led stations clarify concepts and feedback, online stations provide individualized pacing, and collaboration among students develops communication and reasoning. These features directly respond to the limitations of traditional instruction, which often fails to address conceptual depth, learner diversity, and equity of participation.

Despite its promise, the research base on SRM in mathematics remained underdeveloped. Most research has focused on short-term interventions or general BL contexts, leaving unanswered questions regarding the effects of structured, sustained SRM implementation on students' conceptual understanding, engagement, and mathematical performance. This gap points out the necessity to conduct research that critically investigates the extended application of SRM in mathematics, examining not only performance outcomes but also how the model influences students' engagement and depth of understanding over time.

This study addresses the gaps by investigating the impact of SRM on students' mathematics learning over a full academic quarter. Abdul Latif et al.[17] suggest that students may gradually adapt to and become comfortable with the SRM framework, highlighting the importance of examining its long-term effects. Specifically, this research seeks to (1) explore students' perceptions of the station rotation learning modality by examining its perceived effectiveness, level of engagement, compatibility with individual learning preferences, and its influence on motivation, critical thinking, academic performance, and overall learning experience. Moreover, (2) the study wants to investigate if students' perception of learning effectiveness significantly predicts their engagement and satisfaction with the SRM. In addition, (3) the study seeks to develop a thematic framework that captures and explains the key elements of students' learning experiences within the SRM.

METHOD

Research Design

The study utilized a descriptive-correlational mixed-methods approach to investigate students' perceptions and experiences about the Station Rotation Model (SRM) within a blended learning context. The data were collected in the third quarter of the academic year 2024–2025 at a public high school in Iligan City, Philippines. Students moved between teacher-led, online/TV-based, and worksheet stations that were set up to help them stay interested and understand the material. According to Egara and Mosimege[8], SRM frequently entails several phases in practice, including teacher-led instruction, group peer activities, independent assignments, and online tasks.

The study used a structured perception questionnaire with Likert-scale items to collect quantitative data. Then, we used descriptive statistics and correlational techniques to determine relationships between the two main perception dimensions: "Learning Effectiveness and Outcomes" (Category 1) and "Engagement, Motivation, and Satisfaction" (Category 2). Qualitative data derived from open-ended questions, collected using Google Forms, underwent thematic analysis to enhance understanding of students' experiences and to contextualize the quantitative findings.

Research Participants and Setting

The study population consisted of all 128 Grade 10 students who were enrolled in the third quarter of the academic year 2024–2025 at the laboratory high school affiliated with a state university in Northern Mindanao, Philippines. A census sampling technique was used, as every student in each of the four sections was included. A total of 126 students finished the tasks and the survey, yielding a 98,4 % response rate. Other than being formally enrolled in Grade 10 during the study period, no inclusion or exclusion criteria were used because the goal was to include the entire Grade 10 cohort. Likewise, there were no exit requirements; students (n = 2) who did not submit all of their information were simply considered non-respondents.

Instruments

The main instructional resources utilized in the study were the activities conducted across the teacher-led, online, and worksheet stations, all of which addressed the required mathematics topics for the third quarter of Academic Year 2024–2025. To explore students' perception of the station rotation approach in mathematics, a perception questionnaire featuring an AI-generated Likert scale was administered. Although the use of AI-generated items in scale construction is still relatively new, recent research has demonstrated that these items can produce reliable and coherent instruments when they are subjected to expert review and psychometric testing.[18,19] The instrument was subjected to expert face validation to guarantee appropriateness, clarity, and contextual relevance. Before deployment, neither a factor analysis nor a pilot test was carried out. Instead, internal consistency was evaluated during the actual data collection process. Cronbach's alpha for the overall instrument was 0,9543, with Category 1 ("Learning Effectiveness and Outcomes") at 0,9295 and Category 2 ("Engagement, Motivation, and Satisfaction") at 0,7699, indicating excellent and satisfactory reliability, respectively. These findings offer early proof that items produced by AI and contextually adjusted can be a reliable indicator of students' perceptions. Moreover, open-ended questions were administered to participants via Google Forms to explore their experience with SRM. To guarantee clarity and applicability, the questionnaire's content was reviewed by experts after being developed based on well-established research.

Data Collection

The various stations' activities were purposefully created to encourage motivation, engagement, and conceptual understanding. A description of the activities for each station is given in the discussion that follows. The SRM for blended learning was implemented during the third quarter of academic year 2024–2025. Classes were held three times per week, and within this schedule, students engaged in nine SRM activities focusing on exponential and logarithmic functions. Following the implementation, students were asked to answer a structured perception questionnaire using Likert-scale items and reflect on their experience through open-ended questions that were distributed via Google Forms. The researchers were able to gather quantitative measurements of their perceptions as well as qualitative information about students' experiences with SRM. Utilizing Google forms in data collection was also done in recent studies.[20]

The research was carried out in a laboratory high school located in Iligan City, Philippines. Students and parents were informed that the school often does pedagogical research, and the students' safety was ensured. The school administration additionally provided its official authority for teachers to do action research at the school.

Description of the activities per station

In this study, the station rotation model was structured around three stations: teacher, worksheet, and online/TV, each designed with targeted tasks to promote engagement, collaboration, and mastery of exponential and logarithmic functions, as shown in figure 1.

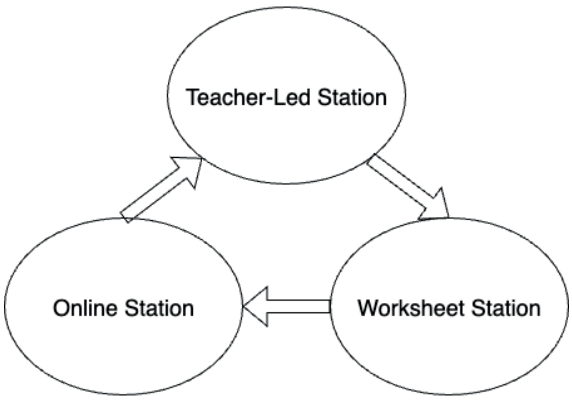

Figure 1. Course design of the station rotation model

Teacher Station. Students rotate across stations in three different sequences: from teacher to worksheet to online, from worksheet to online to teacher, and from online to teacher to worksheet. For students who begin at the teacher station, the teacher delivers the lesson through a traditional board discussion and provides illustrative examples. Those arriving from the online station are prompted to share insights gained from the videos, after which the teacher reinforces key concepts and demonstrates additional examples. Meanwhile, students coming from the worksheet and online stations are engaged in reflective discussion, where the teacher asks about their understanding of the topic, clarifies misconceptions, and facilitates sharing how they arrived at their answers based on the tasks completed in the previous stations.

Worksheet Station. The worksheet stations in the SRM offer a diverse set of tasks that promote both conceptual understanding and procedural fluency in exponential and logarithmic functions. Students work on real-world modeling problems, such as exponential decay scenarios, to connect mathematical concepts to everyday situations. They are also asked to graph functions, interpret visual representations, and identify important characteristics like domain, range, and asymptotes. Open-ended tasks further encourage creativity as learners construct and describe their own exponential equations, helping them understand the effects of changes in function parameters.

In addition to modeling and graphing, students engage in algebraic tasks that involve solving exponential and logarithmic equations using properties such as the one-to-one property and product rule. These problems range from guided examples to independent practice, promoting deeper reasoning and accuracy in symbolic manipulation. Conceptual prompts throughout the tasks encourage reflection and interpretation, reinforcing the meaning behind solutions. Together, the activities provide a complete math experience by mixing real-life situations, visual thinking, skill with symbols, and critical thinking.

Online/TV Station. The Online/TV Station designs its tasks to enhance students' comprehension of exponential and logarithmic functions by utilizing multimedia resources and interactive tools. Students begin by watching videos that introduce exponential functions, highlighting their properties, domain, range, and asymptotes. Based on these materials, they determine which expressions represent functions and explore how to graph them using online tools such as Symbolab and WolframAlpha. These activities reinforce conceptual understanding and visualization of exponential behavior. Another set of tasks allows students to create and graph their own exponential functions using platforms like Desmos and GeoGebra, encouraging exploration and observation of transformations and function forms. According to the qualitative data in the study by Chechan et al.(21), most students believed that using Desmos improved their overall comprehension of function concepts, their capacity to analyze functions, and their ability to visualize their answers, all of which are challenging when working with paper and pencil.

In addition to conceptual exploration, learners engage in procedural tasks involving the solving of exponential and logarithmic equations. They watch short instructional videos on solving exponential equations using exponent rules and one-to-one properties. Students then demonstrate their understanding by solving equations and creating their own, showing detailed solutions. The final task involves watching videos on solving logarithmic equations with the same and different bases, followed by answering reflective questions and solving example problems. These combined activities support independent, tech-enabled learning and promote both procedural fluency and higher-order reasoning. According to Soselisa et al.(22), station rotation is a teaching strategy that can be used in differentiated classrooms to meet all of the students' learning needs and develop their higher-order thinking skills.

While online stations facilitate individualized practice, multimedia engagement, and group projects, teacher-led stations frequently concentrate on direct skill-building, troubleshooting, and feedback.(23) Active reading exercises, creativity-based assignments, and lab experiments are examples of offline or hands-on stations. According to Pereira and Dias(24), the SRM structure should continue to be adaptable to different fields and learning objectives. Additionally, by appreciating student opinions, promoting introspection, and developing empathy, teachers contribute significantly to the development of a supportive environment.

Data Analysis

For data analysis, descriptive statistics, such as the mean, median, and standard deviation, have been employed to interpret students' perceptions of the learning modality. Table 1 shows the interpretation of the mean range for the 5-point Likert scale perception questionnaire. Additionally, simple linear regression was used to examine the relationship between students' perceptions of "Learning Effectiveness and Outcomes" (Category 1) and their "Engagement, Motivation, and Satisfaction" (Category 2). Furthermore, thematic analysis was used to identify and contrast new themes in students' reflections and insights about their experiences with the blended learning model that uses station rotation.

Table 1. Likert Scale Interpretation

Mean Range	Interpretation
4,21 - 5,00	Strongly Agree
3,41 - 4,20	Agree
2,61 - 3,40	Neutral
1,81 - 2,60	Disagree
1,00 - 1,80	Strongly Disagree

RESULTS

Students' Perceptions of the Station Rotation Model

Tables 2 and 3 present indicators of students' perceptions of the station rotation learning modality, focusing on its perceived effectiveness, level of engagement, compatibility with individual learning preferences, and its impact on motivation, critical thinking, academic performance, and overall learning experience, along with the mean, standard deviation, and interpretation.

Table 2. Learning Effectiveness and Outcomes

Indicators	Mean	SD	Interpretation
The station rotation modality implemented in class is effective in enhancing my learning.	3,616	0,89	Agree
The station rotation approach is well-suited to the course content.	3,776	0,89	Agree
The station rotation aligns with my preferred learning style.	3,384	1,12	Neutral
This station rotation learning modality helps me understand complex topics more effectively.	3,408	0,98	Agree
This station rotation learning modality has positively influenced my academic performance.	3,568	0,96	Agree
I feel more confident in applying what I have learned in real-world scenarios.	3,526	0,88	Agree
This station rotation learning modality has enhanced my overall learning experience compared to other methods.	3,528	0,96	Agree
Overall	3,55	0,96	Agree

Based on the findings, students generally agreed that the station rotation modality contributes positively to their learning outcomes. Indicators under this category had mean scores ranging from 3,384 to 3,776, showing overall favorable responses. Students agreed that the approach is well-suited to the course content (M=3,776) and effective in enhancing learning (M=3,616).

Although the statement "The station rotation aligns with my preferred learning style" received the lowest rating (M=3,384, Neutral), this suggests that while the model is beneficial, it does not equally address every learner's preferences. Similarly, students still acknowledged that the modality helps them understand complex topics (M=3,408) and positively influences their academic performance (M=3,568). The students also felt confident in applying what they learned in real-world contexts (M=3,526) and agreed that it enhanced their overall learning experience compared to other methods (M=3,528).

These findings resonate with Akinoso et al.[25] observation that while the SRM supports academic outcomes, students' attitudes toward learning may not shift significantly for all learners.

Table 3. Engagement, Motivation, and Satisfaction

Indicators	Mean	SD	Interpretation
The station rotation model is innovative and engaging.	4,016	0,91	Agree
I feel comfortable participating in class activities under the station rotation model.	3,856	1,00	Agree
I feel more motivated to complete assignments and tasks because of this station rotation learning modality.	3,576	1,03	Agree
The station rotation learning modality encourages me to think critically about the subject.	3,816	0,92	Agree
Overall, I am satisfied with the station rotation learning modality used in this class.	3,728	0,99	Agree
I would recommend this station rotation learning approach for other subjects.	3,568	1,13	Agree
Overall	3,76	0,99	Agree

Students reported stronger levels of agreement in the indicators relating to engagement, motivation, and satisfaction, with mean scores ranging from 3,568 to 4,016. The highest-rated item was "The station rotation model is innovative and engaging” (M=4,016), highlighting the appeal of this approach as stimulating and refreshing compared to traditional instruction. Likewise, students felt comfortable in class activities (M=3,856) and agreed that the modality encouraged them to think critically about the subject (M=3,816).

Motivational aspects were also positively rated: students felt more motivated to complete tasks (M=3,576) and expressed satisfaction with this learning modality (M=3,728). They further indicated willingness to recommend the approach for other subjects (M=3,568), demonstrating recognition of its adaptability and potential for wider application. These findings align with Oktarianto et al.[26], who found that students’ critical thinking significantly improved when using the SRM. Similarly, Fulbeck et al.[14] reported that 96 % of students using this model showed higher levels of engagement and motivation, reinforcing the positive perceptions in this study.

Relationship between students’ perceptions of “Learning Effectiveness and Outcomes” and their “Engagement, Motivation, and Satisfaction”

Students’ perceptions of “Learning Effectiveness and Outcomes” and their “Engagement, Motivation, and Satisfaction” were measured using 5-point Likert scales (1 = strongly disagree to 5 = strongly agree). Mean scores were computed for each construct, and linear regression analysis was performed in Google Sheets to examine whether perceived learning effectiveness predicted engagement, motivation, and satisfaction. Assumptions of linearity, independence, homoscedasticity, and normality of residuals were examined through scatterplots, residual diagnostics, and outlier checks (±3 SD). No major violations were detected.

To provide an overview of students’ responses, descriptive statistics were computed for the two study variables: *Learning Effectiveness and Outcomes* (Category 1) and *Engagement, Motivation, and Satisfaction* (Category 2). The results are presented in table 4.

Table 4. Descriptive Statistics

Variable	N	Mean	SD	Min	Max
Learning Effectiveness and Outcomes (Category 1)	126	3,55	0,96	1,28	5
Engagement, Motivation, and Satisfaction (Category 2)	126	3,76	0,99	1,33	5

Table 4 presents the descriptive statistics for the two study variables. Students reported moderately high perceptions of Learning Effectiveness and Outcomes (M = 3,55, SD = 0,96) and Engagement, Motivation, and Satisfaction (M = 3,76, SD = 0,99). Minimum values (1,28 and 1,33) show that some students expressed less favorable views, while the maximum score of 5 indicates very positive experiences. The standard deviations, close to 1,0, suggest moderate variability in responses. Overall, students generally reported positive perceptions, though variation indicates that it’s important to examine how effectiveness relates to engagement.

Following the descriptive analysis, a simple linear regression was used to examine the extent to which “Learning Effectiveness and Outcomes” explained variance in “Engagement, Motivation, and Satisfaction.” The regression results are presented in table 5.

Table 5. Linear Regression Predicting Category 2 from Category 1

Predictor	B	SE B	t	p
Constant	0,5998			
Learning Effectiveness and Outcomes” (Category 1)	0,8922	0,4937	20,6232	< 0,001

Results, presented in table 5, indicated that “learning effectiveness and outcomes” was a significant positive predictor of “engagement, motivation, and satisfaction,” $f(1, 124) = 425{,}35$, $p < {,}001$. the regression model explained approximately 77,4 % of the variance in students’ engagement outcomes ($R^2 = 0{,}774$).

The regression equation was:

Category 2 = 0,5998 + 0,8922 (Category 1)

This means that for every one-unit increase in “Learning Effectiveness and Outcomes,” students’ “Engagement, Motivation, and Satisfaction” increased by 0,892 units. The strong R^2 value highlights that students’ perceptions of effectiveness are highly influential in shaping their overall satisfaction and motivation within the SRM.

Student Learning Experience in Station Rotation Model

Based on the responses of the students in the open-ended questions, the following themes arise: 1) Use of multiple learning resources; 2) Peer support and collaboration; 3) Independent problem-solving; 4) Strategy and verification; and 5) Station Order/Impact on the Learning Process. In further exploration of the responses, the study proposed relationships among the themes, leading to the students' enhanced understanding and skill mastery, as shown in figure 2.

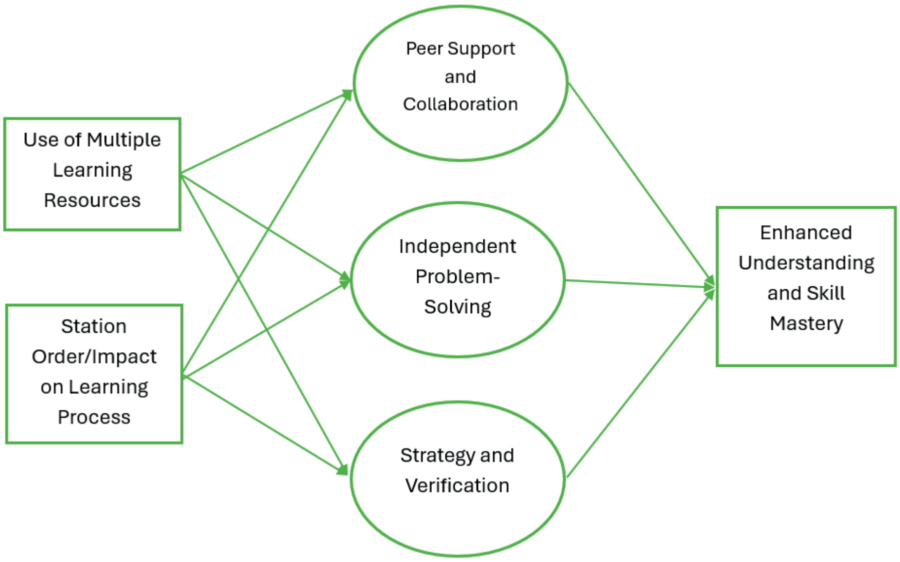

Figure 2. Thematic Framework on Student Learning Experience in Station Rotation Model

Use of Multiple Learning Resources to Peer Support and Collaboration

The integration of multiple learning resources, such as instructional videos, online tools, and teacher-led guidance, played a key role in supporting peer collaboration during the learning process. Students engaged with digital content to build initial understanding, which they then deepened through group discussions and shared problem-solving. Each member contributed their strategies to enrich collaborative activities, resulting in a collective refinement of ideas and solutions. The availability of diverse resources across stations encouraged students to clarify uncertainties, learn from one another, and strengthen their understanding through a combination of individual exploration and cooperative learning. The students demonstrated positive emotions and enhanced their abilities in peer teaching and collaboration.[27]

S45: "I watched the videos that were displayed on the TV in the Online station and discussed with my groupmates."

S46: "We solved the problems by working collaboratively and discussing our thought processes with each other. Each group member shared how they approached the problems, which helped us understand different strategies and find the best solutions. Additionally, we used online resources at the TV/Online Station to reinforce our understanding and clarify any uncertainties. At the Teacher Station, we received guidance and explanations that helped us correct mistakes."

S28: "It was effective when we watched videos and collaborated about the problems."

The majority of students in the study by Abdul Latif et al.[17] strongly agreed that they enjoyed working in groups and collaborating with their peers.

Use of Multiple Learning Resources to Independent Problem Solving

Multiple learning resources, especially instructional videos from the online station and direct instruction from the teacher, supported students' ability to engage in independent problem-solving. These resources provided students with foundational understanding and guided examples, which they then applied on their own when solving problems. Many students first attempted the tasks independently, using insights gained from the videos or teacher explanations to analyze and work through the problems. This approach fostered self-reliance and critical thinking, as learners drew from various inputs to make sense of the tasks before seeking clarification or support when needed. This observation is consistent with the findings of Yılmaz & Açıkgül Fırat.[27] The students felt positive about themselves and said they learned how to learn on their own.

S110: "I solved the problems by watching the videos provided at the online station or by applying the lesson taught to us at the teacher station."

S13: "I first answered the questions by myself and then… I ask my groupmates..."

S1: "I solved the problems by following and analyzing what happened on the videos showed."

The combination of instructional videos and teacher-led explanations empowered students to approach problem-solving with greater independence and confidence. This strengthened their self-reliance and critical thinking while fostering positive attitudes toward learning how to learn on their own.

Use of Multiple Learning Resources to Strategy and Verification

The use of multiple learning resources played a crucial role in supporting students' strategy development and verification of solutions. Worksheets provided clear examples that guided students in formulating their problem-solving approaches, while digital tools like Desmos and Symbolab offered platforms for checking the accuracy of their answers. In addition to these resources, peer assistance served as an important support system for clarifying uncertainties and refining strategies. By combining print materials, technology, and social interaction, students were able to construct, test, and confirm their understanding, leading to more accurate and confident problem-solving.

S16: "I usually relied on the examples given on the worksheet, I also sometimes ask for my classmates' help."

S8: "I would seek help from my classmates and verify my answers using Desmos and Symbolab."

S27: "If it was on the online station, I would watch and observe the topic, during the activity station if I had any problems I would ask others, and then if the board was the last rotation, it would clarify the confusion I had."

The integration of worksheets, digital tools, and peer support enabled students to build and verify their strategies more effectively. This combination of resources fostered accuracy, confidence, and collaboration in their problem-solving process.

Station Order/Impact on Learning Process to Peer Support and Collaboration

The sequence in which students engaged with the learning stations influenced how peer support and collaboration unfolded during the learning process. Initially, some students approached tasks independently and only sought peer input afterward to verify their responses. Others discovered that commencing at specific stations, like the Worksheet Station, exposed gaps in their comprehension, which they subsequently resolved through significant group discussions. This peer collaboration allowed students to hear multiple perspectives and adopt more effective strategies, deepening their conceptual understanding. However, collaborative learning was not immediate for all groups. Early sessions showed limited sharing among peers, which hindered group progress. Over time, with guidance from the teacher emphasizing the importance of discussion and collaboration, students became more open to collaborative problem-solving. This progression underscores how both station order and instructional support can shape the quality and impact of peer collaboration in the SRM.

S10: "I came up with my answers independently and consulted my groupmates when I wanted to check my answer."

S123: "One instance where the station rotation model really helped was during the Worksheet Station. There was one problem I struggled with initially, but after discussing it with my group, I understood my mistake and corrected it. Hearing different perspectives and solutions made me realize an easier way to approach the problem. This experience showed me the value of peer learning and collaboration in understanding difficult concepts."

S46: "When we first started, my groupmates weren't really sharing how they solved their problems, which made it difficult for us to work collaboratively. Because of this, we struggled to fully understand some of the concepts. However, after a few sessions, our teacher reminded us of the importance of collaboration and discussion. With this encouragement, we gradually became more comfortable sharing our ideas and strategies."

Guerrero et al.(28) study also found that students' collaborative work improved with station rotation.

Station Order/Impact on Learning Process to Independent Problem Solving

The order in which students rotated through the stations had a noticeable impact on their ability to engage in independent problem-solving. When students began at stations that provided contextual information or examples, such as worksheets with guided samples, they were better equipped to approach problems with confidence. However, those who started at more task-focused stations, like the worksheet station, faced difficulties in solving problems independently due to a lack of prior exposure to foundational instruction. As students progressed through the different stations, they began to recognize how each one contributed to their overall understanding. They actively connected insights gained from earlier stations and applied them in subsequent tasks, demonstrating adaptability and growing independence in their problem-solving process. This level of understanding highlights the importance of thoughtful station sequencing to scaffold learning effectively.

S25: "We solved the problems by first reading the paper because some of it has its examples already..."

S99: "Depending on which station you went first... the worksheet station... you will be facing the problems head on without the proper introduction…"

S97: "During Math class station rotation model I would try to understand what is happening on each station and then try to note down what would happen and how I could apply them to future problem solvings."

The sequence of station activities played a key role in shaping students' readiness for independent problem-solving, as starting with instructional resources built confidence, while beginning with tasks alone posed challenges. Overall, a well-structured station order helped students connect insights across activities, fostering adaptability and more profound understanding.

Station Order/Impact on Learning Process to Strategy and Verification

The sequence in which students encountered different stations influenced their ability to engage in independent problem-solving. When students began at the worksheet station, some were challenged by the lack of prior explanation or context, which made problem-solving more difficult without initial guidance. Conversely, stations that provided examples or conceptual input, such as the teacher or online stations, better prepared students to approach tasks independently. This variation in learning experience highlights the importance of station order in scaffolding understanding. As students progressed through the rotations, many began to make connections across stations, using insights gained from earlier tasks to inform their strategies and responses in later ones. Ultimately, students learned to adapt by drawing from previous station experiences to enhance their independent problem-solving skills.

S4: "...when we reach the teacher's station I am able to check if my answers are correct and if I had any mistakes and how to fix them."

S23: "Sometimes, if we start in the worksheet station, I'd come up with my own answers first before asking for help..."

S46: "One specific instance where the station rotation model significantly helped me understand the lesson better was when my group started at the Worksheet Station. At first, my classmates and I were confused because we hadn't yet received direct instruction from the teacher, making it difficult to understand how to solve the problems. However, by working together and discussing different approaches, we managed to figure out the solutions. When we moved to the TV/Online Station, the video resources provided additional explanations and introduced us to a faster way to solve the problems."

The order of station rotations significantly shaped students' problem-solving experiences, with instructional stations providing the foundation needed for greater independence, while starting with tasks alone posed initial challenges. Over time, students adapted by linking insights across stations, demonstrating growth in both strategy use and self-reliance.

Peer Support and Collaboration to Enhanced Understanding and Skill Mastery

Peer support and collaboration played a significant role in deepening students' understanding and promoting skill mastery. Through group discussions, students exchanged diverse strategies and approaches, allowing them to see problems from multiple perspectives. This sharing of ideas clarified misconceptions and enriched their problem-solving techniques. Students often combined their individual efforts with peer input, first attempting problems on their own and then refining their understanding through group interaction. The social aspect of learning encouraged active participation, reinforced concepts, and provided immediate feedback, ultimately leading to a more comprehensive grasp of mathematical ideas and improved confidence in applying them. In line with Basuki et al.[29], the SRM provides a collaborative learning environment that affords students the chance to cooperate, share ideas, solve problems, and respect the opinions of others.

S32: "I would rewatch the videos and ask help from my groupmates."

S46: "Each group member shared how they approached the problems, which helped us understand different strategies…"Belazi

S69: "We had a group discussion with our groupmates, where everyone shared their ideas and how they approached the problems."

S77: "First, I tried to answer by myself and after I answer the problem I asked my groupmates…"

Peer collaboration enhanced students' learning by fostering the exchange of strategies, clarifying misconceptions, and reinforcing understanding through shared problem-solving. This cooperative process not only strengthened their mathematical skills but also boosted confidence and engagement in applying concepts independently.

Independent Problem Solving to Enhanced Understanding and Skill Mastery

Independent problem-solving contributed significantly to students' enhanced understanding and skill mastery. Students gained the capacity to think critically and approach problems with greater confidence by utilizing their prior knowledge, classroom instruction, and available learning resources. This data is consistent with the findings of Guerrero et al.[28], which found that station rotation improved critical thinking. They actively recognized patterns, analyzed examples, and applied learned strategies to new situations, demonstrating a growing capacity for independent reasoning. This process allowed learners to internalize mathematical concepts more deeply, as they were not merely following steps but engaging in meaningful analysis to arrive at solutions. As a result, independent problem-solving became a pathway for students to solidify their understanding and strengthen their problem-solving skills. In the study by Belazi et al.[16], one positive aspect was that SRM encouraged students to take ownership of their learning.

S92: "I manage to think critically using my past knowledge and the education given to us at that very moment."

S19: "I recognized patterns from the previous problems and used those as hints…"

S35: "I was able to solve the problems through thinking critically and using the available resources that we have. I analyzed the given examples in each worksheet and through that I was able to come up with an answer to the given problems."

Independent problem-solving empowered students to apply prior knowledge, recognize patterns, and analyze examples, leading to deeper conceptual understanding. This critical engagement not only strengthened their reasoning skills but also built confidence in approaching mathematical tasks.

Strategy and Verification to Enhanced Understanding and Skill Mastery

Engaging in strategy and verification processes supported students in achieving deeper understanding and greater skill mastery. Students demonstrated a proactive approach by initially attempting to solve problems on their own, then verifying their solutions through multiple means, such as consulting peers, revisiting teacher guidance, or using online resources. This practice of rechecking and seeking clarification reinforced correct procedures, addressed misunderstandings, and strengthened conceptual grasp. By actively evaluating the accuracy of their work and refining their methods, students developed a more thorough and confident command of mathematical problem-solving, ultimately leading to improved learning outcomes.

S5: "I recheck all my answers after meeting at the teacher's station."

S103: "I will first answer them by myself then if I'm unsure I will make them recheck and I will ask them questions how to do it."

S115: "I asked help from peers, and used the internet to understand it better."

S72: "When we were stuck on the problem that we didn't understand from the TV station, the teacher station helped us answer and understand how it was answered, giving us the ability to answer similar questions like those and making us able to answer the questions on the worksheet station."

By engaging in strategy use and verification, students reinforced correct procedures, clarified misconceptions, and strengthened their conceptual understanding. This process not only enhanced accuracy but also built confidence and independence in mathematical problem-solving.

DISCUSSION

The study revealed that students expressed favorable perceptions of the station rotation model (SRM), particularly regarding its effectiveness in learning, as well as its impact on their engagement, motivation, and satisfaction. Most indicators in the perception questionnaire received positive ratings, reflecting students' relatively favorable views toward SRM as a classroom modality. This suggests that students not only recognized the model's suitability for learning exponential and logarithmic functions but also perceived that it contributed effectively to their understanding of the content. Similar to the findings of Xiangze et al.[30], who demonstrated that SRM raises motivation, interest, and participation, the present study shows that SRM provided an innovative and engaging strategy that built students' confidence in handling complex mathematical topics and applying knowledge to real-world contexts. These results also resonate with Belazi et al.[16], who emphasized that SRM fosters student ownership of learning, and with Akinoso et al.[25], who highlighted its ability to stimulate multiple senses, improve peer interaction, and integrate digital tools.

Despite these positive outcomes, one notable exception emerged. The indicator relating to the alignment of SRM with students' preferred learning styles received a neutral rating. This echoes Oktarianto et al.[26], who found that although SRM provides varied opportunities for learning through videos, discussions, and self-study, the alignment with personal preferences remains uneven. Similarly, Yılmaz et al.[27] observed that students' enjoyment and autonomy differed across stations, while Pereira et al.[24] emphasized that although SRM promotes dialogue and reflection, it may present challenges when students face complex tasks or technological limitations. The variability value exceeding one in the current study also suggests that students held diverse perceptions, indicating that while SRM is generally effective, it may not fully address differentiated instruction. This points to the need for refinements, particularly in tailoring activities to students' varied learning preferences.

Another significant finding is the relationship between students' perceived effectiveness of SRM and their engagement, motivation, and satisfaction. Consistent with Guerrero et al.[28], who found that station rotation

https://doi.org/10.56294/saludcyt20252287 ISSN: 2796-9711

enhanced critical thinking, the present results suggest that when students perceive SRM as beneficial, they are more likely to engage actively, feel motivated, and report higher satisfaction. This aligns with Basuki et al.[29], who noted that SRM creates collaborative environments where students can cooperate, share ideas, solve problems, and respect the opinions of others. Taken together, these findings reinforce the view that SRM supports immediate engagement and fosters sustained mastery of mathematical content.

The quantitative results were further supported by qualitative findings. The use of multiple learning resources and the structured sequencing of stations, according to students, fostered peer support, collaboration, independent problem-solving, and idea verification. These observations align with Yılmaz et al.[27] conclusion that SRM enhances enjoyment and autonomy with Pereira et al.[24] emphasis on dialogue and reflection. Careful planning of station activities and sequencing, therefore, becomes critical to maximizing these benefits. Ultimately, the findings affirm SRM as a strong alternative to traditional teaching methods. Its processes align with theories of social constructivism and self-regulated learning, as students collaborated with peers and engaged in self-directed study, particularly when supported by digital tools and lecture videos. As Akinoso et al.[25] noted, while SRM supports academic outcomes, students' attitudes toward learning may not shift significantly for all learners—an observation echoed in the variability of perceptions in this study. Nonetheless, SRM demonstrates strong potential in promoting both content mastery and essential 21st-century skills.

Despite these promising outcomes, this study has limitations. Reliance on self-reported perceptions limits objectivity, as students may overstate positive experiences. Moreover, the focus on a single subject and student group restricts generalizability. Future research should employ direct measures of achievement, longitudinal designs to assess enduring effects, and cross-subject comparisons to evaluate broader applicability. Exploring how different station designs or sequences affect diverse learner profiles would also deepen understanding of how SRM supports or constrains engagement.

In practice, the findings suggest that teachers adopting SRM should carefully design station sequences, integrate varied resources to accommodate learning differences, and balance opportunities for peer interaction with independent work. Addressing challenges related to technology and learning preferences will be essential for sustaining motivation. Overall, evidence from this and prior studies suggests that SRM is not only pedagogically sound but also socially acceptable, offering a promising and adaptable blended learning model that cultivates critical 21st-century skills when thoughtfully implemented.

CONCLUSIONS

The results of this study indicate how the station rotation model (SRM) fosters engagement, collaboration, critical thinking, and independent problem-solving while also confirming the model's efficacy as a blended learning strategy. The quantitative results indicated that students who perceived SRM as effective were significantly more motivated, engaged, and satisfied, while the qualitative findings explained this relationship by highlighting the mechanisms that shaped their experiences: access to multiple learning resources, opportunities for peer collaboration, and structured sequencing of station activities. These features supported students to verify strategies, engage in collective thinking, and develop independence through problem-solving, which in turn reinforced their perception of SRM as supportive of learning. Thus, the integration of "what" students valued (effectiveness and engagement) with "how" they experienced it (resource use, collaboration, sequencing, and independent work) illustrates SRM's capacity to support differentiated instruction and cultivate essential 21st-century skills. In summary, these results underscore the possibilities of SRM in mathematics education but also its potential for broader use across disciplines when thoughtfully designed to align structure with student perceptions and experiences.

BIBLIOGRAPHIC REFERENCES

1. Capone R. Blended learning and student-centered active learning environment: A case study with STEM undergraduate students. Can J Sci Math Technol Educ. 2022;22(1):210-36. https://doi.org/10,1007/s42330-022-00195-5

2. Kömür İA, Kılınç H, Okur MR. The rotation model in blended learning. Asian J Distance Educ. 2023;18(2):63-74. https://doi.org/10.5281/zenodo.8197798

3. Thomas S, Joshi M, Anjana C, Dolly, Chavan AV. Blended learning in education: The future of digital pedagogy. J Mark Soc Res. 2025;2(5):329-40. https://jmsr-online.com/

4. Elizondo IJ, Rodríguez MU. The use of the station rotation model to enhance science achievement in secondary education: A systematic review. Rev Investig Educ. 2025;43(1):1-23. https://doi.org/10.6018/rie.599901

5. Nasrullah A, Marlina M, Ratnasari S, Hilman H, Mulyawan G, Ali A. Blended learning in the digital era: An analysis of self-regulated learning assisted with Edmodo-GeoGebra. Int J Geom Res Invent Educ (Gradient). 2024;1(2):1-12. https://doi.org/10.56855/gradient.v1i2.1266

6. Younas M, El-Dakhs DA, Jiang Y. Knowledge construction in blended learning and its impact on students' academic motivation and learning outcomes. Front Educ. 2025;10:1626609. https://doi.org/10.3389/feduc.2025.1626609

7. Zeqiri J, Kareva V, Alija S. The impact of blended learning on students' performance and satisfaction in South East European University. In: Proceedings of the ENTRENOVA - ENTerprise REsearch InNOVAtion Conference; 2020 Sep 10-12; Virtual Conference. IRENET. p. 233-44. https://proceedings.entrenova.org/entrenova/article/view/326

8. Egara FO, Mosimege M. Effect of blended learning approach on secondary school learners' mathematics achievement and retention. Educ Inf Technol. 2024;29:19863-88. https://doi.org/10.1007/s10639-024-12651-w

9. Cao W. A meta-analysis of effects of blended learning on performance, attitude, achievement, and engagement across different countries. Front Psychol. 2023;14:1212056. https://doi.org/10.3389/fpsyg.2023.1212056

10. Haftador AM, Tehranineshat B, Keshtkaran Z, Mohebbi Z. A study of the effects of blended learning on university students' critical thinking: A systematic review. J Educ Health Promot. 2023;12:95. https://doi.org/10.4103/jehp.jehp_665_22

11. Larsari VN, Dhuli R, Chenari H. Station rotation model of blended learning as generative technology in education: An evidence-based research. In: Xu Y, Agarwal A, Zhang H, editors. Digital technology and application. Springer; 2023. p. 553-64. https://doi.org/10.1007/978-3-031-29857-8_45

12. Nugraha DMDP. Station rotation type blended learning model against critical thinking ability of fourth grade students. J Educ Technol. 2020;4(4):516-23. https://doi.org/10.23887/jet.v4i4.29690

13. Ayob NFS, Halim NDA, Zulkifli NN, Zaid NM, Mokhtar M. Overview of blended learning: The effect of station rotation model on students' achievement. J Crit Rev. 2020;7(6):320-6. https://doi.org/10.31838/jcr.07.06.56

14. Fulbeck E, Atchison D, Giffin J, Seidel D, Eccleston M. Personalizing student learning with station rotation: A descriptive study. American Institutes for Research; 2020 Jul. https://files.eric.ed.gov/fulltext/ED610292.pdf

15. Yukhymenko V, Borysova S, Bazyl O, Hubal H, Barkar U. Station rotation model of blended learning in higher education: Achieving a balance between online and in-person instruction. Conhecimento & Diversidade. 2024;16(41):182-202. https://doi.org/10.18316/rcd.v16i41.11434

16. Belazi NA, Ganapathy M. Teachers' and students' perceptions towards the station rotation model: A case of Libyan EFL writing classroom. Asian J Engl Lang Pedagogy. 2023;11(1):22-36. https://doi.org/10.37134/ajelp.vol11.1.2.2023

17. Abdul Latif NH, Shahrill M, Hidayat W. Mastering fractions and innovating with the station rotation model in blended learning. Infinity. 2024;13(2):501-30. https://doi.org/10.22460/infinity.v13i2.501-530

18. Terry J, Strait G, Alsarraf S, others. Artificial intelligence in scale development: Evaluating AI-generated survey items against gold standard measures. Curr Psychol. 2025. https://doi.org/10.1007/s12144-025-08240-w

19. Erdemir N, Atik S. Validity and reliability analysis of the artificial intelligence–digital life balance scale. Psychiatr Q. 2025. https://doi.org/10.1007/s11126-025-10167-1

20. Nguyen VT, Nguyen CTH. The effect of structural equation modeling on chatbot usage: An investigation of Dialogflow. Int J Appl Inf Technol. 2023;6(1):17-28. https://doi.org/10.25124/ijait.v6i01.4840

21. Chechan B, Ampadu E, Pears A. Effect of using Desmos on high school students' understanding and learning of functions. Eurasia J Math Sci Technol Educ. 2023;19(10):em2331. https://doi.org/10.29333/ejmste/13540

22. Soselisa CM, Rusijono, Bachri BS. Station rotation method based on differentiated instruction to improve higher order thinking skills. In: Proceedings of the 3rd International Conference on Education Innovation (ICEI 2019); 2019. p. 116-20. Atlantis Press. https://doi.org/10.2991/icei-19.2019.26

23. Seitova M, Khalmatova Z. The blended learning station rotation model in EFL teaching: Opinions of the implementer. Turk Online J Distance Educ. 2025;26(1):Article 12. https://doi.org/10.17718/tojde.1438392

24. Pereira MJF, Dias SEM. The station rotation methodology: Case study in a rural municipal school in the municipality of Vianópolis, Goiás – Limits and possibilities. Rev Gênero Interdisciplinaridade. 2024;5(6):323-36. https://doi.org/10.51249/gei.v5i06.2332

25. Akinoso SO, Agoro AA, Alabi OM. Effect of station rotation mode of instructional delivery for mathematics in the era of advancing technology. J Int Soc Teach Educ. 2020;24(2):60-72. https://files.eric.ed.gov/fulltext/EJ1304479.pdf

26. Oktarianto ML, Hidayat A, Ghofur A, Dasna IW. The effect of station rotation learning model on critical thinking in elementary school-level students. KnE Soc Sci. 2023;8(8):134-44. https://doi.org/10.18502/kss.v8i8.13292

27. Yılmaz Y, Açıkgül Fırat E. Station-rotation blended learning model in science education: A case study for rural classrooms. Int J Sci Educ. 2024. Advance online publication. https://doi.org/10.1080/09500693.2024.2394707

28. Guerrero LD, Benavides NG. Effect of station rotation model in learning Grade 10 physics. United Int J Res Technol. 2024;5(8):11-8. https://uijrt.com/articles/v5/i8/UIJRTV5I80002.pdf

29. Basuki, Mustaji, Arianto F. The effect of the station rotation model on the collaborative skills of eighth-grade junior high school students. Int J Sci Acad Res. 2023;4(7):5932-4. http://www.scienceijsar.com

30. Xiangze Z, Abdullah Z. Station rotation with gamification approach to increase students' engagement in learning English online. Arab World Engl J Spec Issue CALL. 2023;(9):105-21. https://doi.org/10.24093/awej/call9.7

FINANCING
The authors did not receive financing for the development of this research.

CONFLICT OF INTEREST
Authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION
Conceptualization: Alexis Michael B. Oledan.
Data curation: Alexis Michael B. Oledan.
Formal analysis: Alexis Michael B. Oledan.
Drafting - original draft: Alexis Michael B. Oledan.
Writing - proofreading and editing: Alexis Michael B. Oledan.