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The Effect of the Group Investigation (GI) Type Cooperative Learning Model Based on Experimental Skills on Generic Skills in the Kinetic Theory of Gases Material in the Classroom XI Interest IPA Senior High School Negeri 3 Medan Semester II Academic Year 2024/2025

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Cooperative Learning Model Group Investigation Type, Experimental Skills, Generic Skills.
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ABSTRACT

The objectives of this study are: (1) To determine the differences in generic skills due to the effects of the GI type cooperative learning model and the DI model in class XI of SMA Negeri 3 Medan (2). To determine the differences in generic skills of students who have high laboratory skills and low generic skills in class XI of SMA Negeri 3 Medan (3) To determine whether there is an interaction between the GI type cooperative learning model and the DI learning model with laboratory skills on students' generic skills. The sampling technique used a purposive sample consisting of two classes with a total sample of 72 students. The research instrument was a learning achievement test and a questionnaire on students' generic skills. The test used to obtain data was in the form of multiple choices. The data in the study were analyzed using SPSS 28 with two-way ANOVA. The results of the ANOVA test obtained: 1. The generic skills of learning physics of students taught with the GI type cooperative learning model are higher than the physics learning achievement of students taught with the DI learning model. 2. The physics learning achievement of students who have high generic skills is higher than the physics learning achievement of students who have low generic skills. 3. There is an interaction between the GI type cooperative learning model and laboratory skills on students' generic skills.

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INTRODUCTION

Cooperative learning method utilizes students' tendency to interact. Cooperative learning is a teaching and learning activity in small groups, students learn and work together to achieve optimal learning experiences, both individual experiences and group experiences. Slavin (2008), said that Cooperative learning is a learning model where students learn and work in small groups collaboratively whose members consist of four to six people, with a heterogeneous group structure. Furthermore, it is also said that the success of learning from groups depends on the abilities and activities of group members, both individually and as a group. The achievement of the educational goals will be determined by various supporting elements. Makmun (2020: 3-4) states about the elements contained in the Teaching and

Learning Process (PBM), namely: "(1) Students, with all their characteristics who try to develop themselves as optimally as possible through learning activities, (2) goals, are something that is expected after the teaching and learning activities, (3) teachers, always try to create the right situation (teaching) so that it is possible for the learning process to occur."

Based on the results of the 2018 Program for International Student Assessment (PISA) study, Indonesian students' competency ranking was in the bottom 10 out of 65 countries, indicating that students' weaknesses primarily lie in their weak broad competencies. The same reality also occurs in most high schools in Indonesia, where many students struggle to master academic competencies. One example is reflected in the average Physics exam scores for the odd semester of grade XI science majors at High School Negeri 3 Medan, as shown in Table.

Table 1. Average Physics Grades for Odd Semesters Grade XI Science Majors, Academic Year 2017/2018 to 2019/2020

School year	Average value	K K M
2017/2018	60	70
2018/2019	63	70
2019/2020	65	70

Source: Data on the Administration of State Senior High School 3 Medan

The low learning outcomes of students can be caused by the complexity of the teaching material itself because physics is classified as abstract. In addition, because the presentation of physics is less interesting and boring. This is related to the problem of the quality of the physics teaching design presented by teachers in learning activities, as stated by Gagne in Sanjaya (2021) that: "Teaching is part of learning, where teachers are more emphasized on how to design or arrange various sources and facilities available to be used or utilized by students in learning something."

Table 2. Steps of the cooperative learning model as shown in the table.

FASE	TEACHER BEHAVIOR
Fase 1 Conveying goals and motivating students	The teacher conveys all the learning objectives to be achieved in the lesson and motivates students to learn.
Fase 2 Presenting information	Teachers present information to students through demonstrations or through reading materials.
Fase 3 Organizing students into groups	The teacher explains to students how to form study groups and helps each group make the transition efficiently.
Fase 4 Guiding group work and learning	The teacher guides the study groups as they work on their assignments.
Fase 5 Evaluasi	The teacher evaluates the learning outcomes of the material that has been studied or each group presents the results of their work.
Fase 6 Give awards	Teachers seek ways to recognize both individual and group learning efforts and outcomes.

Group Investigation (investigation group) is perhaps the most complex and most difficult learning model to implement, Group Investigation was developed by Shlomo and

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Yael Sharan at Tel Aviv University, is a common classroom arrangement plan where students work in small groups using cooperative questions, group discussions, and cooperative planning and projects Sharan and Sharan, (Slavin, 2021: 24).

Group Investigation has philosophical, ethical, and psychological roots, written since the early 1900s. The most famous of these orientations is John Dewey. Group Investigation cannot be implemented in educational environments that do not support interpersonal dialogue or that do not address the social dimension of classroom learning. Cooperative communication and interaction among classmates are best achieved in small groups, where peer exchange and cooperative attitudes can be sustained.

The teacher's role in a classroom implementing a Group Investigation project is to act as a resource person and facilitator. The teacher circulates among the groups, ensuring they are managing their tasks, and assists with any difficulties they encounter in group interactions, including problems performing specific tasks related to the learning project. This role is learned through practice over time, just as the role of the students is learned. First and foremost, the teacher must model the communication and social skills expected of the students. In Group Investigation, students work through six stages. These stages and their components are outlined below and described in more detail later.

Generic science skills (KGS) are basic skills that prospective teachers need to possess, can be applied to various fields, and their knowledge is not dependent on a particular domain, but rather leads to cognitive strategies. Brotosiswoyo (2020: 7-21) states that generic skills can be developed through physics learning by paying attention to the methods and topics or learning materials.

Hartono (2021: 118) created indicators of generic science abilities to facilitate the assessment of students' generic science abilities being trained. A number of indicators of generic physics abilities are stated in Table.

Table 3. Generic Science Ability Indicators

No	Generic Science Skills	Generic Physics Ability Indicators
1	Direct observation	a. Using as many senses as possible b. Collecting facts c. Looking for similarities and differences
2	Indirect observation	a. Using direct measuring instruments b. Collecting facts c. Looking for similarities and differences
3	*Sense of Scale*	a. Realizing the size of natural objects
4	Symbolic Language	a. Using mathematical rules to explain problems b. Using mathematical rules to solve problems
5	Principled logical framework	a. Look for a logical relationship between two rules.
6	Logical Inference	a. Understand the rules b. Argue based on the rules c. Solve problems based on the rules d. Draw conclusions based on the rules

7	Cause and effect	a. Connecting two or more variables
8	Mathematical Modeling	a. Expressing phenomena or problems in the form of graphs/tables. b. Expressing phenomena in the form of formulas. c. Proposing alternative solutions to problems.
9	Building Concepts	a. Adding new concepts

Cooperative learning with laboratory skills requires clear objectives to be achieved after the learning process. Some relevant methods for laboratory skills include assignments, demonstrations, experiments, group work, and discussions. In the demonstration method, the laboratory activity process is carried out in front of the class by the teacher (who can be assisted by several students), or by a group of students, while the other students observe without being directly involved in the activity. An experiment is the process of solving problems through the manipulation of variables and observation or measurement. In an experiment, the activity process is carried out by all students. Experiments are generally carried out in groups consisting of several students, depending on the type of experiment and the laboratory equipment available at the school.

Student participation through the GI type of cooperative learning model is more active compared to DI learning, so theoretically the application of the GI type of cooperative learning model in the teaching and learning process tends to show an increase in student learning outcomes. In this case, teachers are expected to use the GI type of cooperative learning model in the teaching and learning process.

METHODS

This research was conducted at High School Negeri 3 Medan in class XI Science major academic year 2024/2025. The population in this study were high school students of class XI Science major consisting of 2 classes, namely: Class XI Science major 1 and class XI Science major 2, Class XI Science major 3, Class XI Science major 4 with a total of 144 people. The sample in this study were students of class XI Science major 1 and class XI Science major 2.

This study was a quasi-experimental study, providing a learning treatment. The experimental design, with a pretest and posttest, examined differences in learning achievement among students taught using a cooperative learning model utilizing flash animation and motivational media.

Table 4. Pretest and Posttest Experimental Design

Kelompok	**Pretest**	**Pembelajaran**	**Postest**
A	√	X1	√
B	√	X2	√

Description:
X1: Class using the GI cooperative learning model
X2: Application of the Direct Interaction learning model.
In this study, two classes received different learning treatments. The first class used the GI cooperative learning model, and the second class used the Direct Interaction learning model. The material used in the study was the Kinetic Theory of Gases, structured based on the teaching materials provided in the syllabus. The research design can be seen in table.
Table 4. Research Design

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Parameter	Experiment (Cooperative learning with animation media)	Control (Cooperative learning without animation media)
High Generic Skills	A_1B_1	A_2B_1
Low Generic Skills	A_1B_2	A_2B_2

Description:

A1B1 = Mean for the experimental class with students with high generic skills.

A1B2 = Mean for the experimental class with students with low generic skills.

A2B1 = Mean for the control class with students with high generic skills.

A2B2 = Mean for the control class with students with low generic skills.

The data collection technique was carried out using research instruments, namely a physics learning achievement test and a learning motivation questionnaire. The instrument is used to measure physics learning achievement, which is structured in the form of an objective or multiple-choice test and to measure student learning motivation.

Objective tests (multiple-choice) are tests that can be assessed objectively. Some of the advantages of objective tests include: (1) they contain more positive aspects, for example, they are more representative of the content and scope of the material, they are more objective, they can avoid the interference of subjective elements from both the student and the teacher who is examining them, (2) they are easier and faster to examine, (3) the examination can be delegated to others, and (4) there are no subjective elements that influence the examination.

To test the validity of the test items, the Product Moment Correlation was used. To obtain the calculated r_{count}, SPSS was used. The test item is declared valid if the calculated $r_{count} > r_{tabel}$ e at a significance level of $\alpha = 0.05$. Conversely, if the calculated $r_{count} > r_{tabel}$, the test item is declared invalid and must be replaced (Surapranata, 2020).

To determine the test reliability coefficient, the Kuder Richardson formula (K-R 20) is used. (K-R 20) is usually used for test items that are systematically designed using multiple choices, for example, multiple choice with five answers, four answers, and so on (Sukardi, 2013). The test reliability coefficient can be determined using the Excel program and the value is consulted with the following limits:

1. Between 0.000 – 0.199 is categorized as very low
2. Between 0.200 – 0.399 is categorized as low
3. Between 0.400 – 0.599 is categorized as moderate
4. Between 0.600 – 0.799 is categorized as high
5. Between 0.800 – 1.000 is categorized as very high

In essence, a good test item is one that is neither too easy nor too difficult. If it is too easy, test takers will not be motivated to increase their efforts in solving it. When a test is designed to measure intelligence, the P value ranges from very difficult to very easy. For classroom use, most educators usually use a moderate test, namely a P between 0.3 and 0.7 (Surapranata, 2020). To determine the level of difficulty of each test item, the formula is used;

$$P = \frac{B}{JS}$$

Description:

P = difficulty level of the question number

B = number of respondents who answered the question correctly JS = number of participants

(respondents)

To interpret the level of difficulty of the test items, the following criteria are used:

0.00 – 0.29 is categorized as difficult
0.30 – 0.69 is categorized as moderate
0.70 – 1.00 is categorized as easy

The discriminatory power of an item is used to determine whether or not a question can differentiate groups in the aspect being measured, based on the differences within those groups, which are used to differentiate between high-ability test takers and low-ability test takers (Surapranata, 2020). To determine the discriminatory power of each test item, the proportion of the upper and lower groups is divided as follows:

1. Data is sorted from highest to lowest scores.
2. Fifty percent of the data is taken from the high-value group (upper group) and 50% from the low-value group (lower group).
3. Perform calculations using the formula:

$$D = \frac{B_A}{J_A} = \frac{B_B}{J_B} = P_A - P_B$$

Description:
D = discrimination index
JA = number of participants in the upper group JB = number of participants in the lower group
BA = number of participants in the upper group who answered correctly
BB = number of participants in the lower group who answered correctly
From the calculation results, the following criteria for the item's discrimination power can be seen:
D = 0.00-0.20: Poor
D = 0.21-0.40: Sufficient
D = 0.41-0.70: Good
D = 0.71-1.00: Very good

Data analysis is a critical step in research. The analytical method used must be clear and precise. Determining the appropriate analytical technique depends on the objectives of the data analysis (Sukardi, 2021). This research employed descriptive and inferential analysis. Data were expressed as mean, standard deviation, median, and mode. SPSS 28 was used for this analysis. Student achievement was calculated using the g-factor (normalized gain score) formula, as follows:

$$G = \frac{Skor\ Post\ Test - Skor\ Pre\ Test}{Skor\ Maksimum - Skor\ Minimum}$$

Description:
g < 0.3 is low category
0.3 ≤ g ≤ 0.7 is medium category
g> 0.7 is high category (Hake in Septa, 2020)

The normality test is intended to determine whether the distribution of research data is normal or not, meaning whether its distribution in the population is normal. The normality test uses SPSS 28 with the Kolmogorop Smirnov test. Data is said to be normally distributed if Asymp.sig (2-tailed) > 0.05 significance level. Homogeneity aims to determine whether the distribution of data in the population is homogeneous. The homogeneity test is carried out using the Levene test using SPSS 28, and the data is declared homogeneous if Asymp.sig (2-tailed) > 0.05 significance level.

The influence of learning methods on cognitive scale learning achievement was analyzed using the General Linear Model (GLM). The statistical hypotheses to be tested in this study include:

1. Ho: μ A1 = μ A2 There is no difference in generic skills due to the effects of the GI and DI cooperative learning models in grade XI science majors at SMA Negeri 3 Medan.

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Ha: μ A2 ≠ μ A2 There is a difference in generic skills due to the effects of the GI and DI cooperative learning models in grade XI science majors at SMA Negeri 3 Medan.

2. Ho: μ B1 = μ B2 There is no difference in generic skills between students with high and low laboratory skills.

   Ha: μ B1 ≠ μ B2 There is a difference in generic skills between students with high and low laboratory skills.

3. Ho: A>< B = 0 there is no interaction between the GI type cooperative learning model and laboratory skills on students' generic skills

   Ha: A>< B ≠ 0 there is an interaction between the GI type cooperative learning model and aboratory skills on students' generic skills.

RESULTS AND DISCUSSION

Based on the results of the test instrument validity test, the calculation results are presented in the following table.

Table 5. Test Validity Test

No Test	r_{count}	r_{tabel}	category
1	0.451	0,304	Valid
2	0.534	0,304	Valid
3	0.297	0,304	Tidak Valid
4	0.292	0,304	Tidak Valid
5	0.503	0,304	Valid
6	0.578	0,304	Valid
7	0.333	0,304	Valid
8	0.316	0,304	Valid
9	-0.094	0,304	Tidak Valid
10	0.368	0,304	Valid
11	0.227	0,304	Tidak Valid
12	0.520	0,304	Valid
13	0.506	0,304	Valid
14	0.378	0,304	Valid
15	-0.054	0,304	Tidak Valid
16	0.366	0,304	Valid
17	0.387	0,304	Valid
18	0.316	0,304	Valid
19	0.428	0,304	Valid
20	0.461	0,304	Valid
21	0.316	0,304	Valid
22	0.292	0,304	Tidak Valid
23	0.161	0,304	Tidak Valid
24	0.714	0,304	Valid
25	0.431	0,304	Valid
26	0.488	0,304	Valid
27	0.550	0,304	Valid
28	0.105	0,304	Tidak Valid
29	0.303	0,304	Tidak Valid
30	0.570	0,304	Valid

Based on the results of the reliability test of the test instrument, the calculation results were obtained which are presented in the following table.

Table 6. Descriptive Statistics Data of Generic Skills Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pretes Eksperimen	38	15	55	35,66	9.807
Postes Eksperimen	38	65	95	84.47	9.642
Pretes Kontrol	38	15	60	32,11	10.820
Postes Kontrol	38	55	95	73.82	8.733
Valid N (listwise)	38				

Based on the results of the calculation of the normality test of the data above, it can be seen that for the Asymp. Sig. (2-tailed) table, both the pretest and posttest of the experimental class and the control class. To determine whether the data is normal or not, it can be known by the criteria if the Asymp. Sig. (2-tailed) value is >α = 0.05 then the data is normal. Based on the calculation results, it is known that all Asymp. Sig. (2-tailed) values as a whole are >α = 0.05, so it can be concluded that all data are normally distributed.

Table 7. Physics Values

Levene Statistic	df1	df2	Sig.
.001	1	74	.972

Based on the calculation results, it is known that all Sig. values are > 0.05, thus concluding that all data are homogeneous.

This hypothesis testing was conducted using a two-way ANOVA technique using SPSS 28. The test criterion used was a calculated F value greater than the table F value at a significance level of α = 0.05, thus accepting the proposed hypothesis.

From the SPSS calculation results, the statistical test output can be seen in the table.

Table 8. Dependent Variable:Skor_Generik

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.459a	3	.153	17.118	.000
Intercept	25.171	1	25.171	2818.537	.000
Interaksi	.459	3	.153	17.118	.000
Error	.402	45	.009		
Total	27.545	49			
Corrected Total	.860	48			

a. R Squared = ,533 (Adjusted R Squared = ,502)

Based on the ANOVA test table above, the F count was 17.118 with a Sig. 0.000. Since the Sig. <α = 0.05, it can be concluded that there is an interaction between GI-type cooperative learning and laboratory skills in influencing generic science skills.

The calculation shows that the percentage increase in learning outcomes for the experimental class (74.7%) is greater than the percentage increase in learning outcomes for the control class (60.9%), with a difference in improvement between the experimental and control classes of 13.8%. This indicates a significant difference in the percentage of learning

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outcomes in Physics taught using the GI-type cooperative learning model using laboratory experiments compared to the learning outcomes of Physics taught using the Direct Interaction learning model.

In this study, based on the second hypothesis test, it was proven that laboratory skills can significantly influence generic science, where F count = 6.841 with a sig. 0.004, while the F table value = 1.91 df (38;38) and the significance level α = 0.05, it turns out that the F count value = 6.841 > F table = 1.91. Therefore, the Sig. value > α = 0.05. The results of the study also revealed that the generic science abilities of students with high laboratory skills are better than those with low laboratory skills.

The results of the hypothesis test for the interaction between the GI type cooperative learning model and Laboratory Skills indicate an interaction. This is evidenced by the ANOVA test table above, which obtained an F count of 17.118 with a Sig. 0.000. Because the Sig. value < α = 0.05, it can be concluded that there is an interaction between GI type cooperative learning and generic skills in generic science abilities.

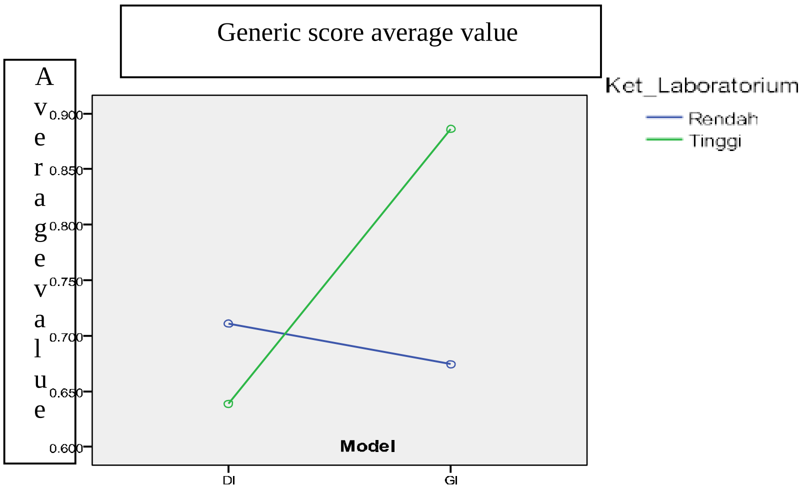

Figure 1. Interaction Line Pattern Between the Group Investigation Type Cooperative Learning Model and the Direct Instruction Learning Model on Generic Science Abilities.

From the graph above, this study concludes that there is an interaction between the learning model and laboratory skills on students' generic science abilities. The graph above shows a difference between the GI type cooperative learning model and the Direct Interaction cooperative learning model on students' generic science abilities. Therefore, the proposed hypothesis H0 is rejected.

CONCLUSION

Based on the results and discussion of the research that has been conducted and described, the following conclusions can be drawn: (1) There are differences in generic skills due to the effects of the GI and DI cooperative learning models in grade XI science majors at SMA Negeri 3 Medan. (2) There are differences in the generic skills of students with high and low laboratory skills in grade XI science majors at SMA Negeri 3 Medan. (3) There is an interaction between the GI and DI cooperative learning models and laboratory skills on students' generic skills.

SUGGESTIONS

From the conclusions drawn, the following recommendations can be made: (1) In physics learning, especially in the Kinetic Theory of Ideal Gases, teachers should pay attention to both generic skills and laboratory skills. (2) Teachers should learn to design

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learning models. (3) Provision of facilities makes it easier for teachers to deliver learning materials.

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