

The Effect of Learning Model and Spatial Intelligence on Learning Outcome

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Abstract—This study aims to determine the effect of learning models and spatial intelligence on mathematics learning outcomes. The learning model given in the experimental class is an integrative learning model which aims to support students to develop a systematic knowledge, while the model applied in the control class is a direct learning model. The research was conducted in Senior High School of State 6 Kendari within 6-time meeting. The data was obtained through the test is given to 48 students using the quasi-experimental method designed by level 2x2. The data were analyzed using two-way analysis of variance (ANOVA). Results showed that: The learning outcomes of students taught by the integrative model were higher than those who were taught by direct learning model; There is an influence of interaction between the learning model and spatial intelligence to the learning outcomes; The learning outcomes of students having high spatial intelligence and taught with integrative learning model was higher than students taught by direct learning; and The learning outcomes of students having low spatial intelligence and taught by integrative learning models were lower than students taught by direct learning. This study suggests that the learning model and spatial intelligence may improve learning outcomes.

Keywords—*integrative learning, direct learning, spatial intelligence*

I. INTRODUCTION

Learning outcomes are a reflection of students' knowledge, attitudes, and skills measured in a test and then accumulated in the form of a number or symbol score [1]–[3]. Problems that occur from year to year, the learning outcomes of mathematics in schools are still low [4], [5]. Some factors that influence mathematics learning outcomes, among others: (1) motivation and interest in learning, (2) interaction between teachers and students, (3) the ability to think critically and solve problems, and (4) student performance, (5) critical thinking skills, and (6) Learning model [6]–[8].

The learning model used in Senior High School of State 6 Kendari is a direct learning model, which is teacher-centered learning, and the teacher is responsible for the learning of all students [9]. Direct learning models can only be used to teach targeted knowledge or skills or both [10]. As a result, direct learning models have not been able to improve students' mathematics learning outcomes. The

teacher should pay attention to the activeness of students in learning so that students can build their knowledge.

One learning model that can activate students is an integrative learning model, namely the ability shown to connect, apply, and/or synthesize information coherently from different contexts and perspectives, and utilize new insights in various contexts [11]. The integrative learning model is a learning model to help students develop a deep understanding of the building of systematic knowledge that simultaneously trains students' critical thinking skills [12]. The integrative model is ideal for teaching conceptual knowledge because the purpose of this model is to foster students' conceptual understanding of the content learned based on facts, concepts, and generalizations. Students begin by learning factual knowledge and then continue to use that knowledge to make greater connections between facts and concepts, and finally make conclusions about information about the content learned earlier [13].

The description above explains that in integrative learning, the teacher is not the only source of knowledge for students, and knowledge is not only obtained from the classroom but more than that, this learning model builds students' knowledge from various sources. The syntax of integrative learning models can be seen in Table 1.

Mathematics is one of the most objective, logical, and practical disciplines [14], as a symbolic language that allows humans to think about quantity problems and can connect between one quantity and another [15], so that in mathematics learning, the teacher must be able to see the whole problem carefully to find the right learning pattern in accordance with the characteristics of students.

Students need to see mathematics as a tool that can be used every day. They must have mathematical sophistication that allows them to think critically and take full advantage of information and communication technologies that penetrate our homes and workplaces because mathematics is the basis for all technology in the world [16]. In addition, one of the main materials in the mathematics lesson is geometry. Geometry occupies a special position in the mathematics curriculum, is the presentation of abstraction from visual and spatial experiences, for example, fields, patterns, measurements, and mapping. Geometry learning is very closely related to students' spatial intelligence [17]. Geometry and spatial intelligence are basic components for learning mathematics [18].

Based on the description, it is necessary to know the phenomenon of both types of integrative models and direct learning models in mathematics subjects, especially in

geometric materials, and how it relates to spatial intelligence to improve mathematics learning outcomes.

TABLE I. TEACHER AND STUDENT ROLES IN THE INTEGRATIVE MODEL [13]

Integrative Model Phases	Teacher Role	Student Role
Describe, compare, and search for patterns	Teacher asks students to describe, compare, and search for patterns in the content examined by students. Teacher guides students through this phase by creating (or co-creating or asking students to create) graphic organizers to scaffold students' understanding and recording of information.	Students analyze the content by describing, comparing, and searching for patterns in the content studied. They (or the teacher) enter data/information into graphic organizers developed by the teacher or students or co-developed by the teacher and students. (Note: Either the teacher or students record data in a graphic organizer.)
Explain similarities and differences	Teacher asks students to explain similarities and differences.	Students explain similarities and differences in the content studied and substantiated their ideas using data from the graphic organizer.
Hypothesize outcomes for different conditions	Teacher asks students to hypothesize outcomes based on different conditions.	Students form hypotheses of possible outcomes related to the content studied and based on different conditions.
Generalize to form broad relationships	Teacher asks students to generalize their conclusions.	Students generalize their understanding to demonstrate an understanding of the broad relationship between content studied.

This study aims to determine: (1) differences in students' mathematics learning outcomes between those taught with Integrative learning models with direct learning models, (2) the effect of interaction between learning models and spatial intelligence on students' mathematics learning outcomes, (3) differences in mathematics learning outcomes students between those who were taught using Integrative learning models and direct learning models, for students who have high spatial intelligence, and (4) differences in students' mathematics learning outcomes between those taught using Integrative learning models and direct learning models, for students who have low spatial intelligence.

II. RESEARCH METHOD

This research method uses quasi-experiment, consisting of independent variables and dependent variables. Dependent variables are students' mathematics learning outcomes, while the independent variables consist of: (1) treatment variables namely integrative learning models and direct learning models, and (2) moderator variables, namely student spatial intelligence, consisting of high spatial intelligence and low spatial intelligence.

The populations in this study were students of class XI Mathematics and Science of Senior High School of State 6 Kendari, registered in the 2017/2018 school year, consisting of five parallel classes totaling 178 students. Since all classes are homogeneous, then the sample of this study was chosen by two classes randomly by lottery method for the experimental class and the control class. The number of students in the experimental class and the control class was 36 students respectively, so the number of samples was 72 students. Before being given treatment, both classes were given a spatial intelligence test to determine groups of students who had low and high spatial intelligence. The number of students in each group is 12 students. Data on mathematics learning outcomes and spatial intelligence were obtained using tests, in the form of multiple choices.

The design of this study is experimental design by the level of 2 x 2 and presented in Table 2.

TABLE II. EXPERIMENTAL DESIGN BY LEVEL 2 X 2

Moderator variable	Treatment Variables	
	Integrative Learning Model (A ₁)	Direct Learning Model (A ₂)
High Spatial Intelligence (B ₁)	A ₁ B ₁	A ₂ B ₁
Low Spatial Intelligence (B ₂)	A ₁ B ₂	A ₂ B ₂

Evidence:

- A₁B₁ : Groups taught through integrative learning models with high spatial intelligence.
- A₂B₁ : Groups taught through direct learning models with high spatial intelligence.
- A₁B₂ : Groups taught through integrative learning models with low spatial intelligence.
- A₂B₂ : Groups taught through direct learning models with low spatial intelligence.
- A : Learning model
- B : Spatial Intelligence

Data analysis techniques include (1) descriptive analysis, used to find mean, median, and standard deviation, (2) analysis prerequisite testing includes normality test and homogeneity test, and (3) inferential analysis, carried out through two-way Variance Analysis (ANOVA). If there is an interaction between the treatment variable and the attribute variable, then the further test is done by the Tukey test [19].

III. RESULT AND DISCUSSION

The results of descriptive analysis of mathematics learning outcomes of the subject of geometry consist of: mean, standard deviation, median and variance can be seen in Table 3.

TABLE III. DESCRIPTIVE ANALYSIS RESULTS

Statistics	A ₁	A ₂	A ₁ B ₁	A ₁ B ₂	A ₂ B ₁	A ₂ B ₂
Mean	73.58	69.21	86.17	61.00	69.75	68.67
Standar Deviation	13.42	7.98	6.07	4.77	8.07	8.08
Median	75.50	68.00	85.00	62.00	68.00	69.50
Varians	178	63.68	36.84	22.73	65.11	65.33

Table 3 shows that the average $A_1 = 73.58$ and $A_2 = 69.21$ gives the meaning that descriptively, the average learning outcomes of students taught by the integrative learning model are higher than the direct learning model. Average $A_1B_1 = 86.17$ greater than $A_2B_1 = 69.75$ and average $A_1B_2 = 61.00$ smaller than $A_2B_2 = 68.67$. This provides an illustration that students' mathematics learning

outcomes are taught with integrative learning models in students who have high spatial intelligence, higher than direct learning models, and students who have low spatial intelligence taught with integrative learning models are lower than direct learning models. The results of testing hypotheses using two-way Variance Analysis (ANOVA) can be seen in Table 4.

TABLE IV. TWO-WAY VARIANCE ANALYSIS RESULTS

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	4036.896 ^a	3	1345.632	33.364	.000
Intercept	244673.521	1	244673.521	6066.571	.000
A	229.688	1	229.688	5.695	.021
B	2067.188	1	2067.188	51.255	.000
A * B	1740.021	1	1740.021	43.143	.000
Error	1774.583	44	40.331		
Total	250485.000	48			
Corrected Total	5811.479	47			

Based on Table 4, it can be seen that the results on the Factor A line obtained by $\text{sig} = 0.021$ is smaller than the significant value $\alpha = 0.05$, and the average value of A_1 is greater than A_2 (see Table III). This result gives the meaning that H_0 is rejected, namely the learning outcomes of students who are taught with higher integrative learning models compared to direct learning models. This is due to the integrative learning model is a learning model that can help students develop a deep understanding of the building of systematic knowledge that simultaneously trains their critical thinking skills [12]. This result is relevant to research [20].

The results on the interaction AB line obtained by the value of $\text{sig} = 0.000$ is smaller than the significant value $\alpha = 0.05$. The results give the meaning of H_0 rejected; namely, there is an influence of the interaction between learning models and spatial intelligence on mathematics learning outcomes. This interaction can be seen in Figure 1.

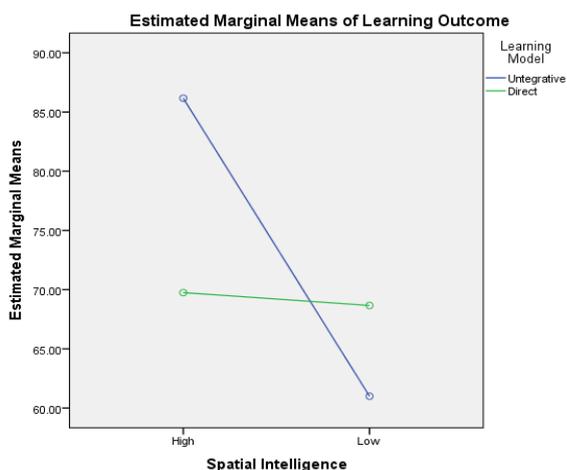


Fig. 1. Interaction Graph

Based on Figure 1 above, it provides an illustration that students' mathematics learning outcomes who have high spatial intelligence taught by integrative learning models are higher than direct learning models, whereas mathematics learning outcomes of students who have low spatial intelligence are taught with more integrative learning models. low compared to direct learning models. These results conclude that there are differences in students' mathematics learning outcomes based on spatial intelligence possessed by students. The results of this study are relevant to [21].

The third hypothesis testing results that students who have high spatial intelligence taught with integrative learning models are higher than direct learning models and indicated by the value of $q = 8.96$ greater than the value of q table = 4.12. These results are supported by research [21], [22] that integrative learning provides significant benefits to students regarding six dimensions of knowledge and enhances students' abilities in: (1) identifying, demonstrating and adapting knowledge acquired in / in different contexts; (2) adapt to differences (people and situations) in order to create solutions; (3) understanding and directing yourself as a learner; (4) being reflexive, accountable and relational learners; (5) identify and differentiate their own and others' perspectives; and (6) developing a professional digital identity. In addition, geometry learning is closely related to the spatial intelligence of students [17]. Students who have high spatial intelligence with an effective learning model will more easily build mathematical knowledge. Students who have high spatial intelligence who are taught by direct learning models who tend to be active and like creative and explorative activities will then become saturated, lazy and motivated in learning, thus impacting their learning outcomes [23].

The fourth hypothesis testing results that students who have low spatial intelligence taught with integrative learning models are lower than direct learning models and indicated by the value of $q = 4.18$ greater than the value of q table = 4.12. This is in line with what was stated by [16], that direct learning is more effective given to students who have learning disabilities. While students with low spatial intelligence with integrative learning models who must be active do not like activities that are creative and explorative, lazy and demotivated in learning, thus impacting on their learning outcomes [17].

IV. CONCLUSION

The integrative learning model is more effectively used in learning mathematics especially the subject matter of geometry by considering the spatial intelligence of students to improve student learning outcomes. The integrative learning model is very appropriate to be used to teach mathematics because the concept can connect mathematical ideas so that students' understanding of mathematical concepts is deeper and last longer.

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