Improving students' mathematical representation skills by using the Osborn learning model

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Abstract
This study aims to determine whether the students 'mathematical representation ability in the experimental class is better than the control class students' mathematical representation ability, to find out whether the experimental class students 'mathematical representation ability increases, and to find out that the increase in the mathematical representation ability of the experimental class students is better than the increase in students' mathematical representation ability. control class. The population in this study were students of class X in a school in Garut. Samples were taken by the purposive sampling technique (sample aims). Retrieval of data in this study using the test method. Data analysis used the data normality test, homogeneous variance test, t-test, and normalized gain test. From the 't-test results, it was obtained that the average mathematical representation ability of the experimental class students was better than the control class students' mathematical representation ability, and the increase in the mathematical representation ability of the experimental class students was better than the increase in the control class students' mathematical representation ability. From the results of the normalized gain test, it was found that the mathematical representation ability of students in the class using the Osborn learning model increased with a gain index of 0.518, included in the moderate category.
Keywords: Mathematical Representation Ability; Osborn; experimental

Abstrak
Penelitian ini bertujuan untuk mengetahui apakah kemampuan representasi matematis siswa kelas eksperimen lebih baik daripada kemampuan representasi matematis siswa kelas kontrol, untuk mengetahui apakah kemampuan representasi matematis siswa kelas eksperimen meningkat, untuk mengetahui peningkatan kemampuan representasi matematis siswa kelas eksperimen lebih baik daripada peningkatan kemampuan representasi matematis siswa kelas kontrol. Populasi dalam penelitian ini adalah siswa kelas X disalah satu sekolah di Garut. Sampel diambil dengan teknik *purposive sampling* (sampel bertujuan). Pengambilan data pada penelitian ini menggunakan metode tes. Analisis data menggunakan uji normalitas data, uji varians homogen, uji-t', dan uji gain ternormalisasi. Dari hasil uji-t' diperoleh rata-rata kemampuan representasi matematis siswa kelas eksperimen lebih baik daripada rata-rata kemampuan representasi matematis siswa kelas kontrol, dan peningkatan kemampuan representasi matematis siswa kelas eksperimen lebih baik daripada

peningkatan kemampuan representasi matematis siswa kelas kontrol. Dari hasil uji gain ternormalisasi diperoleh kemampuan representasi matematis siswa pada kelas yang menggunakan model pembelajaran *Osborn* meningkat dengan indeks gain sebesar 0.518, termasuk dalam kategori sedang.
Kata Kunci: Kemampuan Representasi Matematis*;* Osborn; eksperimen

Introduction

The implementation of mathematics learning in schools is one of the efforts that can be used to achieve learning goals in education. The importance of learning mathematics cannot be separated from its role in various aspects of life (Maulana, 2013; Robbani & Sumartini, 2023). In addition, by studying mathematics, someone is accustomed to thinking systematically, scientifically, using logic, critically, and can increase their creativity (Maulana, 2013; Cahyani & Sritresna, 2023).

Representation ability is one of the general objectives of mathematics learning in schools (Yulia & Surya, 2017; Ulfa & Sundayana, 2022). This ability is very important for students and is closely related to communication and problem-solving skills. To be able to communicate something, someone needs a representation in the form of pictures, graphs, diagrams, or other forms of representation.

The mathematical representation process takes place in two stages, namely internally and externally (Yulia & Surya, 2017; Khoerunnisa & Maryati, 2022). Internal representation is the process of thinking about mathematical ideas that allow a person's mind to work on the basis of those ideas. While external representation is the result of manifestation to describe what students, teachers, mathematicians do internally or internal representation.

Based on the report of the results of The Third International Mathematics and Science Study, it is known that the ability of Junior High School students in Indonesia to present mathematical ideas or concepts in the material of division and numbers, algebra, geometry, data representation, analysis and probability is low (Fuad, 2017; Azkiah 7 Sundayana, 2022). One example, when Indonesian students were asked to make an equation from a table that presents the relationship between two variables, it turned out that the representation ability of Indonesian students was 27% while the international average ability was 45% (Fuad, 2017; Al Addawiyah & Addawiyah, 2022).

Thus, mathematical representation ability is needed by students to find and create a tool or way of thinking in communicating mathematical ideas from the abstract to the concrete, so that it is easier to understand according to (Surya & Istiawati, 2017; Yusriyah & Noordyana, 2021; Marliani & Puspitasari, 2022).

One of the factors that influences the low cognitive competence of students as mentioned above is the learning process (Hardiyanto & Santoso, 2018; Amelia & Indaryati, 2023). This means that the quality of learning implementation is one of the keys to student success. The better the quality of learning, the greater the opportunity for students to achieve a number of expected competencies (Rahmayani & Suwito, 2023). For this reason, teachers can apply various models or methods and learning strategies that support these conditions.

One alternative that can be chosen is the Osborn learning model. The Osborn learning model is a model used to obtain creative ideas in solving problems by collecting ideas from each member spontaneously with the characteristics of brainstorming according to Osborn (Pratiwi et al., 2016; Sari et al., 2023).

The Osborn learning model is a learning model using the brainstorming method or technique. The brainstorming technique is a model that focuses on problems, then provides as many opinions as possible and finds solutions and develops them as far as possible so that students are able to think critically (Hasibuan, 2019; Silviani, Mardiani, & Sofyan, 2021).

Brainstorming technique According to Guntur (Maulidia, 2016; Salam, 2023) is a technique for generating ideas that try to overcome all obstacles and criticisms. Brainstorming is often used in group discussions to solve problems together. Brainstorming can also be used individually. This study aims to determine the improvement of students' mathematical representation abilities by using the Osborn learning model.

Method

The method used in this study is a quasi-experimental method with two sample groups. The group given the Osborn learning model treatment as experimental class 1 and the conventional learning model as experimental class 2.

The population in this study were all students of class XI of SMA Negeri 15 Garut consisting of 11 classes with a total of 363 students. Sampling in this study used the purposive sampling technique (purposeful sampling). Purposive sampling or purposeful sampling is a sampling determination technique with certain considerations. After obtaining two classes as samples, a lottery was carried out with the results of class XI MIPA 4 as a class that uses the Osborn learning model and class XI MIPA 6 as a class that uses the conventional learning model with the number of students for class XI MIPA 4 totaling 28 students and for class XI MIPA 6 totaling 32 students.

The data in this study are the results of students' mathematical representation ability tests using the Osborn learning model and conventional learning models. Data were collected using pretest and posttest techniques. The purpose of the pretest is to determine the initial condition of students before being given treatment. The purpose of the posttest is to determine students' mathematical representation ability after being given treatment. The instrument used in this study is a descriptive test instrument to measure students' mathematical representation ability.

The data from the students' mathematical representation ability test results were analyzed using the data normality test, the two-variance homogeneity test, and the t' test to analyze the differences in mathematical representation ability between students who received the Osborn learning model and students who received the conventional learning model, and using the normalized Gain test (g) to provide an overview of the increase in learning outcomes between before and after learning calculated using the normalized gain formula developed by Hake (Sundayana, 2018), namely as follows:

$$\text{normalized gain (g)} = \frac{\text{posttest score} - \text{pretest score}}{\text{ideal score} - \text{pretest score}}$$

The normalized gain (g) categories according to Hake (Sundayana, 2018) are as follows (see Table 1):

Table 1. Modified Normalized Gain Interpretation

Normalized Gain Value	Interpretasi
$-1,00 < g < 0,00$	There is a Decrease
$g = 0,00$	Still
$0,00 < g < 0,30$	Low
$0,30 < g < 0,70$	Moderate
$0,70 < g < 1,00$	High

Result

Based on the results of the final data analysis, it was found that both sample classes came from normally distributed populations. Therefore, the next test used parametric statistics. In the final stage of data homogeneity test, it was found that both classes had non-homogeneous variances.

Based on the test of the difference of two means (one-tailed test, right-tailed test) obtained t'_{hitung} = -8.529, while W_{hitung} = 2.050. because -2.050 < t'< 2.050 then Ho is rejected and Ha is accepted which means the average posttest mathematical representation ability of class XI students of SMA Negeri 15 Garut who received Osborn learning is better than the average posttest mathematical representation ability of class XI students of SMA Negeri 15 Garut who received conventional learning.

Through the normalized gain criteria, it can be seen how much the increase in the mathematical representation ability of students in experimental class 1 is. Based on the calculation, a classical increase was obtained with (g) = 0.518. This shows that $0.30 < g < 0.70$ is interpreted as moderate. So the normalized gain is in the moderate category, meaning that the mathematical representation ability of students in experimental class 1 increased in the moderate category. The normalized gain criteria were calculated for each student, the calculation results can be seen in the following Table 2.

Table 2. Individual Normalized Gain Criteria

Interpretation	Total	Percentage
There is a Decrease	0	0%
Still	0	0%
Low	4	14,29%
Moderate	17	60,71%
High	7	**25%**
Total		100%

Based on Table 2, 0% of students were in the decreasing category, 0% of students were in the constant category, 14.29% of students were in the low category, 60.71% of students were in the medium category, and 25% of students were in the high category.

Based on the analysis of students' mathematical representation ability scores, it is known that the mathematical representation ability of students using the Osborn learning model is better than classes using conventional learning. This fact is possible because in conventional learning which is centered on the teacher. Where the teacher provides procedural learning such as the application of basic material and students who work on questions given by the teacher. Students are not given the freedom to express their opinions in constructing a concept, so that students' representation abilities are not trained. In contrast to the Osborn learning model, learning is centered on students and researchers act as facilitators. In this learning, students can develop their thinking framework. Students analyze a problem, then make a hypothesis from the results of the analysis carried out. Furthermore, students are asked to choose the best opinion held by members of their group, at this stage it allows students to think actively in choosing the best opinion. Conducting class discussions (synthesis), in this stage students think actively in compiling final conclusions facilitated by the researcher, students become aware of the weaknesses and strengths of their opinions.

Based on the results of the analysis of students' mathematical representation ability values, it is known that the mathematical representation ability of students using the Osborn learning model has increased. The increase in the mathematical representation ability of students using the Osborn learning model is better than the average increase in the mathematical representation ability of students using the conventional learning model. This is indicated by the average increase in the mathematical representation ability of students using the Osborn learning model of 51.76, while the average increase in the mathematical representation ability of students using the conventional learning model is 40.23.

This is supported by the increase in the mathematical representation ability of students using the Osborn learning model indicated by the classical normalized gain value of 0.518, which means the interpretation of the increase in the mathematical representation ability of students in the moderate category. The increase in the mathematical representation ability of students individually was obtained by 0% of students in the decreasing category, 0% of students in the constant category, 14.29% of students in the low category, 60.71% of students in the moderate category, and 25% of students in the high category.

Discussion

The development of mathematical representation skills is a crucial component of effective mathematics education. These skills enable students to express, interpret, and manipulate mathematical ideas in various forms, including graphs, diagrams, symbols, and verbal descriptions. The ability to represent mathematical concepts accurately and flexibly is essential for problem-solving and deeper understanding. The use of the Osborn learning model, known for its emphasis on creative problem-solving and brainstorming techniques, offers a promising approach to enhancing these skills among students.

The Osborn learning model is grounded in the principles of creative thinking, encouraging students to explore multiple perspectives and generate a wide range of ideas before converging on a solution. This approach aligns well with the need for flexibility and creativity in mathematical representation. By engaging students in activities that require them to brainstorm different ways to represent a problem, the Osborn model promotes a deeper understanding of the underlying mathematical concepts.

In traditional mathematics instruction, students often rely on rote memorization and standard procedures to solve problems. However, this approach can limit their ability to adapt and apply mathematical concepts in novel situations. The Osborn learning model, with its emphasis on divergent thinking, encourages students to explore various representations and connections between mathematical ideas. This not only enhances their ability to solve problems but also fosters a more comprehensive understanding of mathematics as a dynamic and interconnected discipline.

Implementing the Osborn learning model in mathematics education can lead to significant improvements in students' representation skills. For instance, when students are encouraged to brainstorm multiple ways to represent a problem—such as using graphs, algebraic expressions, or verbal descriptions—they develop a more versatile toolkit for understanding and communicating mathematical ideas. This versatility is particularly important when tackling complex, real-world problems that may not have a straightforward solution.

Moreover, the Osborn model's focus on collaboration and discussion further enhances students' representation skills. By working in groups, students can share and critique different representations, leading to a more refined and accurate understanding. This collaborative environment also helps students to see the value of different perspectives and approaches, which is a critical component of effective mathematical representation.

While the Osborn learning model offers many benefits, its implementation in mathematics education is not without challenges. One potential challenge is the need for teachers to shift from a traditional, lecture-based approach to a more facilitative role, guiding students through the brainstorming and problem-solving process. This may require professional development and a change in mindset for educators who are accustomed to more structured teaching methods.

Another consideration is the time required to effectively implement the Osborn model. Creative problem-solving activities can be time-consuming, and teachers may need to balance the need for in-depth exploration with the demands of the curriculum. However, the long-term benefits of improved representation skills and a deeper understanding of mathematical concepts may outweigh these initial challenges.

The Osborn learning model represents a powerful tool for improving students' mathematical representation skills. By fostering creativity, collaboration, and flexible thinking, this model helps students develop the ability to represent mathematical ideas in multiple ways, enhancing their problem-solving capabilities and overall mathematical understanding. While challenges exist in its implementation, the potential benefits make the Osborn model a valuable addition to mathematics education, particularly in preparing students for the complex, multifaceted problems they will encounter in both academic and real-world contexts.

Conclusion

Based on the research results, it can be concluded as follows: the mathematical representation ability of students who use the Osborn learning model is better than the mathematical representation ability of students who use the conventional learning model; the mathematical representation ability of students who use the Osborn learning model increases with an index of 0.518. Included in the moderate category; the increase in the mathematical representation ability of students who use the Osborn learning model is better than the increase in the mathematical representation ability of students who use the conventional learning model.

Conflict of Interest

The authors declare that no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely by the authors.

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