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The Use of Picture and Picture Model on Motivation, Mathematical Communication Skills, and Mathematics Learning Outcomes

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ABSTRACT

The purpose of this study is to understand the motivational factors, mathematical communication abilities, and learning outcomes of fourth-grade students who are taught using the Picture and Picture learning model. This study uses a quasi-experimental methodology with a Nonequivalent Control Group Design. The sample consists of 53 students, with 29 in the control group and 24 in the experimental group. Data collection methods include the Learning Outcome Test to evaluate learning outcomes and mathematical communication skills, questionnaires to measure learning motivation, and documentation for additional data. The data analysis techniques used are descriptive statistics, inferential analysis, and hypothesis testing. The results of the multivariate test, with a significance level of 0.000 ($p \leq 0.05$), led to the rejection of the null hypothesis (Ho) and the acceptance of the alternative hypothesis (H1), indicating a statistically significant difference between the control and experimental groups.

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1. INTRODUCTION

Education holds paramount importance in enhancing the quality of life as it is expected to produce individuals of the highest caliber who can effectively compete in the future. The ultimate objective of education is to shape the identity of Indonesians, as stipulated in Article 3, Paragraph 1 of the Republic of Indonesia Law Number 20 of 2003 concerning the National Education System. This law emphasizes the development of a respected national civilization to educate the nation's citizens. National education aims to empower students to reach their full potential, fostering qualities such as reverence for the Almighty, strong moral principles, wholesomeness, intelligence, independence, creativity, and responsible citizenship (Kemdiknas, 2003).

In the realm of mathematics education, one of the key goals is for students to be proficient in explaining situations or solving problems using symbols, tables, diagrams, or other visual aids, as outlined in the Content Standards for basic and secondary education units in mathematics (Ministry of National Education Regulation No. 22 of 2006, dated 23 May 2006). These objectives align with the broader goals set by the National Council of Teachers of Mathematics (NCTM) (Nugroho & Attin Warmi, 2022; Nursalam et al., 2021). Mathematical communication, as emphasized by NCTM, is a central aspect of learning mathematics. However, it remains a challenge that many educators do not prioritize the goals laid out in Permendiknas and NCTM (Fatasya et al., 2023).

Given that mathematics is a compulsory subject at all educational levels in Indonesia, it plays a pivotal role in the advancement of science and technology, as noted (Fatasya et al., 2023; Ismail, Rafki N, 2019; Widiani, 2021). Unfortunately, the prevailing pedagogical approach often renders students passive learners, primarily through a product-oriented education system. Furthermore, research has indicated that students' declining mathematical proficiency in the classroom can be partially attributed to the following factors: (1) instructors providing pre-solved problems as examples; (2) students passively observing and listening to the

teacher's mathematical demonstrations; and (3) instructors introducing topics, followed by examples and practice questions. These learning situations hinder students' development of mathematical communication skills (Samsidar W, 2019).

Communication is highlighted as a fundamental component of mathematics education for two key reasons. Firstly, mathematics serves as a language for solving problems, reasoning, and expressing ideas with precision and clarity (Muslikasari & Rusnilawati, 2023). Secondly, learning and teaching mathematics are collaborative endeavors, requiring effective communication between teachers and students. This sharing of knowledge and experiences is at the core of the teaching and learning process, helping students develop their communication skills, think like mathematicians, and tackle new challenges successfully (Kulsum et al., 2019).

Preliminary observations and interviews with fourth-grade teachers at SD Inpres Teladan Merpati, Bantaeng District, Bantaeng Regency in September 2022 have identified several challenges. These include the continued use of conventional teaching models, heavy reliance on the 2013 curriculum teacher's book as the primary source (Rasidi, 2024; Sholekah, 2020), an overemphasis on teacher-centered learning, students' struggles in translating problems into mathematical language, lack of enthusiasm among students due to a perceived disconnect between learning intentions and academic outcomes, limited communication among students during group learning, insufficient use of engaging teaching materials, and teachers' struggles to motivate students (Islamiah et al., 2023). Research suggests that both internal (health, intelligence, abilities, interests, motivation, and learning styles) and external (family, school, community, and environment) elements impact learning outcomes. Therefore, improving student learning outcomes is contingent on increasing motivation to learn, which is influenced by a variety of internal and external factors (Damayanti, 2022).

To facilitate students' understanding of the curriculum, teachers must innovate and employ new teaching models, approaches, and techniques. Teachers play a pivotal role in the education process and contribute significantly to the enhancement of educational quality as human resources (Mukhzamilah et al., 2023). One effective strategy to address these challenges is to utilize innovative learning models that create dynamic and enjoyable learning environments, such as picture and picture learning (Indarta et al., 2022; Pamungkas & Wantoro, 2020).

A conducive learning environment results from selecting a learning style that necessitates greater student engagement in their educational journey, achieved through teamwork and issue resolution (Aulia Dini Hanipah et al., 2022; Manjillatul Urba et al., 2024; Safira et al., 2018). As per Bruner's theory, which asserts that abstract concepts can be effectively conveyed through visual media, this model employs visuals as a means of information transmission. The Picture and Picture learning paradigma (Abunda, 2021; Shih, 2022; Sutoyo et al., 2022) advocates the use of image-media pairs, logical sequences, and the incorporation of groupings (Setiawan, 2020).

Students bear responsibility for all group activities. Furthermore, students must ensure that their interpretations of the presented images are aligned, ensuring a shared objective among group members. The process of implementing the image and image learning approach, as outlined in (Shih, 2022), involves the presentation of competency information, material presentation, display of images illustrating the subject matter's activities, students (acting as representatives) organizing presentation findings, group members responding to the presentation, role rotation, consensus-building, evaluation, and reflection.

2. METHOD

This research design utilizes a quantitative research methodology. The connection between study variables and the testing of previously developed hypotheses is emphasized in quantitative research (Sugiyono, 2019). Quantitative research yields results in the form of statistical figures, encompassing both descriptive and inferential data. This type of research employs a pseudo-experiment known as a quasi-experiment. Quasi-experimental research is akin to experimental research but lacks the same level of rigor. It is termed quasi-experimental because it is challenging to control numerous variables in this type of experimental inquiry. In this study, the experimental group/class employed the Picture and Picture teaching method, whereas the control group/class employed the standard learning model.

All participants in the study were students of Merpati Inpres Teladan Elementary School in Bantaeng District, Bantaeng Regency, totaling 326 students. The sample represents some characteristics of the overall population (Sukmawati, Salmia, 2023). The cluster random sampling method was utilized to select the sample for this investigation, utilizing a probability sampling approach. This method employs specific groups or regions as the basis for its sampling procedures, with these selected groups serving as both the control and experimental classes.

Research Instruments (Sukmawati, Sudarmin, 2023) Research instruments refer to tools or equipment employed by researchers to collect data, thereby facilitating their work and ensuring that the outcomes are meticulous, comprehensive, and systematic for ease of handling. In this study, the instruments utilized encompassed both tests and non-tests. Tests comprised questions designed to evaluate students' knowledge,

while non-tests involved observations that recorded all activities during the educational process. Scores obtained from student work results were assessed using these instruments.

Quantitative research relies on statistical methods for data analysis. Two categories of statistics are utilized for data analysis in research: descriptive statistics and inferential statistics. This study employed hypothesis testing, specifically using Multivariate Analysis of Variance (MANOVA).

3. RESULTS AND DISCUSSION

The motivation, mathematics communication abilities, and student learning results are examined in this study using an image and picture learning approach. This study took place over the course of four meetings. During the first meeting, students took a pretest to gauge their knowledge of fractional material. In the experimental class, an image and picture learning model was used to instruct the students during the second and third meetings, while traditional learning models were utilized in the control class. Students took a posttest during the fourth meeting to assess whether their motivation levels, mathematics communication abilities, and learning outcomes had changed or improved.

3.1. Motivation to learn

Utilizing SPSS 15, field data were examined. To determine the effect between variables. From the number of student scores can be categorized based on value intervals and classification of student learning motivation questionnaire values.

Table 1. Categorization of Learning Motivation in the Control Class

Interval Values	Classification	Pretest Control Class		Posttest Control Class	
		Frequency	Percentage (%)	Frequency	Percentage (%)
91-100	Very high	0	0	0	0
81-90	Tall	0	0	4	13,79
71-80	Enough	6	20,69	8	27,59
61-70	Not enough	21	72,41	17	58,62
≤ 60	Very less	2	6,90	0	0
Amount		29	100	29	100

The categorization value of the control class students' learning motivation questionnaire showed that during the pretest there were 6 students who received interval scores of 71-80 which were classified as those students who had sufficient motivation in learning mathematics. There are 21 students who have a questionnaire score of 61-70, that these students are less motivated with a percentage of 72.41%. There are 2 students who have very less motivation with a percentage of 6.90%. The treatment with conventional learning was carried out based on the pretest data to assess students' motivation for studying after receiving conventional learning.

After being given the treatment and posttest it can be seen that there are 17 people who get a score of 61-70 meaning that these students are still not motivated in learning mathematics. There are 8 students who are quite motivated in learning mathematics or 27.59% and there are students who have high motivation in learning or a percentage of 13.79. These results indicate that when conventional learning is implemented while in the control class, the average less motivated with knowledge mathematics.

The following is how the picture and picture learning paradigm is put into practice in the experimental class. It involves administering a pretest to ascertain students' starting levels of ability and a posttest to gauge how motivated they are to study now that they have received therapy.

Table 2. Categorization of Experimental Class Learning Motivation

Interval Values	Classification	Pretest Control Class		Posttest Control Class	
		Frequency	Percentage (%)	Frequency	Percentage (%)
91-100	Very high	0	0	4	16,67%
81-90	Tall	0	0	16	66,67%
71-80	Enough	4	16,67%	4	16,67%
61-70	Not enough	16	66,67%	0	0
≤ 60	Very less	4	16,67%	0	0

Amount	24	100%	24	100%

When the plan is put into action pretest, learning styles of students motivation scores showed that 4 students received sufficient scores, or 16.67%, while 16 students received less motivational scores, representing a percentage of 66.67%, and there were 4 students who were extremely unmotivated to learn mathematics. The researcher used the image and image learning approach to assess studeent motivation based on the pretest data. Following the intervention, 4 of the students (16.67%) showed a high level of motivation for learning mathematics. Additionally, with a rate of 66.67%, there are 16 pupils that are highly motivated to learn mathematics. Additionally, four children who received treatment using the picture and picture learning paradigm showed extremely high levels of motivation. The implementation of the image-and-image model of education can boost students' enthusiasm to learn, according to the posttest results.

3.2. Mathematical Communication

Before being given treatment using conventional learning models in the control class, To assess students' abilities in mathematical communication, a pretest was provided to the class and posttest following evaluation of the pupils' mathematical communication abilities. The information below pertains to students' mathematics communication skills in the control group in the pretest and posttest implementation.

Table 3. Categorization of Control Class Mathematical Communication Ability

Interval Values	Classification	Pretest Control Class		Posttest Control Class	
		Frequency	Percentage (%)	Frequency	Percentage (%)
91-100	Very good	0	0	0	0
81-90	Good	0	0	0	0
71-80	Enough	0	0	5	17,24
61-70	Not enough	0	0	11	37,93
≤ 60	Very less	29	100	13	44,83
Amount		29	100	29	100

The categorization value of the control class students' mathematical communication test showed that during the pretest, out of 29 students, the number of students who still did not understand fractions material was very clear. Based on the results of the pretest, conventional learning was used as the treatment to see how well the students could communicate mathematically after receiving that type of instruction. It can be noted that 13 individuals received very low scores on the posttest and after receiving the treatment, with a percentage of 44.83%. With a percentage of 37.93%, 11 students received fewer than passing grades, and 17.24%, 5 students received passing grades. These results indicate that the control class's use of traditional learning still has an averagely low level of mathematical communication.

Furthermorethe, To apply learning in the classroom, a picture and picture learning strategy is used, experimental class. Students took a pretest at the first meeting to gauge their level of mathematical communication skills, and after receiving instruction based on the learning model of pictures and pictures, they took a posttest to gauge their improvement. The experimental class's pretest and posttest results are shown below..

Table 4. Categorization of Experimental Class Mathematical Communication Ability

Interval Values	Classification	Pretest Control Class		Posttest Control Class	
		Frequency	Percentage (%)	Frequency	Percentage (%)
91-100	Very good	0	0	3	12,50
81-90	Good	0	0	7	29,17
71-80	Enough	0	0	14	58,33
61-70	Not enough	0	0	0	0
≤ 60	Very less	24	100	0	0
Amount		24	100	24	100

The researchers used the image and image learning approach to treat the 14 student who improved their grades enough, with a percentage of 58.33%, according to the data on the experimental class's capacity for mathematical communication following the installation of the pretest, which revealed that out of a total of 24 students, only one was still very incapable of communicating mathematically. There are 7 individuals with a proportion of 29.17% that receive good grades in mathematical communication. Additionally, 3 pupils, or 12.50%, receive extremely good grades. These findings suggest that teaching Students' mathematical abilities can be improved with the "picture and picture" method communication abilities.

3.3. Learning outcomes

The purpose of the pretest and posttest was to evaluate student learning prior to therapy and the improvement of learning outcomes following treatment. Student learning outcomes in the experimental class versus the control class.

Table 5. Categorization of Control Class Learning Outcomes

Interval Values	Classification	Pretest Control Class		Posttest Control Class	
		Frequency	Percentage (%)	Frequency	Percentage (%)
91-100	Very good	0	0	0	0
81-90	Good	0	0	0	0
71-80	Enough	0	0	12	41,38
61-70	Not enough	9	31,03	13	44,83
≤ 60	Very less	20	68,97	4	13,79
Amount		29	100	29	100

The control class score interval was according to the implementation that of the pre- and post-test, where 9 students scored worse than average (31.03%) on the pretest, and 20 students scored very poorly (68.97%). In order to determine student learning outcomes, the researcher treated students with traditional learning based on student achievement data from the execution of the pretest.

The control class posttest revealed that there were still 4 pupils with a percentage of 13.79% who received extremely low scores or need additional assistance. 12 students had an average score with a percentage of 41.38%, while 13 students received bad scores with a percentage of 44.83%. These findings indicate that traditional education cannot enhance students' learning outcomes.

Furthermorethe, treatment of the image-based learning model was given to the experimental class. Students were given a pretest prior to therapy to ascertain their starting points, and after treatment, they took a posttest to ascertain whether the learning model had improved their learning outcomes.

Table 6. Categorization of Experimental Class Learning Outcomes

Interval Values	Classification	Pretest Control Class		Posttest Control Class	
		Frequency	Percentage (%)	Frequency	Percentage (%)
91-100	Very good	0	0	4	16,67
81-90	Good	1	4,17	9	37,50
71-80	Enough	2	8,33	10	41,67
61-70	Not enough	9	37,50	1	4,17
≤ 60	Very less	12	50	0	0
Amount		24	100	24	100

Data on the results of the experimental class's students' learning show that 1 student received a good score at a percentage of 4.17%, 2 students received an adequate score at a percentage of 3.33%, 9 students received a less-than-optimal percentage of 37.5%, and 12 students received very low scores at a percentage of 50%. The researcher used the picture and picture learning approach to administer treatment based on the pretest results. After receiving treatment, the students took a post-test. Of the post-test results, 1 student received a

low score or still required help. For enough value, there are 10 individuals with a percentage of 41.67%.. 4 students received very high grades with a percentage of 16.67%, while 9 students received good grades with a percentage of 37.50%. One might draw the conclusion that using pictures Multimodal visual learning techniques can improve students' academic performance based on the experimental class posttest data.

a. Normality test

To ascertain if the given data contains normal data or not, a test known as It employs the normalcy test. the test of Kolmogorov-Smirnov is used in this experiment using SPSS. A significance level larger than 0.05 will be produced if the data obtained meet the criteria for normality. The data obtained is If it is less than 0.05, it is not regularly distributed.

Table 7 Normality test

One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		53
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	.23997501
Most Extreme Differences	Absolute	.130
	Positive	.078
	Negative	-.130
Test Statistic		.130
Asymp. Sig. (2-tailed)		.025[c]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

Using the aforementioned normality test, compare the experimental and control groups. The Asymp value is determined using SPSS's Unstandardized residual of the impact of the dependent variable on the independent variables and one-sample Kolmogorov-Smirnov test. a 2-tailed significance level of 0.025 is higher than a 0.05, indicating a normal distribution for this investigation.

b. Homogeneity Test

A technique called a Using the homogeneity test, sample populations with similar characteristics are examined variance. The SPSS program, which is based on the Levene test, is used to assist with this test analysis. The criteria for this test state that the two groups are homogeneous or have the same variance if the probability value is larger than 0.05. The two groups are not homogenous or have an inhomogeneous variance, however, if the likelihood value is less than 0.05.

Table 8 Homogeneity test

Test of Homogeneity of Variances			
Levene Statistic	df1	df2	Sig.
2.540	1	51	.117

The Levene test's Unstandardized Residual of the Dependent Variable Affecting the Independent Variable was used to analyze the data in the control and experimental classes. The results showed a significance level higher than 0.05 of 0.117, indicating the similarity of the two groups and have a 2.540 statistical leverage.

c. Hypothesis testing

The hypothesis test in this study is using (Multivariate Analysis of Variance). This study will look at the average difference in learning motivation, mathematical communication skills and Comparing and contrasting the the results of teaching with the Picture and Picture learning technique for students with those of students who receive instruction using traditional methods models.

Table 9. Hypothesis Testing

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.997	5293.143[b]	3.000	49.000	.000
	Wilks' Lambda	.003	5293.143[b]	3.000	49.000	.000
	Hotelling's Trace	324.070	5293.143[b]	3.000	49.000	.000
	Roy's Largest Root	324.070	5293.143[b]	3.000	49.000	.000
kelas	Pillai's Trace	.772	55.293[b]	3.000	49.000	.000
	Wilks' Lambda	.228	55.293[b]	3.000	49.000	.000
	Hotelling's Trace	3.385	55.293[b]	3.000	49.000	.000
	Roy's Largest Root	3.385	55.293[b]	3.000	49.000	.000

a. Design: Intercept + kelas
b. Exact statistic

According to the above multivariate test hypothesis test with sig. 0.000 0.05, Ho is rejected and H1 is accepted, indicating that there are simultaneous significant differences in the motivation, mathematical communication skills, The academic progress of fourth-graders at SD Inpres Teladan Merpati, Bantaeng District, Bantaeng Regency taught using the Picture and Picture model.

The researcher administered a pretest to both the control and experimental classes on the first day of the research's implementation. On the second and third days, students in the control class learned using conventional methods, while those in the experimental class learned using the Picture and Picture method. The researcher administered a post-test to determine whether the treatment had improved student motivation, mathematical communication abilities, and learning results in both the experimental and control classes.

With an average score of 71.14 for learning motivation, which can be classified as sufficient, we can conclude, based on the data evaluated using SPSS, that conventional learning cannot alter motivation, mathematical communication abilities, and student learning outcomes in the control class. The average score for students' communication skills in the control class is 64.14, and for learning results, it is 66.17. These values suggest that conventional learning has no impact on these three variables.

Testing the hypothesis: Since substantial disparities in motivation, mathematical ability, and communication abilities simultaneously exist, and learning outcomes taught utilizing the Picture and Picture model for fourth-grade students of SD Inpres Teladan Merpati, Bantaeng District, Bantam District, show that the experimental class using the Picture and Picture learning paradigm can have an impact on all three parameters. This research aligns with the findings of previous studies (Islamiah et al., 2023) and (Lubis et al., 2023) regarding mathematics communication abilities, encompassing understanding, methods for measurement, models, techniques, and various types of questions that can be employed (Hasanah et al., 2024; Sutopo & Waluya, 2023), as well as strategies for their development.

The discussion on the use of the Picture and Picture model in mathematics learning shows positive effects on motivation, mathematical communication skills, and student learning outcomes. According to the theory of constructivism, learning that involves images or visuals helps students build a clearer and more concrete understanding of concepts (Ismail, Rafki N, 2019). The Picture and Picture model, which integrates images or visuals into the learning process, provides opportunities for students to collaborate, interact, and solve problems together. This encourages students to engage more actively in the learning process.

Regarding motivation, (Hamzah B. Uno, 2017)intrinsic motivation theory suggests that learning that is enjoyable and relevant to students' daily experiences can enhance their curiosity and enthusiasm for learning. The Picture and Picture model creates an engaging and challenging learning environment, which can increase students' motivation to learn more diligently.

The theory of mathematical communication also supports the idea that discussion and interaction in groups can enhance students' mathematical communication skills. Through discussions, students can express their thoughts, clarify concepts, and understand how to convey ideas logically. Learning outcomes in mathematics also show improvement after using this model, as students find it easier to understand and apply mathematical concepts through visuals and group discussions.

4. CONCLUSION

Students in the fourth grade at primary school Inpres Teladan Merpati, Bantaeng District, Bantaeng Regency, who are instructed using the Picture and Picture methodology, exhibit significant variations in their motivation, mathematical communication abilities, and learning outcomes. When comparing two groups, it is determined whether there is a significant difference if the p-value is less than 0.05. The utilization of the Picture and Picture learning approach for teaching fractions has the potential to enhance learning. outcomes, mathematical communication abilities, and motivation among students. The technique of learning through pictures actively engages students in the learning process. The school is eagerly awaiting the completion of the necessary infrastructure, which will further facilitate this approach.Additionally, the Image after Image learning model incorporates training sessions that aid teachers in becoming more effective, ultimately leading to improved student learning outcomes. This model can be employed to follow up on the findings of this study, addressing and rectifying issues identified in future research.

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