Mathematical Representation Ability of Middle School Students in the REMAP-TPS Learning Model and Student Activeness

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Abstract
The mathematical representation ability of eighth-grade students at SMPN 1 Way Bungur remains low. Varied learning activities among students contribute to disparate abilities in each student. This highlights the necessity for a revitalized instructional approach employing a learner-centered learning model, fostering increased student activity and understanding of the material. The REMAP-TPS learning model emerges as an innovative approach, engaging students dominantly in the learning process and aiding their exploration of the material through the use of concept maps. This study aims to assess the efficacy of the REMAP-TPS learning model in enhancing students' representational abilities. The research design employed is a quasi-experimental Posttest-Only Control Group Design. The instruments utilized to measure mathematical representation ability include descriptive questions related to flat-sided geometry and a questionnaire to assess learning activity. The test is administered to students upon completion of the learning process, followed by analysis using ANOVA. Based on the results and discussion, it can be concluded that the REMAP-TPS learning model influences students' mathematical representation abilities across different levels of activity-high, medium, and low. However, there is no significant interaction between the REMAP-TPS learning model and student activity regarding mathematical representation ability.
Keywords: *Mathematical Representation; Learning Activity; REMAP-TPS Learning Model.*

Introduction

Representational abilities play a more important role in both contexts of mathematics learning, as the use of several types of representations can enhance the learning experience (Feigenson, Libertus, & Halberda, 2013). Representation is a configuration, sign, character, symbol, or object that can describe, represent, or symbolize in another way (Johar & Lubis, 2018; Lourenço, Costa, Cruz, & Gonçalves, 2022). Mathematical representation abilities can be categorized into four forms of representation, namely: verbal, graphic, algebraic, and numerical (Ke & M Clark, 2020; Kuzu, 2020; Y. E. Setiawan, 2022). Certain representational aids can become dominant in learning mathematics, but representations need to be translated from one form to another. Translating forms of representation is an important skill that needs to be developed by students to become more proficient in learning mathematics. In recent decades, the role of representation in mathematics education has improved but requires more research to explore various aspects of representation. Previous empirical studies have suggested that there is a close relationship between representational abilities and mathematics (Gumilar, Afrian, & Pramiarsih, 2020; Widada, Nugroho, Sari, & Pambudi, 2019; Yuanita, Zulnaidi, & Zakaria, 2018; Yuliardi, Juandi, Maizora, & Mahpudin, 2021).

Mathematical representation ability is one of the skills in presenting and reiterating the main discussion related to a mathematical problem, transforming it into a new form through pictures, words, tables, graphs, or concrete objects, as well as mathematical symbols (Dewi & Sopiany, 2017). This is what causes students' random thoughts to coalesce into a cohesive and easily understandable single thought, making the construction of mathematical concepts easier with the aid of mathematical representation (Fitri, Munzir, & Duskri, 2017). The representation capabilities in mathematics still receive less attention from educators, resulting in low levels of mathematical representation abilities for students (Lestari, Andinasari, & Retta, 2020; Puspandari, Praja, & Muhtarulloh, 2019; Sulastri, Marwan, & Duskri, 2017). Mathematical representation abilities can emerge by guiding students to comprehend and subsequently express it with language, allowing the material to be fully absorbed. Proficiency in mathematical representation can assist students in more effectively organizing their thoughts when solving a problem (Handayani, 2015).

The representation and engagement of students mutually influence each other in the context of learning. Strong representations, whether visual, verbal, symbolic, or manipulative, enable students to better understand and internalize concepts, which in turn can enhance their engagement in learning. When students feel confident in their understanding, they are more likely to be motivated to participate in active learning activities such as discussions, experiments, or problem-solving. Conversely, students' engagement in the learning process can also affect their representations, as active involvement can drive them to create deeper and more diverse representations of the material being studied (Hmelo-Silver, 2004; Mayer, 2014).

Learning models with concept maps can be utilized to help students express ideas and understand the main concepts in comprehending the material (Rahmi, 2020). Students' mathematical representations can be enhanced through the Think-Pair-Share (TPS) learning model (Arnidha, 2016; Sari & Sari, 2019). Due to the students' low abilities, it is necessary to employ the Reading Concept Map Think-Pair-Share learning model (REMAP-TPS), which can train and improve mathematical representation abilities.

The learning process utilizes the REMAP-TPS learning model, demanding students to engage in various learning activities such as reading, creating concept maps, thinking, discussing in pairs, and expressing opinions in front of the class (Antika, 2018). Cognitive learning outcomes, which also involve mathematical representation abilities, can be more easily improved by implementing this learning model (Avila, Mahanal, & Zubaidah, 2017). This demonstrates a relationship between the REMAP-TPS learning model and mathematical representation ability. The steps in implementing the REMAP-TPS learning model can be observed in Figure 1.

Figure 1. REMAP-TPS learning model steps

Success in learning is influenced by students' active participatio (Nurlaila, 2018). Learning activeness can serve as a visual benchmark supporting mathematics learning outcomes. Learning activeness is a process of teaching and learning activities where students are actively involved and participate in the classroom, resulting in varied student behavior (Pour, Herayanti, & Sukroyanti, 2018). This activity can be observed during the learning process, such as students showing enthusiasm for participation (Kharis, 2019). In this research, students demonstrated varying levels of activity, including high, medium, and low activity levels (Purnama, Usodo, & Kuswardi, 2018).

Previous research has explored the enhancement of mathematical representational abilities influenced by various approaches, including a realistic mathematical approach (Sulastri et al., 2017), discovery learning method (Muhamad, 2016), cooperative Think-Pair-Share method (Arnidha, 2016), Novick learning model (Rezeki, 2017) and the contextual teaching and learning model (Damayanti & Afriansyah, 2018). Other studies have investigated the impact of active learning on learning achievement (Septialamsyah, 2014; Ulichusna, Sari, & Susilo, 2019), learning outcomes (Hartika & Mariana, 2019) and student performance (Fadjrin, 2017; Putri, Amelia, & Gusmania, 2019; Ulichusna et al., 2019). The novelty of this research lies in examining the simultaneous and individual influences of the

REMAP-TPS learning model and students' active learning on mathematical representation ability. In light of the above explanation, this study aims to assess the effects of implementing the REMAP-TPS model and student activity on mathematical representation ability.

Research Methods

This study employs a quantitative research approach with a quasi-experimental research design, specifically utilizing a Posttest-Only Control Group Design. The study's population consists of all eighth-grade students at SMPN 1 Way Bungur for the 2020/2021 academic year. The research samples were selected through cluster random sampling, resulting in Class VIII C designated as the control group with 31 students and Class VIII D as the experimental group comprising 32 students. The experimental class applies the REMAP-TPS Learning Model, while the control class does not. This aims to test whether the REMAP-TPS Learning Model can influence students' Mathematical Representation Ability compared to students who do not use the REMAP-TPS Learning Model.

To assess mathematical representation abilities, the research utilizes instruments in the form of descriptive questions. These questions have undergone comprehensive testing for validity, reliability, difficulty level, and differentiating power. The categorization of students into high, medium, and low learning activity levels is determined using a questionnaire. The mathematical representation indicators considered include visual representation, symbolic representation, and verbal representation (Fitrianna, Dinia, Mayasari, & Nurhafifah, 2018; Sabrina, Hidayah, & Kharis, 2021; Shinariko, Hartono, Yusup, Hiltrimartin, & Araiku, 2021). To quantify mathematical representation, an operational form was devised, built upon indicators of mathematical representation as illustrated in Table 1.

Table 1. Mathematical Representation Indicators

Indicator	Operational Form
Visual Representation	Present information through geometric patterns, diagrams, table graphs, and pictures to elucidate the problem.
Symbolic Representation	Compose mathematical equations or expressions, forecast relationship patterns, and solve problems associated with mathematical equations or expressions.
Verbal Representation	Provide interpretations of steps in solving mathematical problems using words or written text.

Data analysis techniques employed to compare mean differences between groups, divided into the experimental class and control class, utilize Two-Way ANOVA (Analysis of Variance) with prerequisite tests, namely normality and homogeneity tests. Scheffe's Test is conducted if H_0 the assumptions are rejected in the Two-Way ANOVA test.

Results and Discussion

The mathematical representation abilities of students who underwent the learning process with the REMAP-TPS learning model and then received posttest questions on the building material of flat side space varied. In the control class, the average was 69.00, whereas in the experimental class, the average was 79.56, as illustrated in Table 2.

Table 2. Presents the data on the results of Mathematical Representation Ability

Statistik	Class	
	Experiment	Control
Maximum (x_{maks})	100	96
Minimum (x_{min})	58	46
Mean ($\bar{X}$)	79,56	68,52
Median (M_e)	79	67
Mode (M_o)	79	67
Range (r)	42	50
Deviation (s)	12,78	13,10

To provide a clearer understanding, data on students' mathematical representation abilities can be observed in Figure 2.

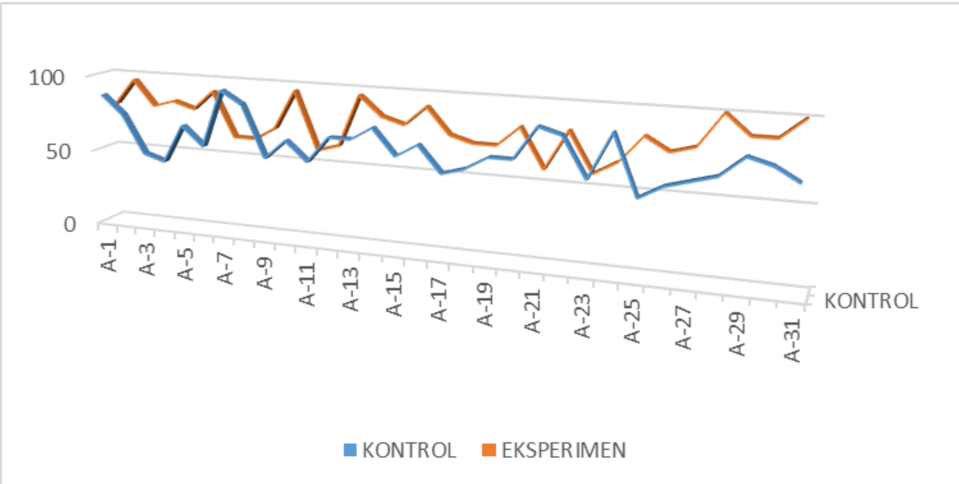

Figure 2. Depicts the graph of Mathematical Representation Capability

It can be observed that the mathematical representation abilities of students in the control class are lower compared to the value of mathematical representation ability in the experimental class. This is because the REMAP-TPS Learning Model may engage students in more interactive, collaborative, and mathematically relevant learning activities. Students in the experimental class may have more opportunities to practice and apply mathematical concepts in meaningful contexts, which can enhance their mathematical representation abilities. Subsequently, prerequisite tests, including normality and homogeneity tests, were conducted. The test results indicated that the samples from both the experimental and control classes follow a normal distribution and exhibit homogeneous variance. Following the prerequisite tests, a two-way ANOVA test was conducted with untreated cells, as summarized in Table 3.

Table 3. Results of the Two-Way Analysis with non-identical cells

Tests of Between-Subjects Effects

Dependent Variable: Representasi_Matematis

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Learning model	578.066	1	578.066	5.399	0.024
Student activity	3733.643	2	1866.822	17.435	0.000
Learning model * Student activity	246.522	2	123.261	1.151	0.324
Error	6103.252	57	107.075		
Total	358471.000	63			

Sig. value on the learning model line $= 0{,}024 < 0{,}05$ so that H_{0A} is rejected, indicating that there is an influence of the REMAP-TPS learning model on the mathematical representation abilities of students. Subsequently, the significance value on the student activity line $0{,}000 < 0{,}05$, so H_{0B} rejected, signifying an influence of students with high, medium, and low learning activeness on the mathematical representation ability. Moreover, the significance value on the interaction between the learning model * student activity $=0{,}324 > 0{,}05$ is not rejected, implying that there is no interaction between the REMAP-TPS learning model and student activity towards mathematical representation abilities.

The difference in average scores in the experimental class indicates that the mathematical representation ability is superior to the control class due to the utilization of the REMAP-TPS learning model. The learning process necessitates students to read carefully first (Wanjari & Mahakulkar, 2011), followed by understanding and rewriting the material in the form of a concept map to foster a deeper comprehension (Y. E. Setiawan &

Syaifuddin, 2020; Tarmidzi, 2019). This disparity demonstrates the effectiveness of REMAP-TPS in generating mathematical representations.

The REMAP-TPS model is a type of REMAP coupled learning model that integrates reading activities, concept map compilation, and cooperative learning (Pangestuti, 2014; Tendrita, Mahanal, & Zubaidah, 2016; Zubaidah, 2014). Students receive materials and questions related to the construction material of flat side space. Subsequently, students are tasked with creating a concept map based on their understanding gained from the reading process. The submission of a concept map by students stimulates their verbal representation abilities.

The learning process in the experimental class is conducted using the REMAP-TPS learning model, which tends to engage students actively throughout the learning process. In its implementation, students delve into discussions to solve problems presented by the teacher. Subsequently, the outcomes are presented in front of the class, allowing other groups to obtain information that was previously unavailable to them (Bobo, 2018; Yuliana, 2019). The subsequent resubmission enhances students' representational abilities. The concept map, derived from the material read, is illustrated in Figure 3.

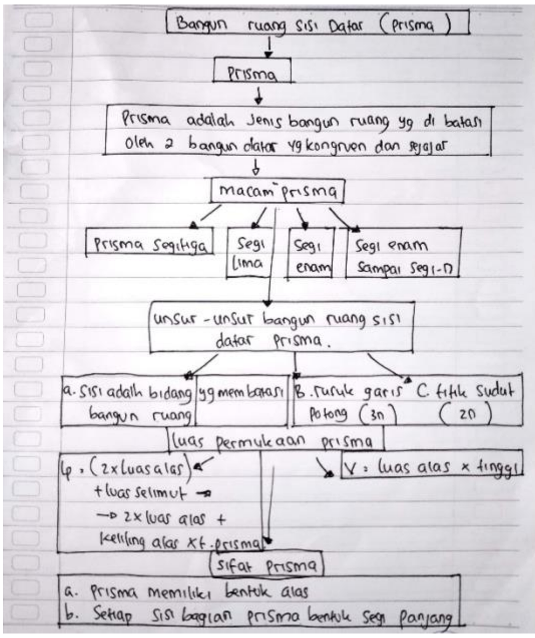

Figure 3. REMAP-TPS model concept map

The control class employs a traditional learning model, characterized by a teacher-centered approach where students merely listen and take notes on important points conveyed by the educator. Nevertheless, some students lack the initiative to document what the teacher imparts. When confronted with a problem, students hesitate to ask questions, reflecting their reluctance to actively participate in the learning process. Consequently, this lack of engagement leads to a deficiency in students' comprehension of the material presented by educators.

This aligns with research conducted by Deny, which explores how the REMAP-TPS model can enhance reading interest and foster the development of metacognitive abilities (D. Setiawan, Zubaidah, & Mahanal, 2020). Further support comes from research by Miswandi Tendrita, stating that the REMAP-TPS learning model has the potential to enhance cognitive learning outcomes (Tendrita, Mahanal, & Zubaidah, 2017). This research underscores the effectiveness of the REMAP-TPS model in improving student learning outcomes, particularly in mathematical representation abilities.

High, medium, and low student activity exert an influence on mathematical representation ability. High student activity in the learning process tends to result in better mathematical representation abilities compared to students with moderate and low activity levels. This high activity may include various aspects of learning such as active participation in class discussions, seeking solutions to problems independently, collaborating with fellow students, and completing challenging assignments. As a result, it can help students understand mathematical concepts more deeply, master mathematical skills more effectively, and develop students' mathematical representation abilities. This aligns with research conducted by Nur Laila who mentioned that 93 % The ability of mathematical representation is caused by the activeness of the fiber educate and 7% others are influenced by other factors (Laila, Hidayat, & Hendriana, 2018). Additionally, Halomoan Harapan asserted that student activity plays a crucial role in constructing and reinforcing the understanding of mathematical concepts (Altaftazani, Rahayu, Kelana, Firdaus, & Wardani, 2020; Dahlan & Wibisono, 2021; Hidayah & Istiandaru, 2018; Komarudin, Monica, Rinaldi, Rahmawati, & Mutia, 2021). Therefore, building mathematical representation abilities becomes more achievable with high student activity.

the interaction between the REMAP-TPS learning model and student activity concerning mathematical representation ability, it was determined that no significant interaction exists. This is because active students are better suited to cooperative learning models, including REMAP-TPS (Destiniar, Jumroh, & Sari, 2019). However, students with medium and low activity levels may find it challenging to keep pace, as the REMAP-TPS model requires them to identify concepts and effectively convey them. The absence of interaction may also stem from students not being forthright when completing the questionnaire, leading to inaccuracies in categorizing students based on their activity levels. Some students may lack independence and collaborate when working on questions. There should be a notable interaction between the REMAP-TPS learning model and student activity regarding mathematical representation abilities.

Conclusion and Suggestion

Based on the results and discussion, it can be concluded that the REMAP-TPS learning model influences students' mathematical representation abilities across different levels of activity-high, medium, and low. However, there is no significant interaction between the REMAP-TPS learning model and student activity regarding mathematical representation ability.

Some recommendations derived from this research include emphasizing individual activity levels in the implementation of the REMAP-TPS learning model, allowing for a balanced combination of students with varying activity levels. For future research, it is suggested to carefully consider the time allocation for each stage in the REMAP-TPS learning model and student activities to ensure a well-executed learning process and proper implementation of all REMAP-TPS learning stages within the planned time allocation.

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