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Improving Students' Problem-Solving Skills and Self-Confidence through Ratiolib-Assisted Problem-Based Learning

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A R T I C L E I N F O

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A B S T R A C T

The purpose of this study is to investigate and assess how the use of Problem-Based Learning (PBL) with RatioLib has improved the mathematical problem-solving abilities and self-confidence of seventh-grade students at SMP Maitreyawira Batam in the area of comparing two amounts. In this study, a mixed methods design is used. A quasi-experimental pretest-posttest control group approach is used in the quantitative phase. The two sets of research participants are the experimental group, which received PBL with RatioLib's assistance, and the control group, which received PBL without RatioLib. Tests were used to gauge mathematical problem-solving abilities, while questionnaires were used to gauge self-confidence. Several students participated in in-depth interviews throughout the qualitative phase to learn more about their learning experiences, opinions about RatioLib, and the elements affecting the development of their problem-solving abilities and self-assurance. The findings of the study should give a thorough picture of how PBL, with RatioLib's help, has been used to boost students' confidence and mathematical problem-solving abilities while also contributing to the creation of more efficient math instruction.

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INTRODUCTION

The 21st century dimension of education emphasizes its role in preparing the younger generation to face the challenges of the future. One of the alternatives as an opportunity in facing these challenges is mathematical skills as part of education to form students who have good problem-solving skills and confidence. Students are more likely to prefer routine problems that are calculative than solving non-routine problems related to daily problems.

The National Council of Teachers of Mathematics (NCTM) asserts that effective mathematics learning can develop a range of crucial skills, including critical thinking, complex problem-solving, creativity, analytical skills, data interpretation and representation, and communication and collaboration (NCTM, 20). These skills are not only important in an academic context, but are also indispensable in many aspects of professional and personal life in the ever-evolving digital age. This is strengthened by the implementation of the Independent Curriculum which emphasizes three main principles in learning, namely student-centered, the application of an interdisciplinary approach, and the development of 21st century skills.

The PISA Mathematics Framework 2021 states that many students do not have effective mathematical problem-solving strategies and are poorly trained in applying mathematical concepts in real-life contexts (OECD, 2018). The UNESCO Incheon Declaration 2021 highlights that the traditional rote-based approach still dominates mathematics teaching in many schools, so problem-solving skills are not built (UNESCO, 2021). Munaji and Setiawahyu's (2020) study on the 2020 Trends in International Mathematics and Science study report concluded that the mathematical ability of Indonesian students is only centered on solving basic and simple mathematical problems.

LITERATURE REVIEW

The fact that so many children still struggle to solve math problems motivates teachers to keep searching for better teaching strategies. According to research by Astuti and Krisnawati (2023), students frequently run into difficulties when attempting to solve contextual problems. Lack of comprehension of fundamental ideas, insufficient ambition to learn, and trouble adjusting to different question kinds all limit students. Research by Haryono, et al. (2021) found that most junior high school pupils felt bored and less interested in learning mathematics. They find it difficult to focus, participate less actively, and are not excited to work on difficult problems.

PBL is a viable approach to teaching mathematics. This approach uses actual problems as a focal point for learning, giving students a difficult and relevant educational experience. PBL is thought to be successful in enhancing two crucial areas: students' confidence and their ability to solve mathematical problems. Present circumstances enable the use of technology-assisted PBL, which can maximize the objectives and procedure of mathematics education.

PBL combined with the RatioLib app is a novel approach that blends digital technology and contextual learning techniques. PBL is distinguished by the real-world problem scenario that students must solve. Conversely, RatioLib offers contextualized and interactive digital content to enhance learning that is

based on problem-solving. RatioLib gives students access to digital resources that can improve their education, promote deeper comprehension, and offer a forum for more dynamic and interactive problem-solving.

This study's theoretical analysis of RatioLib-assisted PBL is crucial since it serves as a basis for developing a conceptual framework and formulating research questions. Important ideas on RatioLib-assisted PBL in enhancing students' confidence and mathematical problem-solving abilities will be covered in this study.

Prior research has examined the potential of PBL to enhance mathematical proficiency and self-assurance. Some earlier research on this subject is as follows:

1. With an N-gain value of 0.62, including in the medium category, Iolanessa et al. (2020) discovered that research on the use of the PBL learning model can enhance students' problem-solving abilities. This demonstrates how well the PBL learning paradigm works to help students become more adept at solving problems.
2. Sujarwo (2020) discovered that self-efficacy had a significant value of 0.038 and problem-solving abilities had a significant value of 0.031. The fact that both of these significant values were below 0.05 suggests that PBL had a major impact on students' self-efficacy and problem-solving skills.
3. According to Ulva et al. (2020), the usage of PBL had an impact on students' Mathematical Problem Solving Ability (MPSA), which was evaluated for all students. MPSA pupils who used the PBL model outperformed those who used traditional learning.
4. To find out how well problem-based learning might improve students' academic performance, problem-solving abilities, and trust in statistics, Ismail and Imawan (2021) carried out a study. Academic performance exams, self-confidence surveys, problem-solving evaluations, and observational notes were among the tools employed. The results showed that students' learning outcomes were improved via problem-based learning.
5. In comparison to traditional training, Brahim et al. (2023) discovered that problem-based learning (PBL) was more successful in improving students' mathematical problem-solving skills. The study also showed that students with high and medium degrees of self-confidence were better at solving mathematical problems than students with low levels of confidence.

METHODOLOGY

a. Type of Research

This study is a mixed study (quantitative and qualitative) with a quasi-experimental approach, where it is used to evaluate the impact of treatment or intervention on groups without perfect randomization. The methods in this research design are based on pre-test and post-test control group design. The study involved two groups of participants selected based on comparable characteristics, and will look at the differences in results between the

experimental group that received the RatioLib-assisted PBL method, and the control group that received the PBL method. Researchers were able to assess the effect of improving problem-solving skills and self-confidence after students received RatioLib-assisted PBL treatment and compared with the control group before and after the intervention.

The pre-test, treatment, post-test (p+t+p) research design proposed by Murray (2003:53) allows researchers to more accurately measure the influence of a subject matter. By providing an initial test before learning and a final test afterwards, researchers can compare the improvement of students' abilities. The difference between the scores of these two tests is considered a direct contribution of the material studied. Thus, this design not only measures the learner's final knowledge, but also the extent to which the material is able to improve their understanding compared to the initial knowledge.

Research Design

Class	Initial Conditions	Initial Conditions	Final Conditions
Experimental Class	X1	T1	X2
Control Class	X1	T2	X2

Information

X1 : Pre-test, Experimental Class Questionnaire and Control Class
X2 : Post-Test, Questionnaire, Experimental Class Interview and Control Class
T1 : Treat learning with the RatioLib-assisted PBL method
T2 : Treat learning with the PBL method

According to the justification provided, students will first receive a pre-test and a self-confidence questionnaire before any intervention is made as part of the research. Lastly, to determine the improvements in problem-solving skills and self-confidence before and after receiving the PBL technique intervention with RatioLib, students will be given post-tests, questionnaires, and interviews on their self-confidence.

b. Population and Sample

A set of individuals that meet specific characteristics relevant to the subject of the study is referred to as a population. For this study, the population used was 320 students from grade VII of Maitreyawira Junior High School, starting from class 7A to class 7J.

Table 1
Students of Maitreyawira Junior High School Batam Grade 7
Academic Year 2024/2025

Class	Number of Male Students	Number of Female Students	Total	Average Age
7A	17	15	32	13 tahun
7B	17	15	32	13 tahun
7C	17	15	32	13 tahun
7D	18	14	32	13 tahun
7E	18	15	33	13 tahun

7F	15	16	31	13 tahun
7G	17	15	32	13 tahun
7H	16	16	32	13 tahun
7I	15	17	32	13 tahun
7J	16	16	32	13 tahun

The sample selected for observation is a representation of the population, namely by purposive sampling technique.

Table 2 Research Sample

Class	Sample Class
7A	Experimental class of RatioLib-assisted PBL method
7D	PBL method control class

RESEARCH RESULT

Pretest and posttest results on problem-solving abilities, self-confidence questionnaire results, and interview results on problem-solving abilities and self-confidence have all been generated by the learning process that was conducted in the experimental and control classes.

1. Results of Problem-Solving Skills
   a. Descriptive Analysis

   The results of the pretest and posttest of students' problem-solving skills are presented in the following table

Table 3 Results of Pretest and Posttest Problem-Solving Skills of Experimental and Control Classes

Descriptive Analysis	Experimental Classes		Control Classes	
	Pretest	Posttest	Pretest	Posttest
Mean	68.83	76.17	69.06	75.31
St Dev	9.57	10.34	9.15	9.89
Min	50.00	55.00	52.50	57.50
Max	87.50	92.50	87.50	97.50
Incomplete	59%	25%	50%	25%
Complete	41%	75%	50%	75%
Very High	3%	16%	3%	13%
High	34%	53%	38%	53%
Low	59%	31%	56%	34%
Very Low	3%	0%	3%	0%

Based on the results of the descriptive analysis in Table 3 above, it can be seen that the average value of students' problem-solving ability in the experimental class has increased significantly, from 68.83 to 76.17. The percentage of students who reached the completion criteria (≥70) increased from 41% to 75%. In the control class, the average score of problem-solving ability also increased, from 69.06 to 75.31 with an increase in completeness from 50% to 75%.

The percentage of students who obtained very high and high categories experienced a significant increase in the experimental class, while in the control class the increase was relatively smaller. The percentage of students who obtained the low and very low categories experienced a significant decrease in both groups, especially in the experimental class.

When compared, the experimental class showed a better increase in terms of average scores and the percentage of students who completed. This indicates that PBL assisted by RatioLib is effective in improving students' problem-solving skills compared to PBL applied to the control class.

b. Normality Test

The normality test from the data of the pretest and posttest results of students' problem-solving skills in the experimental class and control class is presented as follows

Table 4 Normality Test of Experimental Class Problem Solving Ability

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	.149	32	.069	.975	32	.644
Posttest	.144	32	.088	.951	32	.157

a. Lilliefors Significance Correction

Based on the results of the Kolmogorov-Smirnov and Shapiro-Wilk normality tests in Table 4.2, it can be seen that the pretest and posttest data of problem-solving ability in the experimental class produced a significance value (Sig.) greater than 0.05. This indicates that it means receiving H0, which is normally distributed data.

Table 5 Control Class Problem-Solving Ability Normality Test

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	.104	32	.200*	.977	32	.707
Posttest	.099	32	.200*	.976	32	.682

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on the results of the Kolmogorov-Smirnov and Shapiro-Wilk normality tests in Table 4.3, it can be seen that the pretest and posttest data of problem-solving skills in the control class produced a significance value (Sig.) greater than 0.05. This indicates that it means receiving H0, which is normally distributed data.

c. Homogeneity Test

The following are the results of the homogeneity test of the problem-solving ability of the experimental class and the control class, namely

Table 6 Homogeneity Test of Problem-Solving Ability of Experimental Class and Control Class

Test of Homogeneity of Variances

Pretest

Levene Statistic	df1	df2	Sig.
.133	1	62	.717

Posttest

Levene Statistic	df1	df2	Sig.
.302	1	62	.584

The results of Levene's test in Table 4.4 show that the pretest data has a significance value (Sig.) of 0.717 (>0.05) and the posttest data has a significance value (Sig.) of 0.584 (>0.05). This indicates that there is no significant difference between the variance of the experimental and control groups in the pretest data and posttest data. So it is concluded that the assumption of homogeneity of variance is fulfilled for both pretest and posttest data.

d. Paired T Test

Table 7 Paired t-Test Problem-Solving Ability of Experimental Class

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 Pretest - Posttest	-7.343	4.442	.785	-8.945	-5.742	-9.352	31	.000

It is evident from the above table that |tcal| = 9.352 > ttable = 1.669 at a significance threshold of α = 5%. This condition demonstrates that there is a statistically significant difference between the experimental class's pupils' problem-solving skills pretest and posttest scores (H0).

Table 8
Paired t-Test Control Class Problem-Solving Ability

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 Pretest - Posttest	-6.250	2.540	.449	-7.165	-5.334	-13.919	31	.000

It is evident from the above table that |tcal| = 13.919 > ttable = 1.669 at a significance threshold of α = 5%. This condition demonstrates that the difference between the pretest and posttest scores of the control class students' problem-solving abilities is statistically significant (H0).

Both the experimental class and the control class's problem-solving skills before and after the therapy differed significantly, according to the Paired t-Test results.

e. Unpaired t-test

The Unpaired t test is shown as follows

Table 9 Unpaired t-Test Problem-Solving Ability of Experimental Class and Control Class

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Post test	Equal variances assumed	.302	.584	.340	62	.735	.8594	2.5294	-4.1968	5.9156
	Equal variances not assumed			.340	61.881	.735	.8594	2.5294	-4.1970	5.9158

As can be shown from the above table, |tcal| = 0.34 < ttable = 1.670 at a significance threshold of α = 5%. This condition indicates that, if H0 is accepted, there is no discernible difference between the experimental class's and the control class's average posttest scores.

f. Interview Results

Experimental Class Problem Solving Ability Interview

Interviews about problem-solving skills were conducted to 6 students consisting of 3 students with high ability, and 3 students with low ability based on the results of the pretest.

Students with high abilities consistently stated that PBL assisted by RatioLib helps them understand math problems more easily and feels more helpful in planning and implementing problem solving. By participating in PBL learning assisted by RatioLib, students with high abilities better understand the purpose of the step of rechecking their answers. This shows that PBL RatioLib can help learners develop problem-solving skills.

Students with low ability tend to have difficulties in understanding some concepts and in carrying out calculations. They are also still experiencing difficulties in carrying out re-examination steps. This shows that there is a need for additional support for students with low ability so that they can make optimal use of PBL assisted by RatioLib.

Control Class Problem-Solving Ability Interview

The results of the interviews above show that students with high abilities are more effective in using textbooks in the problem-solving process during PBL learning. It is easier for them to understand problems, plan solutions and implement them. On the other hand, students with low ability tend to experience difficulties in these three stages. This indicates that PBL with textbooks can be a valuable tool in improving problem-solving skills, especially for students with better skills. However, there is a shortcoming in the use of textbooks, namely the lack of guidance on the steps to recheck answers. As a result, both students with high and low

abilities have difficulty evaluating their work results. So it can be concluded that RatioLib-assisted PBL has great potential to improve problem-solving skills.

2. Self-confidence results
   a. Descriptive Analysis

Table 12 Results of Self-confidence Questionnaire for Experimental Class and Control Class

Descriptive Analysis	Experimental Classes		Control Classes	
	Beginning	End	Beginning	End
Mean	49.677	53.548	51.000	54.781
St Dev	7.842	8.314	8.791	8.650
Min	37	36	34	39
Max	69	74	68	72
High Level	9%	28%	22%	28%
Medium Level	91%	72%	75%	72%
Low Level	0%	0%	3%	0%

Table 12 presents a comparison of students' self-confidence in the experimental class (using the PBL RatioLib method) and the control class (using the PBL method) before and after the treatment. Overall, both the experimental and control classes experienced an increase in the mean self-confidence score after the treatment. However, the experimental class using the PBL RatioLib method showed a slightly higher increase in the mean score compared to the control class.

At the beginning of the study, the two groups had a relatively similar distribution, but after treatment, the proportion of students with high scores in the experimental class tended to be larger than in the control class. These results show that the PBL RatioLib method is slightly more effective in increasing students' self-confidence than the PBL method.

   b. Normality Test

The normality test of the data from the results of the self-confidence questionnaire of students in the experimental class and control class is presented as follows

Table 13 Normality Test Self-confidence Experimental Class

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre	.094	32	.200*	.968	32	.434
Post	.071	32	.200*	.986	32	.937

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on the results of the Kolmogorov-Smirnov and Shapiro-Wilk normality tests in Table 13, it can be seen that the initial and final self-confidence data produce a significance value (Sig.) greater than 0.05. This indicates that receiving H0 i.e. data comes from a normally distributed population.

Table 14 Self-confidence Normality Test of Control Class

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre	.116	33	.200*	.974	33	.603
Post	.078	33	.200*	.971	33	.506

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

It is evident from Table 14's results of the Shapiro-Wilk and Kolmogorov-Smirnov normality tests that both the beginning and final self-confidence data yield a significance value (Sig.) higher than 0.05. This suggests that the data is from a population that is regularly distributed, or H0.

c. Homogeneity Test

Table 15 Self-confidence Homogeneity Test of Experimental Class and Control Class

Test of Homogeneity of Variances

Pre

Levene Statistic	df1	df2	Sig.
.193	1	62	.662

Post

Levene Statistic	df1	df2	Sig.
.056	1	62	.814

The original data has a significance value (Sig.) of 0.662 (>0.05), while the final data has a significance value (Sig.) of 0.814 (>0.05), according to the Levene's test results in Table 15. The assumption of variance homogeneity is satisfied since this shows that the variance of the experimental and control groups does not differ significantly.

d. Paired t-test

The Paired t-test is shown as follows

Table 16 Paired t-Test Self-confidence Experimental Class

Paired Samples Test

	Paired Differences				t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			

				Lower	Upper			
Pair 1 Pre - Post	-4.0313	4.0837	.7219	-5.5036	-2.5589	-5.584	31	.000

As can be observed from the above table, |tcal| = 5.584 > ttable = 1.669 at a significance level of α = 5%. This condition demonstrates that there is a statistically significant difference between the experimental class students' initial and final self-confidence scores when they receive H0.

Table 17 Paired t-Test Self-confidence Control Class

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1 Pre - Post	-3.7813	2.7677	.4893	-4.7791	-2.7834	-7.728	31	.000

It is evident from the preceding table that |tcal| = 7.728 > ttable = 1.669 at a significance threshold of α = 5%. This condition demonstrates that obtaining H0 indicates that the difference between the students in the control class's initial and final self-confidence scores is statistically significant.

e. Unpaired t-test

The Unpaired t test is shown as follows

Table 18 Unpaired t-Test Self-Confidence Experimental Class and Control Class

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Post	Equal variances assumed	.056	.814	-.666	62	.508	-1.4063	2.1115	-5.6272	2.8147
	Equal variances not assumed			-.666	61.853	.508	-1.4063	2.1115	-5.6274	2.8149

From the table above, it can be seen that the significance value for the F test (Sig. = 0.056) is greater than 0.05 means that the variance of both groups is the same. With a significance level of α = 5%, |tcal| = 0.666 < ttable = 1.670. This condition showed that receiving H0 was no significant difference between the average self-confidence score of students in the experimental group and the control group.

f. Interview

Results of the Experimental Class Self-confidence Interview

Interviews about self-confidence were conducted to 6 students consisting of 3 students with high self-confidence, and 3 students with medium self-confidence based on the results of the initial questionnaire.

Interviews about self-confidence were conducted to 6 students consisting of 3 students with high self-confidence, and 3 students with medium self-confidence based on the results of the initial questionnaire.

Most students, both students who have high and moderate levels of self-confidence, feel more confident in solving problems, are more active in group discussions, and feel more proud of their abilities after using RatioLib. Students feel that the features in RatioLib, such as learning videos, interactive quizzes, and games help increase their self-confidence. In general, learners feel that the use of RatioLib has increased their self-confidence. Based on the results of this interview, it can be concluded that the PBL RatioLib method has great potential in increasing students' self-confidence.

Control Class Self-confidence Interview

Students with high self-confidence tend to give more positive answers and show a better understanding of the PBL process. They feel more confident in solving problems, active in group discussions, and feel their math skills are improving. Meanwhile, students with moderate self-confidence tend to give more hesitant answers and show some difficulties in following the PBL process. They feel less confident in solving problems independently, although they recognize the benefits of group discussions.

Based on the results of interviews with students who participated in PBL assisted by RatioLib and PBL, there was a significant difference in self-confidence obtained by students, namely :

1) PBL assisted by RatioLib has an impact on increasing self-confidence for students with high and moderate self-confidence. Interactive features such as learning videos, quizzes, and games are considered to be very helpful in improving material understanding and self-confidence in solving problems, being active in discussions, and being proud of their abilities.
2) PBL has an impact on increasing self-confidence in students with high self-confidence and is less effective for students with moderate self-confidence. Students with moderate self-confidence tend to still doubt and find it difficult to solve problems. So PBL assisted by RatioLib provides a more interactive and interesting learning experience, so that it can be more effective in increasing students' self-confidence, especially for those who initially have moderate self-confidence.

3. Correlation Analysis

To determine the degree to which self-confidence can predict problem-solving ability, correlation analysis was performed using the posttest score of problem-solving ability as the dependent variable and the final questionnaire score of self-confidence as the independent variable. The following table displays the correlation analysis's findings.

Table 19 Results of Pearson Correlation Analysis

Correlations

		POSTTEST	Self Conf
POSTTEST	Pearson Correlation	1	.966**
	Sig. (2-tailed)		.000
	N	32	32
Self Conf	Pearson Correlation	.966**	1
	Sig. (2-tailed)	.000	
	N	32	32

**. Correlation is significant at the 0.01 level (2-tailed).

The posttest score of problem-solving ability and the final score of students' self-confidence showed a very strong and substantial positive association (r = 0.966), as shown in Table 19 above. After using PBL with RatioLib, students' self-confidence and their ability to solve problems have a positive linear relationship, as indicated by a positive r value near 1. Following PBL with RatioLib's assistance, students' self-confidence and their capacity to solve problems are positively correlated, as indicated by a $p < 0.05$ value.

The results of linear regression are shown in the following table

Table 20 Linear Regression Results

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	11.443	3.179		3.600	.001					
	Self Conf	1.213	.059	.966	20.597	.000	.966	.966	.966	1.000	1.000

a. Dependent Variable: POSTTEST

The aforementioned regression analysis's findings indicate that, following the use of RatioLib-assisted PBL, there is a highly significant and beneficial interaction between students' problem-solving abilities and their level of self-confidence. P = 11,443 + 1,213 S is the linear regression equation that is produced, where P is the posttest result and S is the self-confidence score following PBL with RatioLib's help.

DISCUSSION

The results of data analysis of pretest, posttest, self-confidence, and interviews in the experimental class (PBL assisted by RatioLib) and control class (PBL) showed that there was a significant difference in students' problem-solving skills and confidence levels after participating in learning.

1. The effect of the implementation of RatioLib-assisted PBL on mathematical problem-solving ability.

   The results show that the implementation of RatioLib-assisted PBL significantly improves students' mathematical problem-solving skills. This was marked by an increase in the average posttest score to 76.17, exceeding the minimum completeness score set. In addition, the proportion of students who achieved learning completeness reached 75%, demonstrating the effectiveness of PBL assisted by RatioLib in helping students master problem-solving skills.

   Following their involvement in PBL with RatioLib's assistance, students' problem-solving abilities significantly improved, according to the findings of the paired t-test. This is consistent with constructivism, which emphasizes the value of pupils actively creating their own knowledge. Learners may autonomously investigate mathematical ideas, solve problems, and get immediate feedback thanks to RatioLib's interactive elements, which include videos, simulations, and quizzes. Students can develop a profound and significant understanding in this supportive learning environment.

   However, the unpaired t-test findings revealed no discernible difference in the enhanced problem-solving skills of the experimental group (PBL with RatioLib assistance) and the control group (PBL). This suggests that both teaching approaches are equally successful in enhancing students' ability to solve problems. But bear in mind that earlier studies (Sulsana, 2024) demonstrated that the use of interactive learning materials can enhance problem-solving abilities and promote a more thorough comprehension of ideas.

   The improvement of problem-solving ability in the experimental group is strongly thought to be influenced by the use of RatioLib. Interactive features on RatioLib allow learners to :

   a. Learn concepts visually because videos and simulations help learners visualize abstract mathematical concepts
   b. Learn concepts visually because videos and simulations help learners visualize abstract mathematical concepts
   c. Collaborating with peers because the game feature allows students to exchange ideas and help each other in solving math games.

   The results of the interviews that have been conducted show that there is a significant difference between the learning experience of students in the experimental group (PBL assisted by RatioLib) and the control group (PBL). Students with high abilities in the experimental class, gave positive feedback on the use of RatioLib in the learning process. They feel that interactive features such as videos, simulations, and quizzes are helpful in understanding math concepts and provide clear and structured guidance in solving problems. However, students

with low abilities still need additional support to be able to take advantage of RatioLib's features optimally.

Learners in the control group generally rely on textbooks as the main source of learning. Students with high abilities can use textbooks effectively, but they also have difficulty in rechecking answers. This shows that textbooks, while useful, have limitations in providing immediate and specific feedback.

So PBL learning assisted by RatioLib can be an effective alternative to improve problem-solving skills. Teachers can integrate this technology into learning to create a more active, engaging, and student-centered learning environment.

2. Effect of RatioLib-assisted PBL implementation on self-confidence

Based on the data analysis and interview results, it can be said that PBL with RatioLib's help significantly boosts seventh-grade students' self-confidence. Following learning, students' self-confidence scores increased statistically significantly in both the experimental and control groups, according to the results of the paired t-test. This suggests that self-confidence can be raised through both traditional PBL and PBL aided by RatioLib. The mean final self-confidence scores in the two groups did not, however, differ significantly, according to the unpaired t-test results. This indicates that the rise in self-confidence was the same for the groups that utilized RatioLib and those that did not.

The interview's findings paint a fuller picture of how PBL, with RatioLib's help, affects students' self-esteem. After studying PBL RatioLib, students in the experimental class typically feel more assured when it comes to problem-solving, participate actively in discussions, and take pride in their skills. Interactive elements like games, quizzes, and films are thought to be particularly beneficial for boosting confidence and understanding of the subject matter. Students in the control group, on the other hand, also reported feeling more confident, particularly when it came to their ability to solve problems and participate in group discussions. Students who have a modest level of self-confidence, however, still frequently hesitate and struggle to solve problems on their own.

Based on the study's findings, it can be said that grade VII students' self-confidence is positively impacted by the use of PBL with RatioLib assisting. RatioLib adds value in terms of boosting students' enthusiasm and confidence, especially for those with a moderate level of self-confidence, even though traditional PBL is also successful.

3. Interaction between self-confidence and students' problem-solving ability after the implementation of RatioLib-assisted PBL

The results of the correlation test obtained a positive r value of 0.966 which stated that there was a positive linear relationship between

problem-solving ability and self-confidence of students after the implementation of PBL assisted by RatioLib. The results of the regression test also showed a very strong and significant positive interaction between self-confidence and students' problem-solving ability after the implementation of RatioLib-assisted PBL. The linear regression equation obtained is P = 11,443 + 1,213 S, where P is the result of the posttest and S is the self-confidence score after PBL assisted by RatioLib.

The results of this study provide strong empirical evidence regarding the positive relationship between problem-solving ability and self-confidence of students after the implementation of RatioLib-assisted PBL. This finding is in line with the research of Dewi et al. (2023) which stated that the higher the confidence of students, the better their ability to solve mathematical problems.

This is also in line with the view of constructivism which views knowledge as the result of the active construction of individuals through interaction with their environment. RatioLib-assisted PBL provides a learning environment that allows learners to actively build their own knowledge through authentic problem-solving. The interactive features on RatioLib encourage students to explore, hypothesize, and test their ideas. This active knowledge construction process not only improves problem-solving skills, but also increases students' self-confidence.

PBL assisted by RatioLib also facilitates social interaction among students. Through group discussions and collaboration, students can exchange ideas, provide feedback, and build mutual understanding. This social interaction not only improves communication and cooperation skills, but also strengthens their self-confidence. Based on the above description, it can be concluded that PBL assisted by RatioLib provides a positive interaction between self-confidence and students' problem-solving skills.

CONCLUSIONS AND RECOMMENDATIONS

Based on the data analysis and discussion above, it is concluded that :

1. The implementation of PBL assisted by RatioLib has a significant influence on the mathematical problem-solving ability of grade VII students. This is shown by the increase in the average posttest score, the proportion of students who achieve learning completion, the results of the paired t-test and the results of interviews.
2. The implementation of RatioLib-assisted PBL significantly increases students' self-confidence. This is shown by the results of the paired t-test and the results of interviews.
3. The results of the unpaired t-test showed that there was no significant difference between the average score of the mathematics problem-solving test results of students who participated in RatioLib-assisted PBL learning and students who participated in PBL learning.

4. The implementation of RatioLib-assisted PBL shows a positive interaction between self-confidence and students' problem-solving skills. This is shown by the results of the correlation and linear regression test which means that the higher the self-confidence, the better the student's ability to solve problems.

The suggestions that can be considered are :

1. Further research

   Further research can be carried out by implementing PBL assisted by RatioLib in measuring the level of critical thinking and learning motivation of students. Examine how RatioLib can be integrated with a project-based learning approach to improve ratio-related problem-solving capabilities. Further research can also be conducted by comparing the effectiveness between RatioLib-assisted PBL and artificial intelligence-based learning models or hybrid learning approaches.
2. School

   Schools can integrate the use of RatioLib in formative and summative assessments for ratio topics.
3. Teacher

   Teachers can design lesson plans that integrate RatioLib's features (games, quizzes, materials, videos) in a sequential and structured manner to maximize students' understanding of ratios. Teachers can also create additional learning videos and discussion forums that can be integrated into RatioLib so that the learning process can be tailored to the specific needs of students.

ADVANCED RESEARCH

There are undoubtedly limitations to all research. Limitations might be external to the research, such as time and resource constraints, or they can be research limitations that impact the researcher's capacity to examine the data under study. Therefore, more research is required to make this study excellent.

REFERENCES

Astuti, P., & Krisnawati. (2023). Kesulitan peserta didik SMP kelas VIII dalam memahami konsep matematika pada materi sistem persamaan linear dua variabel (SPLDV). MEGA: Jurnal Pendidikan Matematika, 4(1), 506-513. https://e-journal.unmuhkupang.ac.id/index.php/mega/article/view/865/584

Dewi, A. K., Zaenuri, Walid, Sugiman, & Pujiastuti, E. (2023). Pengaruh kepercayaan diri terhadap kemampuan pemecahan masalah matematis peserta didik SMP N 7 Salatiga. JIPMat (Jurnal Ilmiah Pendidikan Matematika), 8(2), 174-181. https://core.ac.uk/download/pdf/591679082.pdf

Haryono, Y., Juwita, R., & Vioni, S. (2021). Analisis kesulitan dalam pemecahan masalah matematika ditinjau dari minat belajar peserta didik berdasarkan langkah Polya. AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 10(2), 849-859. https://ojs.fkip.ummetro.ac.id/index.php/matematika/article/view/3510/pdf

Iolanessa, L., Kaniawati, I., & Nugraha, M. G. (2020). Penerapan model pembelajaran problem based learning untuk meningkatkan kemampuan pemecahan masalah peserta didik. WaPFi (Wahana Pendidikan Fisika), 5(1), 113-117. https://ejournal.upi.edu/index.php/WapFi/article/view/23452/11557

Ismail, R., & Imawan, O. R. (2022). The Effectiveness of Problem-based Learning in Terms of Learning Achievement, Problem-Solving, and Self-Confidence. In Proceedings of the 5th International Conference on Current Issues in Education (ICCIE 2021) (pp. 238-243). Atlantis Press. https://www.atlantis-press.com/article/125969615.pdf

Munaji, & Setiawahyu, M. I. (2020). Profil kemampuan matematika peserta didik SMP di kota Cirebon berdasarkan standar TIMSS. Teorema: Teori dan Riset Matematika, 5(2), 249-262. https://jurnal.unigal.ac.id/teorema/article/view/3732/3406

NCTM. (2020). Catalyzing change in middle school mathematics: Initiating critical conversations. National Council of Teachers of Mathematics.

OECD. (2018). PISA 2021 Mathematics Framework. OECD Publishing.

OECD. (2022). PISA 2022 results. https://www.oecd.org/pisa/publications/pisa-2022-results.htm

Polya, G. (1945). *How to solve it*. Princeton University Press.

Sujarwo, D. T. (2020). Pengaruh problem based learning terhadap kemampuan pemecahan masalah dan self-efficacy peserta didik. Alphamath**,** 6(1), 46-54. https://jurnalnasional.ump.ac.id/index.php/alphamath/article/view/7948/3261

Sulsana, R. M., Karma, I. N., & Nurwahidah, N. (2024). Model problem based learning berbantuan media digital Kahoot untuk meningkatkan pemahaman konsep matematis peserta didik sekolah dasar. *Educatio***,** 10(2), 491-497**.** https://doi.org/10.31949/educatio.v10i2.8669

UNESCO. (2021). Education 2030: Incheon Declaration and Framework for Action for the implementation of Sustainable Development Goal 4. UNESCO.

Ulva, E., Maimunah, M., & Murni, A. (2020). Pengaruh model problem based learning terhadap kemampuan pemecahan masalah matematis peserta didik kelas VII SMP N se-Kabupaten Kuantan Singingi pada materi aritmetika sosial. Jurnal Cendekia: Jurnal Pendidikan Matematika**,** 4(2), 1230-1238. https://j-cup.org/index.php/cendekia/article/view/356/228