The effect of the group investigation-guided inquiry (GI-GI) learning model to improve students’ collaboration and science process skills

Indrawati, I K Mahardika, J Prihatin, Supeno, S Astutik, Sudarti, and I Wicaksono*
Faculty of Teacher Training and Education, University of Jember, Jember, Indonesia

iwanwicaksono.fkip@unej.ac.id

Abstract. The GI-GI learning model is a combination of the Group Investigation and the Guided Inquiry model. The research aimed to examine the effect of the GI-GI learning model on collaboration and students’ science process skills. The type of research carried out was Quasi-Experimental and used a post-test only control group design and purposive sampling covering four high schools in the Besuki Residency, two classes as the experimental class and the control class. The research instrument used tests, observations, and documentation. The results showed a significant effect of the GI-GI learning model on collaboration and students’ science process skills. This research implies that the GI-GI learning model can condition students to research in groups to interact actively with friends and educators to exchange opinions, knowledge, or experiences, find and solve problems, and hypothesize through investigation, exploration, and discussion outside or inside in class.

1. Introduction
Science learning plays a significant role in the educational process because science can generate interest in developing science. Science is a study about the universe and its contents, as well as the events that occur in it, and is produced by experts through a series of scientific processes that are carried out carefully [1]. Science is related to finding out about nature systematically so that it is not only mastery of a collection of knowledge in the form of facts, concepts, or principles but also a discovery process [2]. Therefore, learning science teaches students to be active in finding concepts, principles, and theories to develop knowledge.

The results of the Research Group research based on road maps in 2018, 2019, 2020 provide an overview of follow-up that is relevant to needs, including (1) the model used tends to be teacher-centered, this results in learning that does not involve students actively through scientific activities; (2) students are not familiar with the nuances of collaboration in understanding science subject concepts; and (3) the need for a learning model that trains science process skills that are used to find a concept or theoretical principle, to develop a pre-existing concept that is an overall directed scientific skill. The results of other studies show that the learning process in the classroom still uses the lecture and discussion method, which does not emphasize the process aspect [3]. Collaboration and science process skills are essential for every student to develop science and develop their knowledge.

The learning model that refers to a student-centered approach is included in the Constructivism Theory. The constructivism approach is learning that makes students the center of the learning process.
One learning model that refers to Constructivism Theory is the GI-GI (Group Investigation-Guided Inquiry) learning model. The GI-GI learning model is a combination of the Group Investigation model with the Guided Inquiry model, which has a syntax consisting of four phases, namely building a concept (Constructing of Concept), proposing/asking for guidance from an instructor or teacher (Guiding), formulating and testing hypotheses (Hypothesizing and Testing), communicating and assessing results (Communicating and Assessing).

Collaboration has been accepted as an essential skill for achieving effective and meaningful learning and work outcomes. In today’s time, collaboration is not only crucial; everyone needs it. Students must collaborate as a learning process to plan and work together, weigh different views/perspectives, and participate in discussions by brainstorming, listening, and supporting others [4]. Collaborative indicators include: contributing actively, working productively, demonstrating flexibility & compromising, managing projects well, demonstrating responsibility, and showing respect.

Science process skills are essential for every student as a provision to develop science. They are expected to gain new knowledge or develop the understanding they already have [5]. Fundamental science process skills indicators consist of observing, classifying, measuring, communicating, drawing conclusions, and predicting. The indicators for integrated science process skills consist of formulating hypotheses, naming variables, controlling variables, making operational definitions, conducting experiments, interpreting, designing investigations, applying concepts [6]. Science process skills emphasize the growth and development of several science process skills in students to process information so that new things are found that are useful in the form of facts, concepts, and the development of attitudes and values.

Therefore, the Research Group needs to look at the effect of the GI-GI learning model on students’ collaboration and science process skills.

2. Method

The type of research conducted is Quasi-Experimental and uses a post-test-only control group design [7]. In the experimental pattern, the post-test-only control group design uses two groups, namely the group that is treated using the GI-GI (Group Investigation-Guided Inquiry) learning model is called the experimental group. In contrast, the group that is not treated is the control group that uses ordinary learning applied in school. Determination of the sample in this research using purposive sampling, the example in this research was four high schools in the Ex-Residency of Besuki, each with two classes as the experimental and control classes. The research implementation time is in the Odd Semester of 2021/2022. The research instrument uses tests, observations, and documentation. The technique of analyzing student collaboration data is by giving a score for each collaboration task for each student as follows [8].

\[
\text{% score for each task} = \frac{\text{Total scores of all students}}{\text{Total maximum score}} \times 100\%
\]

| Table 1. Guidelines for converting percentage intervals into categories |
|---------------------------------|------------------|
| Percentage (%)                  | Category         |
| 80 < X ≥ 100                    | Very good        |
| 60 < X ≤ 80                     | Good             |
| 40 < X ≤ 60                     | Enough           |
| 20 < X ≤ 40                     | Less             |
| 0 < X ≤ 20                      | Very Less        |

Data analysis technique by giving the percentage of science process skills as follows [9].

\[
P_{\text{KPS}} = \frac{P}{N} \times 100\%
\]
Explanation:

\[ P_{Kps} = \text{Percentage of students’ science process skills} \]
\[ P = \text{Total score obtained from each indicator} \]
\[ N = \text{Total maximum score} \]

Further analysis for the criteria of science process skills is as follows [8].

| Percentage of Science Process Skills | Science Process Skills Category |
|-------------------------------------|---------------------------------|
| ≥ 85%                               | Very good                       |
| 71% − 84%                           | Good                            |
| 56 − 70                             | Enough                          |
| 41 − 55                             | Less                            |
| ≤ 40%                               | Very Less                       |

After obtaining the collaboration scores and students’ science process skills, the data normality test was conducted using SPSS software with a 5% confidence level. If the data obtained are typically distributed, then parametric statistical analysis is used, namely, the independent sample t-test. If the data obtained are not normally distributed, non-parametric statistical analysis, namely the Wilcoxon test, is used.

\[ H_0 = \text{there is no significant difference between collaboration scores or science process skills in the experimental and control classes} \]
\[ H_a = \text{there is a significant difference between collaboration scores or science process skills in the experimental and control classes} \]

3. Result and Discussion

The research was conducted for three weeks in both classes. Learning in the experimental and control classes is carried out online. The experiment class uses the GI-GI learning model, observing collaboration indicators and students’ science process skills. However, the control class uses the usual learning done by the teacher.

3.1. Collaboration

| No | Indicator                             | Experiment Class | Control Class |
|----|---------------------------------------|------------------|--------------|
|    |                                       | Percentage (%)   | Category     | Percentage (%) | Category |
| 1  | Contribute actively                   | 86.13            | Very good    | 70.42          | Good      |
| 2  | Work productively                     | 85.12            | Very good    | 63.65          | Good      |
| 3  | Demonstrate Flexibility & compromise  | 78.38            | Good         | 49.13          | Enough    |
| 4  | Manage projects well                  | 71.52            | Good         | 53.52          | Enough    |
| 5  | Show responsibility                   | 74.63            | Good         | 59.63          | Enough    |
| 6  | Show respect                          | 76.68            | Good         | 62.68          | Good      |
|    | Average                               | 78.74            | Good         | 59.83          | Enough    |

Based on Table 3 above, the experimental class collaboration has an average of 78.74, categorized as good. In contrast, the control class has an average of 59.83, which is classified as sufficient. The results of statistical tests using independent sample t-test obtained the value of Sig. > 0.05 so that \( H_a \) is accepted; there is a significant difference between the experimental and control classes' collaboration.
scores. Collaboration is a philosophy about relating to others (how to learn and work), which is a way to deal with others by respecting differences, sharing power, and gathering knowledge from others. In collaborative classrooms, students will share goals, learn together, engage in meaningful assignments, and build prior knowledge to generate ideas and various products [9]. The results showed that collaboration skills provide students with opportunities to interact in activities working together to achieve goals by respecting differences, participating in discussions, brainstorming, listening, and supporting others [10].

The GI-GI learning model makes students more active in the learning process and better understand science concepts and principles. In contrast, the control class students are more dominant passive, and the teacher plays an active role in the learning process. When carrying out the process of actively contributing, students can conclude and present experimental data that has been obtained with the direction and guidance of the teacher. Thus students can interpret or interpret and analyze a problem given by the teacher to conclude. The advantages in the learning process are that students can play an active role in the learning process, can solve problems in the discussion, and play a direct role in the learning process so that it is easier for them to understand the material [11].

### 3.2. Science process skills

|   | Indicator            | Experiment Class | Control Class |
|---|----------------------|-----------------|---------------|
|   | Percentage (%)       | Category        | Percentage (%)| Category|
| 1 | Observe              | 86.98           | 77.27         | Good    |
| 2 | Grouping             | 78.21           | 70.42         | Good    |
| 3 | Interpret            | 74.44           | 71.44         | Good    |
| 4 | Predict              | 74.51           | 60.51         | Enough  |
| 5 | Formulating Hypotheses | 68.39          | 53.53         | Enough  |
| 6 | Planning an Experiment | 72.62          | 57.62         | Enough  |
| 7 | Communicating        | 77.01           | 72.34         | Good    |
|   | Average              | 76.02           |               | Good    |
|   |                      |                 |               | Enough  |

Based on the data in Table 4 above, the science process skills of the experimental class have an average of 76.02, which is categorized as good. In contrast, the control class has an average of 66.16, which is classified as sufficient. The results of statistical tests using independent sample t-test obtained the value of Sig. > 0.05 so that $H_a$ is accepted; there is a significant difference between the scores of science process skills in the experimental class and control classes. Science process skills are essential for every student as a provision to develop scientific knowledge. They are expected to gain a new understanding or be able to create the knowledge they already have. Science process skills can be used to find a concept or theoretical principle, to develop a pre-existing idea that is a whole directed scientific skill (both cognitive and psychomotor) [12]. The results showed that students’ intellectual abilities were because they used their minds or cognitive skills to carry out scientific process skills [13].

The GI-GI learning model involves physical movement and intellectual activity of students to find problem-solving strategies and strengthen the knowledge gained by students through discovery learning in groups to acquire knowledge independently through scientific methods in experimental activities. The GI-GI learning model can foster students’ scientific attitudes. By researching in groups, students can interact actively with friends or teachers to learn new knowledge or information, find and analyze problems, exchange opinions, knowledge, and even experiences [14]. Students can also develop skills to respect ideas, dare to have thoughts, be responsible, and work together. Another advantage of the GI-GI learning model is that it can allow students to interact with their groups to discuss observations. Besides, students are directly involved in teaching and learning activities to be motivated to learn [15].
4. Conclusion

Based on the results of data analysis and discussion, it can be concluded that there is a significant effect of the GI-GI learning model on collaboration and students’ science process skills. This research implies that the GI-GI learning model can condition students to research in groups to interact actively with friends and educators to exchange opinions, knowledge, or experiences, find and solve problems, and hypothesize through investigation, exploration, and discussion outside or inside in class.

Acknowledgments

The successful implementation of this research cannot be separated from the assistance of various parties. Therefore the research team of the 21st Century Science Teaching Model Research Group (21st Century STM) expresses its gratitude to LP2M Jember University through Research Group Grants and Research Partner Schools with Assignment Agreement Number 2700 /UN25.3.1/LT/2021.

References

[1] Budiastra A A K, Wicaksono I and Erlina N 2020 J. Educ. Gift. Young Sci. 8 1291–304
[2] Siahaan K W A, Lumbangaol S T P, Marbun J, Nainggolan A D, Ritonga J M and Barus D P 2020 J. Basicedu 5 195–205
[3] Budiastra A A K, Wicaksono I and Sanjaya I G M 2020 Int. J. Instr. 13 763–80
[4] Der Linden J, Erkens G, Schmidt H and Renshaw P 2000 Springer 3 37–54
[5] Budiastra A A K, Erlina N and Wicaksono I 2019 New Educ. Rev. 57 187–99
[6] Erlina N, Susantini E, Wasis, Wicaksono I and Pandiangan P 2018 J. Balt. Sci. Educ. 17 972–85
[7] Rogers J and Révész A 2020 Experimental and Quasi-Experimental Designs The Routledge Handbook of Research Methods in Applied Linguistics (New York: Routledge)
[8] Yuliati Y 2017 J. Cakrawala Pendas 3 21–8
[9] Juhji J and Nuangchalerm P 2020 I J. Educ. Gift. Young Sci. 8 1–16
[10] Wicaksono I, Wasis and Madlazim 2017 J. Balt. Sci. Educ. 16 549–61
[11] Joice B and Weil M 1980 Model of Teaching (London: Printice-Hall Inc)
[12] Listyawati M 2012 J. Innov. Sci. Educ. 1 91–9
[13] Wicaksono I, Supeno and Budiarso A S 2020 Int. J. Instr. 13 157–70
[14] Le H, Janssen J and Wubbels T 2018 Cambridge J. Educ. 48 103–22
[15] Tyas E H and Naibaho L 2021 Int. J. Res. 9 176–82