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# Application of Group Investigation Learning Models and Inquiry Learning Strategies to Improve Students' Learning Outcomes

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## ABSTRACT

Group investigation is a learning model focused on collaboration between teachers and students, involving task sharing, sub-theme assignments, and presentation schedules. Inquiry learning emphasizes critical and analytical thinking to solve problems or answer questions, and it can involve the use of miniature models to enhance cognitive and metacognitive skills. The aim of this study is to determine how the integration of the Group Investigation Learning Model and Inquiry Learning Strategy impacts cognitive and metacognitive learning outcomes in students at the Fourth Public Senior High School of Ambon, Maluku Province. The methods used in this research are descriptive statistics and inferential statistics. Based on the cognitive learning results of analysis covariance, the significant value is 0.001, which is less than the critical value of 0.05. This means that the research hypothesis is accepted, indicating that there is an influence of the Group Investigation model and Inquiry Strategy on the improvement of learning outcomes for students in the Eleventh Grade Natural Sciences Interest Group. Additionally, the metacognitive learning result has a significant value of 0.006, which is less than critical value, meaning that the hypotheses are accepted, indicating that Group Investigation and learning strategies have a positive influence on improving students' metacognitive learning outcomes.



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## INTRODUCTION

Group Investigation (GI) is a form of cooperative learning model that emphasizes student participation and activity to search for lesson information to be learned through available materials such as from textbooks or searching through the Internet (Wena, 2011). Rusman, (2012) mentions that the cooperative learning model of the type of group investigation was developed by Shalomo and Yael. Generally, the planning of class organization using the technique of cooperative group investigations is a group formed by the students themselves with a population of 2-6, each group is free to choose sub-themes from the entire unit of material (a language tree) to be taught, and then or to propose group reports. Next, each group presents its report to the whole class, to share and exchange information with them. The Group Investigation cooperative learning model will be more effective if the teacher understands the important components of cooperative education. Moreover, in the Group investigation model, the teacher acts only as a source and facilitator. Teachers oversee the course of group investigations, to see if they can manage their tasks, and help with any difficulties they encounter in group interaction, including problems in performance to tasks related to learning (Slavin, 2011). Based on previous research and the theory that has been described shows that the learning model of GI focuses on the process of investigation and collaboration of learners, while the inquiry approach also focused on the research and activity of students. Therefore, the two can be combined into a single ageing, the Group Investigation Inquiry Learning carried out in eleventh grade students in the study of the circulatory system.

Inquiry learning has been widely used in biology learning. Some researchers have applied inquiry teaching to the concepts of anatomy and physiology of vertebrate animals (Bagatto, 2009; Chaplin, 2003; Kolkhorst, et al., 2001; Brown, 2010). The researchers showed that the inquiry approach is suitable for biology lessons in schools. Inquiry in learning emphasizes the discovery activities carried out by students and requires intensive activity. Natalina *et al*. (2013) stated that the guided inquiry model can be used as one of the alternative learning models that can build students' scientific attitudes. The integration of GI and guided inquiry learning models is a learning method with the following phases. *Phase I*: Identifying topics and organizing students in groups (Guided GI and Inquiry Integration); *Phase II*: Discussion of problems (guided inquiries); *Phase III*: Planning learning tasks; *Phase IV*: Implementation of investigation. *Phase V*: Preparation of the final report of GI; *Phase VI*: Presentation of final reports of GI; *Phase VII*: Conclusions of GI; *Phase VIII*: Evaluation of GI; *Phase IX*: Extension or repetition of GI (Pujiastuti, 2023).

The intended collaboration is a collaboration between Group Investigation and the Inquiry Learning approach. According to Santyasa *et al*. (2019), the GI learning model is suitable for learning experiences that are oriented to the results of investigation, analysis, and synthesis of information in an effort to solve a problem, so it is appropriate for use in science learning. According to Doymus (2009), learning group investigation is suitable for science lessons that aim to involve students in scientific research and encourage students to contribute to learning in the classroom. Meanwhile, Arinda *et al*. (2019) stated that the GI learning model collaborated with the Phet media (Physics Technology) could lead the academic attitude of students to be improved. Collaborations by previous researchers have shown that the GI learning model is suitable to be combined with an inquiry learning approach. According to Sanjaya (2010), the cognitive domain means the level of knowledge of the student, which according to Bloom’s Taxonomy consists of six stages, namely: (1) Considering: relating to the knowledge of specific things; ways and means to deal with particular things; things that are universal and abstract, such as principles, generalizations, theories and structures; (2) Understanding: related to translation, interpretation, estimates of information; (3) Applying: relates to the use of abstraction in particular situations and implementing procedures in existing situations; (4) Analyzing: relate to the dissolution of something intact into pieces and distinguishing these pieces into 9 in elements, relationships, and organizational principles; (5) Evaluating: concerning the assessment in terms of internal evidence or logical consistency and external evidence or coherence with facts developed elsewhere; (6) Creating: collecting and putting various elements together to form a total conformity and recognizing the whole element in such a new pattern or structure.

Metacognitive thinking is an assessment of the ability of consciousness to the learning process and the strategy to learn. Fitri (2017) concluded metacognition as a person’s ability to learn, which includes how best learning is done, what is already and what is not known, which consists of three stages of planning what to do, monitoring self-development in learning; and evaluating what the subject is learned. Yusnaeni & Corebima (2017) argue that empowering metacognitive skills in learning is essential because it plays an important role in solving student learning problems. In the meantime, Nurmalasari *et al*. (2015) revealed that metacognition abilities enable students to manage cognitive abilities and be able to see their weaknesses so that improvements can be made. Budiman & Marianti (2020) added GI learning activities such as planning, information management, monitoring, reviewing, and evaluating are a network of empowering metacognitive skills. Miniature is a model of the simplification of a reality but also shows activity or shows a process. This miniature is capable of explaining to students the details of an object that has become a topic of three-dimensional discussion (Munadi, 2008). A miniature medium is a medium used in learning that resembles the real object or is smaller than the original object with a specific scale and shape of three dimensions and visual delivery. SMA Negeri 4 Ambon (State Senior High School 4 in Ambon, Maluku) has a laboratory room, but its equipment is insufficient to be used effectively as a learning medium for the blood circulation system. In addition to the lack of adequate learning media, the students' understanding of the circulatory system is also not fully developed due to several factors as follows: 1) teachers have not used the proper learning tools, 2) teacher is more likely to be more active than students, and 3) teacher only gives lessons and expects students to read, memorize and remember the lessons. This condition means that knowledge in the Eleventh Class today is still passive to the material of the circulatory system. The Fourth Public Senior High School of Ambon has not yet implemented an inquiry learning strategy, then authors interested in doing research using GI learning models and integrating GI learning in making miniatures in the biology learning process on circulatory material.

## MATERIALS AND METHOD

The research was conducted using quasi-experimental research type, with several test, where the initial test ($Y_1$) as pre-test, before the treatment (X), and then final test ($Y_2$) as post-test. While, control class was not applied the treatment or no treatment. The treatment Integration Learning Model Group Investigation and Learning Strategy Inquiry (X) in making Miniature Blood Circulation System to improve cognitive and metacognitive learning outcomes in Eleventh Class of the Fourth Public Senior High School of Ambon, as presented in **Table 1**.

**Table 1**. Type of research that is used is the type of quasi-experimental research.

| Class | Pre-Test | Treatment | Post-Test |
|---|---|---|---|
| Experiment | $Y_1$ | X | $Y_2$ |
| Control | $Y_1$ | - | $Y_2$ |

Source adapted from Sukardi (2009).

**Population and samples**. In this study are students of the Eleventh Class of the Fourth Public Senior High School of Ambon which has a total of 5 classes. The sample in this research is 4$^{th}$ sub-class as a control group that has 17 students, and 5$^{th}$ sub-class as an experimental group which has also 17 students. Total number of both classes is as many as 34 students.

**Stage of research**. The next stage of the research is how to gather data and group it in 4 steps: (1) Initial Tests; (2) Implementation of Integration of Learning Models and Inquiry Strategies in Making Miniature Blood Circulation Systems for Improvement of Cognitive and Metacognitive Learning Results in the Eleventh Class of Natural Sciences Interest Group of Eleventh Class of the Fourth Public Senior High School of Ambon; (3) Final Tests; and (4) Assessment of Learning Outcomes Cognitively and Metacognitively.

**Data analysis**. Data analysis is descriptive statistical techniques and inferential statistics. The results of statistical data description for the initial test and final test of students on cognitive learning outcomes and metacognitive, uses the Sturges Formula to find out the class intervals, frequencies, and relative frequency of students towards learning treat. Inferential class statistics were used in the study of Analysis of Covariance (Ancova) for cognitive and metacognitive learning results, using the SPSS software version 20. Then, the Least Significant Difference (LSD) test was performed on both cognitive and metacognitive learning results to compare the control and experimental classes.

## RESULTS AND DISCUSSION

Cognitive learning results of students of the Eleventh Class of the Fourth Public Senior High School of Ambon which describes the initial ability of students in performing initial and final tests before and after using the learning model group investigation and learning strategy inquiry. Based on the data of initial test and final test values for such cognitive study results, the next step is to determine maximum values, minimum values and intervals using the Sturges Formula in the following result as **Table 1**.

**Table 1**. Descriptive statistics of cognitive learning outcomes.

| Control Class of Cognitive | | | | | | Experiment Class of Cognitive | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Initial Test | | | Final Test | | | Initial Test | | | Final Test | | |
| Interval | F | RF (%) | Interval | F | RF (%) | Interval | F | RF (%) | Interval | F | RF (%) |
| 29-31 | 10 | 58.82 | 53-59 | 3 | 17.64 | 34-36 | 2 | 11.76 | 75-77 | 4 | 23.52 |
| 32-37 | 4 | 23.52 | 60-64 | 2 | 11.76 | 37-40 | 4 | 23.52 | 78-80 | 5 | 29.41 |
| 38-41 | 1 | 5.88 | 65-67 | 4 | 23.52 | 41-44 | 7 | 41.17 | 81-85 | 5 | 29.41 |
| 42-47 | 2 | 11.76 | 68-70 | 8 | 47.05 | 45-47 | 1 | 5.88 | 86-89 | 3 | 17.64 |
| | | | | | | 48-50 | 3 | 17.64 | | | |
| Total | 17 | 100.00 | | 17 | 100.00 | | 17 | 100.00 | | 17 | 100.00 |

F= frequency; RF= relative frequency. Source: analysis of the research data.

On the basis of **Table 1**, the initial and final test scores for cognitive learning outcomes are presented for both the control and experimental classes, with 17 students in each class. Both the control and experimental classes experienced improvements in cognitive learning outcomes. Nonetheless, the experimental class showed a markedly greater enhancement in academic achievement following the post-test. Their scores increased significantly, rising from a range of 34–50 to 75–89. In contrast, the control class showed a more modest improvement, with scores moving from 29–47 to 53–70.

Students learning outcomes are viewed on the basis of the initial and final test results of students' metacognitive learning outputs in the control and experimental classes, which can be seen in **Table 2**. The data presents the pre-test and post-test scores for metacognitive learning outcomes in the control and experimental classes, each consisting of 17 students. The metacognitive learning outcomes in both the control and experimental groups demonstrated a slightly positive progression. Nevertheless, the post-test results in the experimental group revealed a substantially greater improvement in academic performance compared to the control group. Specifically, student scores in the experimental group increased from a range of 36–59 to 53–63. In contrast, the control group exhibited a more modest gain, with scores rising from 25–44 to 46–54.

**Table 2**. Descriptive statistics of metacognitive learning outcomes.

| Control Class of Metacognitive | | | | | | Experiment Class of Metacognitive | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Initial Test | | | Final Test | | | Initial Test | | | Final Test | | |
| Interval | F | RF (%) | Interval | F | RF (%) | Interval | F | RF (%) | Interval | F | RF (%) |
| 25-28 | 5 | 29.41 | 46-48 | 3 | 17.64 | 36-40 | 8 | 47.05 | 53-55 | 10 | 58.82 |
| 29-30 | 5 | 29.41 | 49-50 | 5 | 29.41 | 41-45 | 3 | 17.64 | 56-60 | 3 | 11.76 |
| 31-40 | 5 | 29.41 | 51-52 | 6 | 35.29 | 46-50 | 1 | 5.88 | 61-63 | 4 | 23.52 |
| 41-44 | 2 | 11.76 | 53-54 | 3 | 17.64 | 51-59 | 5 | 29.41 | | | |
| Total | 17 | 100.00 | | 17 | 100.00 | | 17 | 100.00 | | 17 | 100.00 |

F= frequency; RF= relative frequency. Source: analysis of the research data.

Analysis of Covariance to examine whether the learning model group investigation and learning strategy inquiry have a significant influence on the cognitive and metacognitive learning outcomes of student's eye on biology subjects in the Eleventh Class of the Fourth Public Senior High School of Ambon. This analysis also examines the influence of pre-test on post-test.

## A. Students' Cognitive Learning Outcomes

Data on Ancova Test on cognitive learning capabilities of the Eleventh Class of the Fourth Public Senior High School of Ambon obtained under the learning process by applying learning model group investigation and learning strategy inquiry can be seen in **Table 3**.

**Table 3**. Covariance analysis of cognitive learning result.

| Source | Type of Squares | DF | Mean Square | F | Significance |
|---|---|---|---|---|---|
| Corrected Model | 2088.049 [a] | 2 | 1044.025 | 45.420 | 0.000 |
| Intercept | 2612.163 | 1 | 2612.163 | 113.641 | 0.000 |
| *Cognitive* | 22.608 | 1 | 22.608 | 0.984 | 0.329 |
| **Model** | 952.130 | 1 | 952.130 | 41.422 | **0.001** |
| Error | 712.568 | 31 | 22.986 | | |
| Total | 185303.000 | 34 | | | |
| Corrected Total | 2800.618 | 33 | | | |

[a] R Squared = 0.746; Adjusted R Square = 0.729. Source: analysis of the research data.

In accordance with **Table 3**, it shows early cognitive learning outcomes (prepresses) and integration of models (treatments) against post-test values. The F value for the initial cognitive learning outcome is 0.984 with a probability significance value of 0.329. A probability value $\leq 0.05$ indicates that the pretext gives influence on the post at a 5% significance level. The value of the F for the model integration is 41.422 with a sig. or probability of 0.001. Cognitive learning outcomes are an overview of the level of mastery of the student in the subject he or she is studying or mastering something in the learning activity of knowledge or theory that involves the knowledge and development of intellectual skills that includes the recall or recognition of facts, procedural patterns, and concepts in the development of the intellective ability and skills of the pupil (Potter & Kustra, 2012). Further research by Indriati & Indriwati (2012) explains that practical learning implemented on the basis of inquisition can improve student activity in the study and student biology learning outcomes. Another study conducted by Hapsari *et al*. (2012) explains that inquiry learning guided by variations of techniques (fishbone and vee diagrams) positively influences learning outcomes including cognitive, psychomotor, and affective areas.

The learning model and strategy used is Group Investigation and Inquiry where the learning model group investigation emphasizes the implementation of collaboration in groups so that students can solve a problem and develop research skills especially in the field of science, while the learning strategy inquiry emphasizes on the process of finding and finding. In learning students are required to be more active in searching and finding the materials they learn, educators only act as facilitators who are tasked to guide and direct students.

**Table 4**. Least Significant Difference (LSD) test for cognitive learning results.

| Class | Mean | Notation |
|---|---|---|
| Control | 65.47 | a |
| Experiment | 81.06 | b |

Source: analysis of the research data.

Based on **Table 4**, it shows that the highest average score in the experimental class was 81.06 while the lowest average in the control class was 65.47. Further LSD notation provides information that learning control class and experiment is different.

## B. Students' Metacognitive Learning Outcomes

The data for Ancova test of metacognitive learning outcomes of the Eleventh Class of the Fourth Public Senior High School of Ambon students obtained during the learning process by applying learning model group investigation and learning strategy inquiry can be seen in **Table 5**.

**Table 5**. Covariance analysis of metacognitive learning result.

| Source | Type of Squares | DF | Mean Square | F | Significance |
|---|---|---|---|---|---|
| Corrected Model | 398.487 [a] | 2 | 199.243 | 35.645 | 0.000 |
| Intercept | 1950.582 | 1 | 1950.582 | 348.965 | 0.000 |
| *Metacognitive* | 68.016 | 1 | 68.016 | 12.168 | 0.002 |
| **Model** | 47.726 | 1 | 47.726 | 8.538 | **0.006** |
| Error | 173.278 | 31 | 5.590 | | |
| Total | 98424.000 | 34 | | | |
| Corrected Total | 571.765 | 33 | | | |

[a] R Squared = 0.697; Adjusted R Square = 0.677. Source: analysis of the research data.

Table 5, showing early metacognitive learning outcomes (pre-presses) and model integration (treatments) against post-test values. The F value of the initial cognitive learning outcome is 12.168 with a probability significance value 0.001. A probability value ≤ 0.05 indicates that the pretext gives influence on the post at the level of 5% significance, the F value for the integration of the model is 8.538 with the significance 0.006, which has value less than 0.05, shows that the treatment gives a significant influence in influencing the post-test on the 5% significance level.

**Table 6**. LSD test for metacognitive learning results.

| Class | Mean | Notation |
|---|---|---|
| Control | 50.53 | a |
| Experiment | 56.76 | b |

Source: analysis of the research data.

Based on Table 6 shows that the highest average score in the experiment class is 56.76 while the lowest average in the control class is 50.53. Furthermore, the LSD notation gives information that learning control class and experiment is different. Metacognition is a cognitive process that relates to knowledge and consciousness, or knowledge of the mind and the way it works. This metacognition has a very important meaning, because the knowledge is arranged and selected to enhance its cognitive capabilities in the future. (Nurani, 2017).

Therefore, metacognitive abilities play an important role in biology learning, especially in regulating and controlling the cognitive activity of students in learning and thinking so that the learning and thought done by students becomes more effective and efficient. (Nurmalasari, 2015). The results of this study prove that metacognitive skills trained through a guided inquiry learning model can be delivered very well. This statement shows a consistency with the results of the study (Irawati et al, 2015) which explains that there is a significant difference between the inquiry-led learning model and metacognitive skills. The results of the analysis showed consistency with the results of Malinda & Azizah (2019), concluded that metacognitive skills can be trained by means of guided learning models. These results are also consistent with the results of Tamsyani (2016) research explaining that between learning models and metacognitive consciousness have interactions that can affect learning outcomes.

Metacognitive skills and learning results indicate a positive correlation. A good learning outcome will be obtained by a learner's subject when he has good metacognitive skills (Azizah et al, 2019; Andini & Azizah, 2021). This statement is also demonstrated by the results of research Rosyida et al, (2016) using a sample of control class trained metacognitive skills with conventional learning methods showing fewer maximum results, so cognitive results are also less maximum. According to some research results, Sudjana and Wijayanti (2018) explain that metacognitive has an important role in learning success, so students need to know their metacognitive skills, to know and apply their learning strategies to the desired learning achievement.

Wicaksono (2014) also concluded that learning outcomes and metacognitive skills have a significant correlation. According to Fitria et al, (2020) research, there is a correlation between metacognitive awareness and student learning outcomes. Tamsyani (2016) also explained that metacognitive awareness affects student learning outcomes.

## CONCLUSION

The Group Investigation Learning Model and Inquiry Learning Strategy significantly improve students' cognitive and metacognitive learning outcomes in the Eleventh Grade at the Fourth Public Senior High School of Ambon, with significance values of 0.001 for cognitive learning and 0.006 for metacognitive learning, both of which are below the critical value of 0.05.

## AUTHORS CONTRIBUTION

T. Ifaksasily designed and conducted the study, analyzed and interpreted the data, and wrote a draft of the manuscript, while M. Muskita designed the research, analyzed and interpreted the data.

## CONFLICT OF INTEREST

The authors declare no conflicts of interest and take full responsibility for the content of the article, including any implications of AI-generated art.

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