STUDENT RETENTION IN ARITHMETIC SEQUENCES AND SERIES LEARNING THROUGH MATH MAZE

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ARTICLE INFO	ABSTRACT
	Kurangnya minat siswa dalam mempelajari matematika berdampak pada daya ingatnya terhadap materi yang diajarkan. Lemahnya daya ingat dalam memahami materi menjadi salah satu kendala dalam pembelajaran matematika. Hal ini menjadi tantangan bagi para pendidik untuk menemukan metode pembelajaran yang tepat. Saat mempelajari barisan dan deret aritmatika, daya ingat yang kuat sangat membantu pemahaman siswa. Dalam penelitian ini labirin matematika digunakan sebagai metode pembelajaran untuk memperkuat retensi siswa. Tujuan penelitian adalah untuk mendeskripsikan retensi hasil belajar siswa setelah pembelajaran matematika berbantuan Math Maze pada materi barisan dan deret aritmatika. Penelitian ini menggunakan pendekatan kualitatif. Proses pengumpulan data dilakukan dengan cara post-test dan re-test. Berdasarkan hasil analisis data disimpulkan bahwa retensi hasil belajar siswa pada pembelajaran barisan dan deret aritmatika melalui labirin matematika relatif tinggi. Artinya labirin matematika dapat menjadi salah satu alternatif pembelajaran matematika. *Students' lack of interest in studying mathematics has an impact on their memory of the material taught. Weak memory in understanding the material is one of the obstacles in learning mathematics. This becomes a challenge for educators to find the right learning method. When studying arithmetic sequences and series, a strong memory really helps students' understanding. In this research, the mathematical maze is used as a learning method to strengthen student retention. The aim of the research is to describe the retention of student learning outcomes after mathematics learning assisted by Math Maze on arithmetic sequences and series. This research uses a qualitative approach. The data collection process was carried out by post-test and re-test. Based on the results of data analysis, it was concluded that the retention of student learning outcomes in learning arithmetic sequences and series through the mathematical maze was relatively high. This means that the math maze can be an alternative for learning mathematics.*

How to Cite:

1. INTRODUCTION

Mathematical skills are very useful both for daily activities and for technological development. Therefore, mathematics is taught at all levels of educational units, from elementary school to university. Mathematics is a subject that is expected to be useful in daily life (Damayanthi et al., 2022). However, in reality, students do not like mathematics subjects because students think that mathematics is difficult (Permatasari, 2021). Based on interviews conducted by researchers with three educators at the high school/vocational school level in Bandung, the results of the interviews showed that many students did not like mathematics subjects because they were difficult to understand. Therefore, educators need to look for interesting and appropriate strategies, learning models, or learning methods to overcome student boredom and improve the quality of mathematics learning (Cahya, 2021).

Numbers are one of the topics of mathematics taught in school. On the topic of numbers there are subtopics, one of which is arithmetic sequences and series. In practice, the achievement of learning outcomes on the topic of sequences and series is still not as expected. Students are not yet able to create mathematical models, apply formulas, make calculation errors, and conclude errors (Nahriah, 2021). Lack of understanding of concepts and students' errors in solving problems in arithmetic sequences and series material are indicators that show that students' retention ability in learning mathematics is not yet optimal.

Masfiyah et al. (2019) stated that student retention is the ability of students to receive, input information, and bring back things previously obtained. With good memory, students can achieve optimal learning outcomes, but memory for information can decrease over time. In efforts to increase mathematics retention among students, students must be actively involved in classroom learning. Thus, there is a need for planning, selecting, and implementing learning models that can increase student learning activity.

One of the causes of low levels of education is the low level of student retention (Firdayanti et al., 2019). Therefore, efforts are needed to increase student retention. Implementing learning that is interesting to students has the potential to improve learning retention. Korompot et al. (2020) stated that interest in learning could be expressed by students in their daily activities as learners, manifested through active participation in learning activities. High interest in learning will result in a successful learning process (Hidayati et al., 2023). Students who do not have an interest in learning mathematics will find it difficult to develop a desire to study mathematics because interest can encourage students to use their abilities and explore creatively to find solutions to various problems that arise.

One form of learning strategy in mathematics subjects is by using the Game-Based Learning learning method. Based on the results of interviews conducted by researchers with three educators at the SMA/K level, they are of the opinion that Game-Based Learning can increase students' motivation and interest in learning. Henry (Nurhayati, 2020) stated the positive impact of using games, one of which is that games are fun and entertaining and games can be a means of training to solve problems and logic so that they get used to actively thinking, learning, and practicing.

Researchers have conducted interviews with high school teachers who have used games in teaching mathematics. These competitive learning games can increase student interest and retention. Therefore, the application of games to learning sequences and arithmetic series also has the potential to strengthen the retention of student learning outcomes. Researchers apply a maze-assisted mathematics learning design to discuss arithmetic sequences and series. Math Maze is an educational game that is expected to have the potential to strengthen the memory of class X vocational school students to find solutions to the problems presented.

Based on the background that has been presented, this research examines the learning retention of students who study using Math Maze. The research is limited to discussing the determination of the difference, the nth term, and the sum of the nth terms of an arithmetic series. Therefore, this research aims to describe student learning retention in learning arithmetic series using Math Maze.

2. RESEARCH METHOD

A qualitative research approach was used to answer how to student retention learning outcomes in learning arithmetic sequences and series using math mazes. The application of math mazes in learning arithmetic sequences and series is designed to strengthen the retention of student learning outcomes. Retention of learning outcomes is really an aspect that is really paid attention to in this research. Based on a qualitative approach, the research tries to describe the retention achievements of student learning outcomes in the arithmetic sequences and series learning carried out. Learning is carried out at one of the vocational high schools in West Java. Data collection was carried out using test instruments. The test was carried out twice. After completing the learning, a posttest is carried out, and one week later a re-test is carried out. The test is presented in the form of a short description.

Table 1. Scoring Guidelines

Rated Aspect	Category	Score
Understand the problem	Doesn't say what is known and what is asked.	0
	Mentioning what is known without stating what is being asked is not appropriate.	1
	State what is known and what is asked appropriately.	2
Plan a solution	Not planning a problem solution at all.	0
	Made a plan to answer, but it wasn't quite right.	1
	Made a plan to answer and be able to solve problems appropriately	2
Implement the plan	No answer at all	0
	The answer is wrong and only a small part is correct.	1
	The answers are detailed and some are wrong.	2
	Simple and correct answer	3
Interpret the results obtained	There is no conclusion.	0
	There are answers, but no conclusions	1
	Correct answers and conclusions.	2

Source: Putera & Yulita (2019)

Post-test and re-test are used to measure student retention levels. The test given is in the form of a description of the sub-chapter material on sequences and arithmetic series. Post-test and re-test use the same questions. The results of measuring retention levels are used to measure the effectiveness of learning design assisted by Math Maze media. In this research, the comparison of the percentage of post-test and re-test results is used to determine and measure the level of student learning retention. Guidelines for assessing student post-test and re-test results are explained in Table 1 and Table 2.

Data were analyzed using the formula in Equation 1. Meanwhile, the reference level for retention of student learning outcomes refers to Table 2. The reference equation and criteria for retention strength are based on the opinion of Setiawan et al. (2012).

$$Retention\ power = \frac{retest\ score + posstest\ score}{2} \times 100 \ \dots\dots (1)$$

Tabel 2. Criteria for Retention Strength

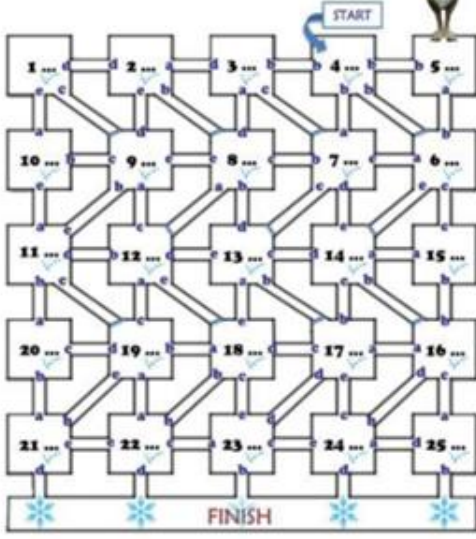| No.	Retention (R)%	Criteria
1.	$R \geq 70$	High
2.	$60 < R < 70$	Medium
3.	$R \leq 60$	Low

3. DISCUSSION

This research applies math mazes to learning arithmetic sequences and series as an effort to strengthen students' memory. Math maze is applied because it presents many exercises presented in the form of a game. This development in learning can strengthen students' interest in learning. Likewise, lots of practice has the potential to strengthen students' memory in understanding lesson material. Several parts of the math maze in learning arithmetic sequences and series are presented in Figure 1.Researchers implemented learning assisted by the Math Maze game which was the result of previous research. Learning arithmetic sequences and series through Math Maze is carried out in class X of high school. Learning was carried out in 3 meetings. At the first meeting, the material on arithmetic sequences and the technicalities of playing Math Maze, and the practice of Math Maze level 1, were discussed. Students followed the learning according to the instructions given in the technicalities of playing Math Maze. At the second meeting, learning discussed arithmetic series material with the help of Math Maze level 2. Then at the third meeting, learning applied Math Maze level 3 to practice questions at the level of national olympiads, college selection and tests for prospective civil servants. Setelah tahap pembelajaran selesai, peneliti menyelenggarakan post-test dan re-test untuk mengetahui daya retensi peserta didik. Post-test dilaksanakan setelah selesai mengerjakan Math Maze level 3. Sedangkan re-test dilaksanakan setelah satu minggu pelaksanaan post-test.

The post-test results are part of the data to measure students' retention levels on sequence and arithmetic series material. In this test, four questions are given in the form of descriptions. The post-test results of learning arithmetic sequences and series through the math maze are presented in Table 3.

Figure 1. Math Maze in Learning Arithmetic Sequences and Series

Table 3. Post-Test Results Data for Arithmetic Sequences and Series Learning

Post-Test Descriptions	Score
Maximum score	100
Average	82.8
Standard Deviation	15.4

The re-test was held one week after the post-test. This refers to Shofiah et al. (2017) who stated that the method of measuring student retention was carried out within a week after the post-test took place. This re-test is used to measure the percentage of student retention that can persist. The results of the re-test of learning arithmetic sequences and series through the math maze are presented in Table 4. A recapitulation of the post-test and re-test results in learning arithmetic sequences and series is presented in Table 5.

Tabel 4. Re-Test Results Data for Arithmetic Sequences and Series Learning

Re-Test Descriptions	Score
Maximum score	100
Average	87.6
Standard Deviation	14.7

Tabel 5. Retention Data for Arithmetic Sequences and Series Learning

Average			Criteria
Post-test Score	*Re-test Score*	Retention Score (%)	
82.8	87.6	85.2	High

Retention is a very important aspect of learning. This is in line with Wijayanti & Lutfi (2021) statement that strong retention of material can make learning more meaningful. Referring to this statement, researchers implemented math maze learning to facilitate student retention. Researchers have measured the level of student retention in mathematics learning through post-test and re-test activities. To measure student retention levels, researchers conducted a re-test after one week of implementing the post-test. This refers to Shofiah et al. (2017) who stated that the method of measuring student retention was carried out within a week after the post-test took place. Based on the post-test results described in Table 3 and the re-test described in Table 4, the student retention results are presented in Table 5. In Table 5 it can be seen that the retention score is 85.2. This score is then compared with the retention level based on Table 2. Table 6 shows the distribution of student learning retention levels.

Table 6. Distribution of Student Learning Retention Levels

Criteria	Percentage
High retention	80%
Medium retention	10%
Low retention	10%

Based on Table 2, the retention level criteria are clear, if the retention percentage score is more than 70%, it is a high criterion, a retention percentage of 60.1% to 69.9% is a medium criterion, and a retention percentage score of less than 60% is a low criterion. In Table 6, it can be seen that almost all students are in the high category or 80%. Then students in the medium category are 10% and in the low category are 10%. Thus, after learning through the math maze, almost all students have a high level of retention criteria.

From the post-test and re-test results data, most students experienced an increase in test results. Some students also still experience obstacles in learning. Errors made by students in the post-test were errors in calculating related to mathematical operations such as multiplication, division, addition, subtraction, use of formulas, and writing conclusions. Improvements can be seen in the re-test results, errors in calculating or applying mathematical operations have been reduced.

From the explanation that has been described based on the measurement of student retention level criteria adapted from Setiawan et al. (2012), it can be stated that almost all students who have carried out learning using Math Maze media have high retention criteria. From these results, it can be concluded that Math Maze can be used to increase retention in mathematics learning.

Student interest in learning is a situation where students can develop a sense of enjoyment, generate enthusiasm, and be involved in learning activities. More varied or fun learning methods such as using learning games can also attract students' interest in learning mathematics and are interested in active learning (Friantini & Winata, 2019). The application of game-based learning with the help of Math Maze has referred to this opinion. To measure interest in learning, researchers provided a questionnaire that students had to fill out shortly after learning. The results of the questionnaire stated that 93.6% of students were very interested in the learning presented. Referring to the interpretation of students' interest in learning as stated by Fatmawati (2016), the percentage score of 85.01% to 100% is included in the category of very high interest in learning. From these results it can be concluded that the application of math mazes is one solution to overcome students' low interest in learning.

The application of game-based learning, especially Math Maze, can minimize students who don't like mathematics. The mistakes that students often make in studying the material on sequences and arithmetic series proposed by Nahriah (2021) can be overcome by student retention because good retention and can produce optimal learning.

4.   CONCLUSION

This research concludes that students' learning retention in learning sequences and arithmetic series using Math Maze is in the high category. This also means that the Math Maze design for learning arithmetic sequences and series can facilitate students' learning retention. It is also known that students' interest in learning sequences and arithmetic series using Math Maze is in the very high category. This also means that the learning design of arithmetic sequences and series using Math Maze can facilitate students' learning interests. Based on the results of this research, the author proposes several suggestions for using learning designs using math mazes in the form of 1) developing content or material on other topics, 2) developing display designs to suit the characteristics of students, 3) developing superhero characters that students are interested in.

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