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Implementation of Problem-Based Learning Assisted by Assemblr Edu: An Innovative Strategy to Encourage Students' Creative Thinking in Trigonometry.

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Abstract: This study was conducted to investigate the effect of the Problem-Based Learning Model assisted by Assemblr Edu to encourage students' creative thinking skills in trigonometry material in class IX MTs Al-Ma'shum Sidodadi in the 2024/2025 school year. This study used a pretest-posttest quasi-experimental design, focused on all ninth-grade students. IX-A was used as the experimental class using the problem-based learning model, and class IX-B as the control class using the direct learning model. Random samples were taken randomly before learning began, with average pretest results of 66.38 for the experimental and 57.06 for the control classes. After the teaching is complete, the T-test results are obtained.$T_{hitung} > T_{tabel}$ $(4{,}265 > 2{,}704)$ thenH_o is rejected andH_a Is accepted, meaning that there is an Effect of Problem Based Learning Model Assisted by Assemblr Edu to Encourage Students' Creative Thinking Ability in Trigonometry Class IX MTs Al-Ma'shum Sidodadi academic year 2024/2025.

Keywords: *Problem-Based Learning, Assemblr Edu, Creative Thinking*

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INTRODUCTION

According to (Sotonade & Onabanjo, 2022) Education is the most important process in today's development, encompassing more than just being in a classroom or formal institution such as a school. Schools remain the primary place where education is imparted. In a broader perspective, education imparts knowledge and involves character building and skills training. Education can also be referred to as the process or act of teaching, where lessons are applied to the mind or character of people. Education serves as a tool for change, not as a permanent entity. Its main goal is to influence the social behaviour of the person being educated, which positively impacts society. Education can mould people, open their eyes, and provide them with skills relevant to everyday life, which shows how important education is.

Education is one of the essential things for humans because they can gain the knowledge needed in life. Mathematics education is one of the basic sciences that are

studied from elementary, junior high and high school to higher education. Mathematics has a relationship and supports various fields of science and different aspects of life. (Sari et al., 2017) Mathematics is the study of numbers and the science of interconnected logic. It is divided into three major groups: algebra, analysis, and geometry. With mathematics, students can think systematically, critically, creatively, and logically.

(Sopiyuloh et al., 2024) States that mathematics is the science of quantity, shape, arrangement, and size, the main thing is the method and process of finding with the right concepts and consistent symbols, properties and relationships between quantities and sizes, either abstractly, pure mathematics or about the benefits of applied mathematics which requires good thinking skills.

According to (Rahmah, 2018) "The development of creativity is neglected in formal education (school), even though it is significant for the development of children's potential as a whole and the advancement of science and cultural arts". The problems above are by the facts that occur in the field with many lessons using conventional models that prioritise lecture methods, text book oriented and teacher centred. As a result, the thinking ability of primary level students is still relatively low because they only pay attention to the teacher.

Another thing that hinders students' creative thinking skills is the fixation of students' answers to the material or concepts in the book and the opinions of others, so that they cannot develop properly. In line with the opinion of (Sohibi & Siswanto, 2012) "Most schools do not encourage students to expand their thinking by creating new ideas and rethinking existing conclusions". Thus, students' creative thinking skills need to be improved in schools by providing opportunities for students to express what is in their thoughts.

Thinking is a mental activity that a person experiences when faced with a problem or situation that must be solved. The thinking process consists of three steps, namely understanding formation, opinion formation, and conclusion drawing. In the thinking process step, creativity is needed. Creativity is a skill that can be learned; it gives power to people by exerting power for their natural abilities that can result in great teamwork, productivity, and profit. (Rauf et al., 2022) The characteristics of a person's creative thinking ability can be seen from three indicators: fluency (fluency) is shown in the number of ideas made in response to commands, flexibility (flexibility) is shown in changes in approach when responding to commands, and originality (originality) is shown in the novelty of ideas/ideas made in response to commands.

According to (Mulyana, 2010) "Creative thinking or divergent thinking is providing various possible answers based on the information provided with an emphasis on the diversity of answers and suitability." A student can be said to be creative if they can solve problems with their own ideas and produce new ideas.

Creative thinking skills that will be developed in learning include aspects of fluent thinking, flexible thinking, original thinking, and elaboration thinking, which is in line with the opinion of (Husen, 2015). Creative thinking is considered the highest level of cognitive process, which automatically includes all other lower cognitive processes when enacting a creative thought. Guilford reported that "divergent thinking" is much closer to creativity, which includes four basic components: fluency, flexibility, originality, and elaboration (Mohanty, 2015). Creative thinking is needed very often in learning because it has so many topics strongly related to the need to use and utilise creative thinking skills.

Many students still have not been able to think creatively because the model used in schools does not support the ability to think creatively. One tactic to meet the demands of today's students is the collaborative problem-based learning model. This model can help students understand the basic steps of solving and encourage them to work together to think creatively in the classroom.

Thus, learning that can facilitate students' collaborative and problem-solving skills in higher education is needed. Researchers constructed a new problem-based learning (PBL) model in this study. Integrating these two learning models is to overcome the weaknesses of collaborative and problem-based learning. In this study, PBL is seen as learning conducted in groups that can reduce competition and individual feelings, and each group member can achieve goals and acquire new knowledge through creative thinking activities. (Hendarwati et al., 2021)

Barrow (Huda, 2013) defines Problem-Based Learning or PBL as "Learning that is obtained through a process towards understanding or resolution of a problem". Meanwhile, according to (Sujana & Atep, 2014) "PBL is a learning that presents a variety of problematic situations that are authentic and functional for students, so that these problems can be used as stepping stones for investigation and research". Therefore, PBL is a learning approach that requires students to construct their knowledge through problems.

Through this model, students are directed to increase learning independence and creativity and improve problem-solving skills. (Kholifah et al., 2021) According to Arend in Trianto (2010), the steps in problem-based learning (PBL) consist of five phases: (a) Providing orientation about the problem to students, (b) Organising students to research, (c) Assisting independent and group investigations, (d) Developing and presenting artefacts and exhibits, (e) Analysing and evaluating the problem-solving process.

The learning media is also needed to support the success of the learning model used, learning media is a tool used to provide content or information to students during the learning process. One of the purposes of learning media is to accommodate learners to develop their ability to understand and assess the material that has been presented. An important part of the learning process is the learning material. To create learning media, teachers today need to be imaginative and creative. One way is to incorporate technology into learning media.

To help teachers teach and clarify learning materials, educators must create learning materials that align with the times. One way to do this is by utilising technology that uses interactive learning media maker applications. (Isye et al., 2024) Augmented reality (AR) technology, which can turn virtual objects into real objects in 2D and 3D, is one of the technologies used to make learning media. Assemblr Edu is an application that uses AR technology.

As for the media that can support the problem-based learning model, one of them is Assemblr EDU. The Assemblr EDU application is a platform that can make the learning atmosphere more lively. This Assemblr EDU application has provided various learning topics that can be used for free. If the material presented does not suit our needs, we can design and create our own from scratch using the augmented reality editor feature (Assemblr, 2023)

An example of technology-based learning media is the Assemblr EDU application. This platform allows teachers and learners to create and share interactive

learning materials that use augmented reality technology. (Rachmawati et al., 2020) States, "This platform combines Lego and Pokémon Go". Lego and Pokémon Go are augmented reality-based games. Augmented reality technology has been widely applied in various fields, one of which is the field of education.

METHOD

This research was conducted at MTs Al-Ma'shum Sidodadi Westisaran, located at Jl. Batu Asah, Rintis 2, Westisaran District, Asahan Regency. This research uses a quantitative approach with a quasi-experimental method to examine the effectiveness of the Problem-Based Learning (PBL) learning model assisted by Assemblr EDU in improving students' creative thinking skills in trigonometry material. Specifically, this study describes how students demonstrate their creative thinking skills in solving trigonometry problems by applying the PBL model supported by augmented reality (AR) technology from Assemblr EDU. The analysis is based on the students' creative thinking ability level, including fluency, flexibility, and originality indicators. Through this approach, it is expected to know the extent to which the integration of AR-based technology in problem-based learning can increase students' engagement and creativity in learning mathematics.

Two different classes received the therapy in this trial. One served as the control class and the other as the experimental class using a pretest-posttest design. 123 students of class IX of Mts Al-Ma'shum Sidodadi participated in this study during the academic year 2024-2025. The sample used was random. 30 students of class IX-B, applying Direct Learning, and 31 students of class IX-A, part of the experimental class using the problem-based learning model, were sampled.

Table 1: Research design

Group	Pre Test	Treatment	Post Test
Experiment Class	P-1	M-1	P-2
Control Class	P-1	M-2	P-2

(Sugiyono 2018, Page 79)

Description:

P-1 = Pre-Test

P-2 = Post-Test

M-1 = *Problem-Based Learning* (PBL) Model

M-2 = Direct Learning

This research uses various descriptions as a method and incorporates quantitative data. Collecting information about problem-solving ability in the material of building space before and after treatment. Validity, reliability, difficulty index, and differentiating power were the data collection tools. Data analysis was conducted using the Collaborative Problem-Solving Approach to measure the impact of students' problem-solving skills.

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The analysis requirement tests included normality, homogeneity tests, and hypothesis testing.

RESULT AND DISCUSSION

Research Results

The data shows the creative thinking ability of MTs Al-Ma 'shum Sidodadi students after applying the problem-based learning model in the experimental class and Direct Learning in the control class. The following table presents a summary of this issue:

Table 1. Pretest and Posttest Results of Experiment and Control Class Students

Creative Thinking Ability	Class	Sample	Min	Max	Average
Pretest	Experiment	31	55	81	66,38
	Control	30	40	75	57,06
Posttest	Experiment	31	50	94	80,48
	Control	30	50	85	67,7

Based on the table above, students in the experimental class had good problem-solving skills, with an average of 80.48, and in the control class, with an average of 67.7.

Data Analysis

This study will test students' ability to think creatively in two sample classes. To do this, do the following:

Normality Test

Normality test based on *the Lilliefors test* formula ($a = 0{,}05$):

$$z_1 = \frac{x_i - \bar{x}}{s}$$

$$(Z_1) = P(p \leq z_1)$$

$$Sz_i = \frac{banyaknya\ z_1, z_2, \dots\dots, z_n \leq z_i}{n}$$

For the formulation of the hypothesis used, namely:

H_o The sample comes from a distributed population

H_a The sample does not come from a normally distributed population

The test criteria are:

If$\boldsymbol{L_{hitung} \leq L_{tabel}}$, thenH_o is accepted

If$\boldsymbol{L_{hitung} > L_{tabel}}$, thenH_a is accepted

Table 2. Data Normality Test Results Before and After the Test

Class	Data	N	L_{hitung}	L_{tabel}	Description
Experiment	Pretest	31	0,0777	0,1591	Normally Distributed
	Posttest		0,1311		
Control	Pretest	30	0,1307	0,161	Normally Distributed
	Posttest		0,0806		

Mentioned in the table thatL_{hitung} *Pretest* experimental class 0.0777 andL_{hitung} *Posttest* experimental class 0.1311 whileL_{tabel} 0.159. With$n = 31$ at the real level$a = 0{,}05$, so$L_{hitung} < L_{tabel}$ In the experimental class$(0{,}0777 < 0{,}159)$ and$(0{,}1311 <$

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0,159) . In addition,L_{hitung} *Pretest of* control class 0.1307 andL_{hitung} *Posttest* of control class 0.0806 whileL_{tabel} 0.161. With$n = 30$ at the real level$a = 0{,}05$, thus$L_{hitung} < L_{tabel}$ In the control class$(0{,}1307 < 0{,}161)$ and$(0{,}0806 < 0{,}161)$. Then both datasets are Normally Distributed.

Homogeneity Test

This test assesses whether the variables are equal or not. The F-statistical test is used to test the homogeneity of the sample variance, using the following formula:

$$F = \frac{Varians\ Terbesar}{Varians\ Terkecil}$$

The formulation of the hypothesis in the homogeneity test is:
H_o = Students' problem-solving ability test data have the same variance.
H_a = The students' problem-solving ability test data have unequal variances.
Criteria:

1. If$F_{Hitung} \leq F_{Tabel}$, thenH_o is accepted
2. If$F_{Hitung} > F_{Tabel}$, thenH_a is accepted

For homogeneity testing, the F test was used in Before and After, presented below:

Table 3. Homogeneity Test Results of *Pretest* and *Posttest* Data

Class	Data	N	F_{hitung}	F_{tabel}	Description
Experiment	Pretest	31	1,63	1,85	$F_{hitung} < F_{tabel}$
Control		30			
Experiment	Posttest	31	1,13	1,85	$F_{hitung} < F_{tabel}$
Control		30			

The table shows that.$F_{hitung} < F_{tabel}$ andH_o Are accepted, which means that the test data varies significantly/homogeneously.

Hypothesis Test

The findings of the previous test showed that both sample classes had normal distributions and homogeneous variances. Therefore, the t-test was used to test the hypothesis, according to the following formula:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \text{ By } S = \frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1 + n_2 - 2}$$

(Sugiyono, 2016)

Ket:

$\bar{X}_1$ = Experimental class average
$\bar{X}_2$ = Control class average
n_1 = Number of experimental class students
n_2 = Number of control class students
S_1 = Variance of experimental class
S_2 = Variance of control class

Criteria:

1. $T_{hitung} \leq T_{tabel}$ thenH_0 is rejected
2. $T_{hitung} > T_{tabel}$ thenH_1 is accepted

Table 1.4 Hypothesis Test Results (T-Test)

Class	$\tilde{x}$	N	T_{hitung}	T_{tabel}
Experiment	80,48	31	4,265	2,704
Control	67,7	30		

Proposed hypothesis:

$H_0: \mu_1 \leq \mu_2$: The problem-based learning model supported by *Assembler Edu* did not have a significant impact on students' creative thinking skills.

$H_a: \mu_1 > \mu_2$ The problem-based learning model supported by *Assembler Edu* significantly impacts students' creative thinking.

Based on the calculation results$T_{hitung} = 4{,}265$ while$T_{tabel} = 2{,}704$, then at the level of$\alpha = 0{,}05$, then$T_{hitung} > T_{tabel}$ is$4{,}265 > 2{,}704$ meansH_0 is rejected,H_a is accepted, so the Problem-Based Learning Model Assisted by Assemblr Edu affects the Creative Thinking Ability of Trigonometry Class IX MTs Al-Ma'shum Sidodadi TA 2024/2025.

Discussion

Furthermore, the findings show that the mean values of the Pretest and Posttest of the experimental and control classes were 66.38 and 80.48, respectively. While in the control group, they were 57.06 and 67.7, respectively. Because$L_{hitung} < L_{tabel}$ The population in the normality test for the Pretest and Posttest questions is usually distributed. Based on the homogeneity test, the student problem-solving ability test has the same variance on the Pretest question.F_{hitung} (1.63) <F_{tabel} (1.85), and the *Posttest* questionF_{hitung} (1.13) <F_{tabel} (1.85), so the variance is the same.

In the t-testT_{hitung} (4.265) >T_{tabel} (2.704) thenH_a is accepted andH_o Is rejected. So that the Problem-Based Learning Model assisted by Assemblr Edu significantly affects Students' Creative Thinking Ability, it has been proven that the model increases students' creative thinking. With this method, students communicate and achieve positive learning outcomes. The findings show that, in the 2024-2025 academic year, the Assemblr Edu-assisted Problem-Based Learning Model significantly influences Creative Thinking ability related to Trigonometry material.

The results of research from Putri Novella (2024) with the title "The Effect of Problem Based Learning Model Assisted by Assemblr Edu Media on Problem Solving Ability of Grade V Students" namely the application of the Problem Based Learning (PBL) model assisted by Assemblr Edu media has a positive influence on the problem solving ability of grade V students. Students who learn using this model significantly improve their understanding and problem-solving skills compared to conventional learning methods. Using Assemblr Edu media as a visualisation tool also increases students' motivation and engagement, contributing to the learning process's increased effectiveness. Thus, technology-assisted PBL can be an alternative teaching method that effectively improves students' problem-solving skills. Thus, the results of this study entitled "Implementation of Problem Based Learning with Assemblr Edu: An Innovative Strategy to Encourage Students' Creative Thinking in Trigonometry Material", namely the score of students' creative thinking skills treated with the problem-based learning model obtained an average of 80.48 while the average score of students' creative thinking skills treated with the direct learning model is 67.7. This means that when treated with

the problem-based learning model, students' creative thinking ability is better than that of the direct learning model. The treatment was given through the post-test question to determine students' mathematical problem-solving ability to solve the given problems. The results of the Post-test values were analysed using the normality and homogeneity tests, which showed that both samples were normally distributed and homogeneous. Thus, the problem-based learning model assisted by the Assemblr edu technology media can be an alternative teaching method that effectively improves students' creative thinking skills.

CONCLUSION

Based on the research, the conclusions are as follows: The results of the hypothesis testing are obtained.$T_{hitung}(4{,}265) > T_{tabel}(2{,}704)$, soH_O is rejected,H_a It is accepted that the problem-based Learning Model assisted by Assemblr Edu affects Students' Creative Thinking Ability.

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