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Effectiveness of the Group Investigation (GI) learning model to increase collaboration skills and science literacy of junior high school students

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Abstract
Students' low levels of collaboration skills and scientific literacy pose challenges in science learning at the junior high school level. Science instruction in Indonesia tends to rely on lectures and minimal practical work. This study aims to analyze the effect of the Group Investigation (GI) learning model on the collaboration skills and scientific literacy of junior high school students. The study used a quasi-experimental method with a nonequivalent control group design, involving eighth grade students of junior high school in Gondangrejo in the 2024/2025 academic year. The research instruments included a GI syntax observation sheet, a collaboration skills observation sheet, and a written science literacy test. The results showed that the application of GI syntax was in the very good category (average 95.5%). The Independent Sample T-Test showed a significance value <0.05, which means the GI model has a significant effect on collaboration skills (sig. 0.000) and students' scientific literacy (sig. 0.024). These findings indicate that the GI model is effective in science learning to improve students' collaboration skills and scientific literacy.

1. Introduction

Education is a fundamental right for every Indonesian citizen, as guaranteed by the 1945 Constitution Article 31 Paragraphs (1) and (2), which affirms that every citizen has the right and obligation to receive education, and the government must fund basic education. In the 21st century, education plays a more crucial role than ever, as it is expected to produce individuals equipped with the skills needed to thrive in a global and technologically advanced society. Among these essential skills are collaboration and scientific literacy, which are fundamental for students to actively engage in learning and to critically analyze social and scientific issues (Costa et al., 2021; Fau et al., 2023).

Despite its importance, existing research indicates that Indonesian students still demonstrate low levels of collaboration and scientific literacy. Collaborative skills remain underdeveloped, as students often lack the ability to participate actively, share responsibility, work productively in groups, and show mutual respect (Greenstein, 2012; Li, H., 2025). At the same time, results from the PISA 2018 assessment show that Indonesia ranked 74th out of 79 countries in scientific literacy, with average scores consistently below the international standard (OECD, 2019).

Science education in Indonesia continues to be dominated by conventional teaching methods, particularly teacher-centered approaches such as lectures, which focus on memorization rather than conceptual understanding (Haridza & Irving., 2017; Sappaile et al., 2023). These traditional models do not support active learning, collaboration, or the development of scientific reasoning. Therefore, there is a need for updated learning models that foster students' collaboration skills and scientific literacy, one of which is the Group Investigation (GI) model. While various studies have proposed the Group Investigation (GI) model as an effective tool to enhance collaborative and literacy skills, most existing research has been limited to primary education or thematic content areas (Slattery et al., 2024). There remains a lack of empirical studies examining the impact of the GI model specifically in integrated science learning at the junior high school level.

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This study offers a novel contribution by applying the Group Investigation (GI) model to integrated science learning at the junior high school level, which has rarely been explored. GI is a cooperative learning strategy that actively involves students in the inquiry process, enabling them to collaboratively explore scientific issues and construct knowledge through group interaction (Zorlu & Sezek., 2020; Siew & Chai 2024). Unlike other cooperative methods, GI places a stronger emphasis on student autonomy, group dynamics, and the integration of social and scientific reasoning aligning well with the goals of 21st-century education (Ekizer & Yildirim., 2023). This research fills a critical gap by evaluating the dual impact of the GI model on both collaboration skills and scientific literacy in a secondary school science context.

This study aims to (1) analyze how the syntax of the Group Investigation (GI) model affects students' collaboration skills and scientific literacy; (2) determine the effect of the GI model on the collaboration skills of junior high school students; and (3) examine the effect of the GI model on the scientific literacy of junior high school students.

2. Method

This study employed a quantitative approach using a quasi-experimental method with a Non-Equivalent Pretest-Posttest Control Group Design. The research was conducted at Junior High School in one of the cities of Solo, during the even semester of the 2024/2025 academic year, specifically from March to April 2025. The population consisted of 190 eighth-grade students from six classes, and a total of 63 students were selected through cluster random sampling. Class VIII B (32 students) was assigned to the experimental group, while Class VIII C (31 students) served as the control group.

The experimental group received science instruction using the Group Investigation (GI) learning model, while the control group was taught using conventional teaching methods. A pre-test was administered solely to assess scientific literacy, as the construct of collaboration skills required observable behavior during group-based learning. Following the instructional intervention, both scientific literacy and collaboration skills were assessed using post-tests. This design enabled the evaluation of both direct effects of the GI model and its comparison with traditional teaching methods.

Data were collected using two main instruments a 25-item multiple-choice test to assess students' scientific literacy, and a rubric-based observation sheet to measure collaboration skills. Instrument validity was confirmed by expert judgment, and reliability was tested using SPSS version 25. To ensure consistent implementation, the GI model was delivered according to a structured lesson plan, and its fidelity was monitored through an observation checklist completed by observers. Inter-rater reliability was also calculated to strengthen the credibility of observational data.

For data analysis, normality and homogeneity assumptions were tested using the Kolmogorov–Smirnov test and Levene's test, respectively. Hypothesis testing was conducted using the Independent Sample T-Test for comparing post-test scores between groups. To determine practical significance, the effect size was calculated using Partial Eta Squared (η^2) with interpretation thresholds small (≥ 0.01), medium (≥ 0.06), and large (≥ 0.14), following the guidelines by Lakens (2013). Research procedure can be seen in Figure 1.

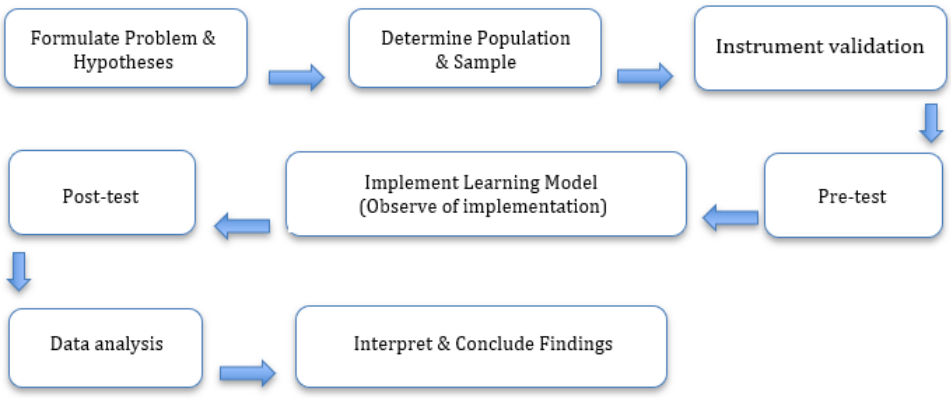

Figure 1. Research Procedure

3. Results and Discussion

3.1. Results

Normality and homogeneity tests were conducted before hypothesis testing. The Kolmogorov-Smirnov test indicated that all data were normally distributed ($p > 0.05$), and the Levene's Test confirmed homogeneity of variance across groups presented Table 1 and Table 2.

Table 1. Results of Data Normality Test for Collaboration Skills and Science Literacy

No	Variable		Kelas	Sig. (p)	Decision
1	Collaboration Skills	Post-test	Experimental	0.097	Sig. value ≥ 0.05 Data is normally distributed
			Control	0.200	Sig. value ≥ 0.05 Data is normally distributed
2	Science Literacy	Pre-test	Experimental	0.101	Sig. value ≥ 0.05 Data is normally distributed
			Control	0.065	Sig. value ≥ 0.05 Data is normally distributed
		Post-test	Experimental	0.192	Sig. value ≥ 0.05 Data is normally distributed
			Control	0.200	Sig. value ≥ 0.05 Data is normally distributed

Table 2. Results of Homogeneity Test of Collaboration Skills and Science Literacy Data

No	Variable		Sig. (p)	Decision
1	Collaboration Skills	Post-test	0.596	Nilai Sig.≥ 0.05 Homogeneous data
2	Science Literacy	Pre-test	0.263	Nilai Sig.≥ 0.05 Homogeneous data
		Post-test	0.226	Nilai Sig.≥ 0.05 Homogeneous data

Measurement of the influence of the GI learning model on students' collaboration and science literacy skills using the T-Test presented Table 3.

Table 3. Results of Hypothesis Testing of Collaboration Skills and Science Literacy Data

No	Variable		Sig. (p)	Significance Level	Decision
1	Collaboration Skills	Post-test	0.00	0.05	Sig value. < 0.05 There is an influence
2	Science Literacy	Pre-test	0.995		Sig value. > 0.05 There is no influence
		Post-test	0.024		Sig value. < 0.05 There is an influence

Hypothesis testing on post-test values shows that the significant value is <0.05, which states It was revealed that the Group Inquiry (GI) learning model had a significant influence on cooperation and scientific literacy of junior high school students There were no baseline differences in science literacy ($p = 0.995$), confirming equivalence. The post-test showed significant differences in both collaboration ($p = 0.000$) and science literacy ($p = 0.024$). Continued by calculating the magnitude of the influence that appears by finding the partial eta squared value with a formula adapted from Lakens (2013), the results obtained presented Table 4.

Table 4. Partial Eta Square Calculation Results for Collaboration Skills and Science Literacy Data

No	Variable	t	df	Sig. (p)	Partial Eta Squared	Decision
1	Collaboration Skills	-4.043	61	0.00	0.211	Big influence
2	Science Literacy	-2.319	61	0.024	0.081	Moderate influence

The partial eta squared value is categorized by looking at the categories according to Cohen (1988), the results obtained show that the GI model has a significant effect on collaboration skills and the GI model has a moderate effect on science literacy skills.

3.2. Discussion

This study demonstrates that the implementation of the Group Investigation (GI) learning model has a significant impact on students' collaboration skills and a moderate effect on their scientific literacy. The findings align with the characteristics of 21st-century learning, which emphasize student-centered instruction, cooperative learning, and inquiry-based activities.

3.2.1. Collaboration Skills Improvement

The improvement of students' collaboration skills in the experimental class confirms the suitability of the GI model in supporting interpersonal and cooperative competencies. Students were actively involved in group planning, investigation, discussion, and presentation activities. These processes naturally fostered contribution, problem solving, and teamwork, consistent with the theoretical foundation of sociocultural learning proposed by Vygotsky, which emphasizes social interaction in cognitive development.

However, the lower score on the time management indicator in the experimental group suggests that collaborative learning does not automatically guarantee efficiency. The greater number of investigative and reflective tasks in the experimental class consumed more time than expected. This finding is consistent with Bektas and Ünver (2022), who emphasized that student-led investigations often require extended time to be completed meaningfully.

The comparative performance of students' collaboration skill indicators between the experimental and control groups is illustrated in Figure 2.

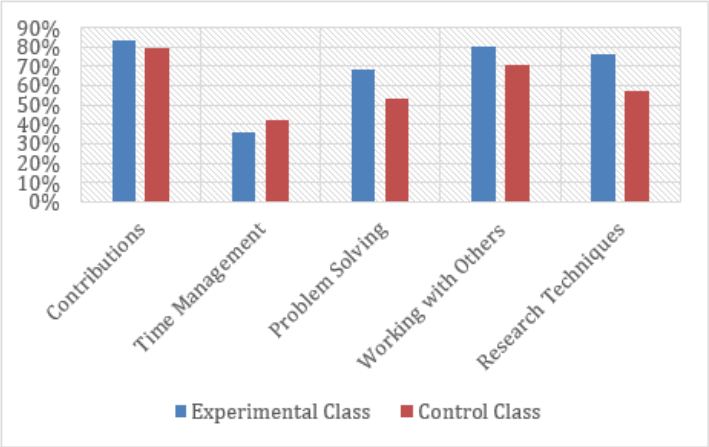

Figure 2. Percentage of Collaboration Skills Indicators

3.2.2. Scientific Literacy Enhancement

The moderate effect of the GI model on scientific literacy indicates that collaborative inquiry contributed to improved understanding of science concepts. Students in the experimental group demonstrated growth in all three indicators of science literacy as defined by the OECD (2024): Explaining Phenomena Scientifically, Evaluating and Designing Scientific Inquiry, and Interpreting Data and Evidence Scientifically.

The improvement can be attributed to the integration of real-world problems, group discussions, and practical investigations. These learning experiences provided opportunities for students to actively construct knowledge and develop scientific reasoning. As supported by Shengqiang et al (2025), combining simple experiments with collaborative discussions enhances students' engagement and understanding in science learning.

However, the relatively small effect size ($\eta^2 = 0.081$) suggests that the potential of the GI model was not fully realized. The evaluation phase, which should allow students to reflect and draw conclusions, was limited by time constraints. This inhibited students' ability to synthesize knowledge and connect investigations to broader scientific concepts (Fitzgerald et al., 2019).

The comparative performance of students' scientific literacy indicators between the experimental and control groups is illustrated in Figure 3.

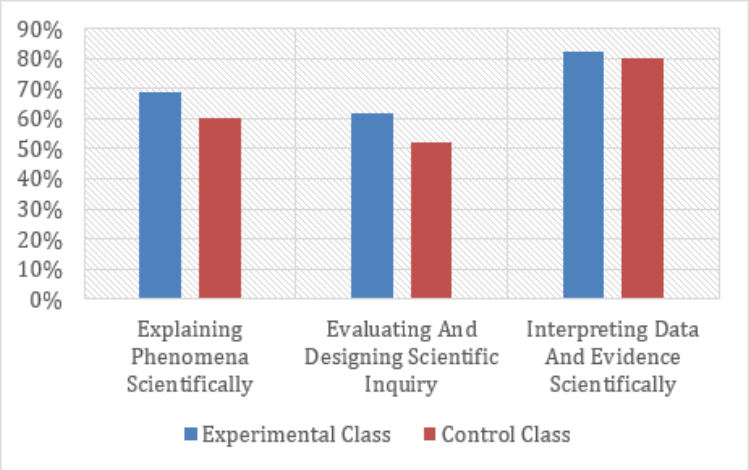

Figure 3. Percentage of Science Literacy Indicators Post-Test

The results showed that the Interpreting data and evidence scientifically indicator in the control class had a very small percentage difference with the experimental class. Due to the reading activities carried out in the control class and the experimental class. Students' science literacy is closely related to scientific reading activities, and that effective scientific reading activities help students accumulate scientific knowledge and thus improve students' science literacy (Cao et al., 2024). According to the findings in Hollenweger's (2024) research, interdisciplinary teaching practices such as close reading empower secondary school science teachers to facilitate students' development of reading proficiency and understanding texts while increasing scientific knowledge.

The GI model is a classification of cooperative learning that emphasizes the active involvement of students in planning, investigating, and presenting topics related to everyday life problems. GI is designed to encourage collaboration, critical thinking, and meaningful learning (Sharan & Sharan, 1992; Slavin, 2005; Joyce et al., 2024). Learning by presenting problems in everyday life as the main topic in learning can improve students' scientific literacy (Nainggolan et al., 2021). However, in the study, the discussion related to problem-solving solutions that were used as learning topics was not conveyed properly at the end of the learning, namely the evaluation syntax. Due to insufficient time allocation. This is one of the causes identified as making the GI model have a small effect on students' scientific literacy.

The implementation of the syntax of conducting investigations in experimental classes, in addition to being carried out through reading activities, is also carried out through "action" activities. What is meant by action is by carrying out practical activities. Practical activities in this study are known to foster growth in students' scientific literacy competencies. Practical activities have increased students' scientific literacy by means of practical application on teaching materials acquired theoretically in the classroom (Kelkay, 2023). The teacher's method plays an important role in learning with practical work which is crucial for the advancement of students' scientific literacy, this has a substantial influence on enhancing their comprehension of concepts pertinent to the scientific phenomenon under investigation (Oliveira & Bonito, 2023). As well as the implementation of the syntax of compiling a final report in the experimental class which trains students in analyzing data and evidence through a scientific lens through the results of practical work or observations and literature sources. In compiling the final report, students link the results of the practical work with the theory obtained and are linked to solutions to problems that arise at the beginning of learning. Through discussions between group members, by exchanging ideas or arguments. That learning that implements discussion activities and simple experiments can actually improve students' scientific literacy skills (Wele et al., 2024).

3.2.3. Integration of Collaboration and Science Content

Although collaboration is often categorized as a non-cognitive skill, in this context it directly supported students' conceptual understanding. During investigative tasks, students negotiated meaning, interpreted data collectively, and evaluated evidence critically. These collaborative processes were instrumental in constructing scientific knowledge. The findings align with Oliveira

and Bonito (2023), who assert that guided collaboration during practical work enhances students' understanding of scientific mechanisms.

This study is not without limitations. First, the duration of the intervention was short and did not allow for full implementation of all GI phases, particularly reflection and synthesis. Second, the sample size was limited to one school, which restricts the generalizability of the findings. Third, the measurement of collaboration relied on observation, which, despite validation, may contain subjective bias. Fourth, science literacy was measured only through multiple-choice tests, potentially overlooking deeper conceptual insights. Future studies are encouraged to:

a. Extend the duration of implementation to allow better integration of reflective and evaluative stages.

b. Utilize alternative assessments such as student journals or project portfolios to capture more holistic indicators of scientific literacy.

c. Explore teacher scaffolding techniques that support group dynamics without diminishing student autonomy.

d. Investigate the long-term impact of the GI model on students' scientific reasoning and collaboration over time.

4. Conclusion

The results and discussion indicate that there is an effect of the implementation of the Group Investigation (GI) learning model on students' collaboration skills and scientific literacy, this can be seen from the average value in the experimental class obtained higher than the control class. In addition, it is also supported by the results of the hypothesis test showing that the significant value <0.05 which states that there is a significant influence between the Group Investigation (GI) learning model on the collaboration skills and scientific literacy of junior high school students. With the assessment results showing that the observation sheet for the implementation of the Group Investigation (GI) model syntax is used to collect data on the percentage of learning with the GI model implemented by 95.5% with a very good category.

Author Contributions

All authors have equal contributions to the paper. All the authors have read and approved the final manuscript.

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Declaration of Conflicting Interests

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References

Bektas, O., & Oguz Unver, A. (2022). Teachers' effective use of time in scientific inquiry lessons. *International Journal of Research in Education and Science*, 8(4), 647–661. https://doi.org/10.46328/ijres.2918

Cao, C., Zhang, T., & Xin, T. (2024). The effect of reading engagement on scientific literacy: An analysis based on the XGBoost method. *Frontiers in Psychology*, 15, Article 1329724. https://doi.org/10.3389/fpsyg.2024.1329724

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Routledge.

Costa, A. M., Ferreira, M. E., & Loureiro, M. J. d. S. (2021). Scientific literacy: The conceptual framework prevailing over the first decade of the twenty-first century. *Revista Colombiana de Educación*, (81), 195–228. https://doi.org/10.17227/rce.num81-10293

Ekizer, F. N., & Yildirim, S. S. (2023). 21st century skills and learning environments: ELT students' perceptions. *Educational Research and Reviews*, 18(6), 114–128. https://doi.org/10.5897/ERR2023.4332

Fau, J. F., Mendrofa, K. J., Wau, M., & Waruwu, Y. (2023). Pendidikan jendela dunia. *Jurnal Visi Pengabdian Kepada Masyarakat*, 4(2), 69–77. https://doi.org/10.51622/pengabdian.v4i2.1350

Fitzgerald, M., Danaia, L., & McKinnon, D. H. (2019). Barriers inhibiting inquiry-based science teaching and potential solutions: Perceptions of positively inclined early adopters. *Research in Science Education*, 49(2), 543–566. https://doi.org/10.1007/s11165-017-9623-5

Greenstein, L. (2012). *Assessing 21st century skills: A guide to evaluating mastery and authentic learning*. SAGE Publications.

Haridza, R., & Irving, K. E. (2017). The evolution of Indonesian and American science education curriculum: A comparison study. *Educare*, 9(2).

Hollenweger, N. C. (2024). *Unlocking understanding: Enhancing scientific literacy through interdisciplinary reading strategies in high school science classes* (Doctoral dissertation, Rowan University). Rowan Digital Works.

Joyce, B., & Calhoun, E. (2024). *Models of teaching* (10th ed.). Taylor & Francis.

Kelkay, A. D. (2023). Science practical work and its impact on students' science achievement: The case of secondary school students. *Journal of Science Education*, 24(1).

Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: A practical primer for t-tests and ANOVAs. *Frontiers in Psychology*, 4, Article 863. https://doi.org/10.3389/fpsyg.2013.00863

Li, H. (2025). Impact of collaborative learning on student engagement in college English programs: Mediating effect of peer support and moderating role of group size. *Frontiers in Psychology*, 16, Article 1525192. https://doi.org/10.3389/fpsyg.2025.1525192

Olivera, H., & Bonito, J. (2023). Practical work in science education: A systematic literature review. *Frontiers in Education*, Article 1151641. https://doi.org/10.3389/feduc.2023.1151641

Organisation for Economic Co-operation and Development. (2019). *PISA 2018 assessment and analytical framework*. OECD Publishing.

Organisation for Economic Co-operation and Development. (2019). *PISA 2018 assessment and analytical framework* (Updated ed.). OECD Publishing.

Sappaile, B. I., Lasinggaru, E. D. F., & Mokodenseho, S. (2023). Analyzing the influence of digital learning platforms on student engagement and academic performance. *West Science Interdisciplinary Studies*, 1(2), 65–73. https://doi.org/10.58812/wsis.v1i6.89

Shengqiang, L., Nankhantee, A., & Srikhao, S. (2025). Combining inquiry-based learning and collaborative learning: A new model for improving students' teamwork and problem-solving skills. *Journal of Education and Educational Development*, 12(1), 13–38. https://doi.org/10.22555/joeed.v12i1.1296

Siew, N. M., & Chai, W. L. (2024). The integration of 5E inquiry-based learning and group investigation model: Its effects on level four science process skills of form four students. *Problems of Education in the 21st Century*, 82(1), 133–147. https://doi.org/10.33225/pec/24.82.133

Slavin, R. E., Hurley, E. A., & Chamberlain, A. (2005). Cooperative learning and achievement: Theory and research. In I. B. Weiner & W. M. Reynolds (Eds.), *Handbook of psychology: Educational psychology* (Vol. 7, pp. 177–198). Wiley.

Slattery, E. J., Butler, D., O'Leary, M., & Marshall, K. (2024). Teachers' experiences of using Minecraft Education in primary school: An Irish perspective. *Irish Educational Studies*, 43(4), 965–984. https://doi.org/10.1080/03323315.2023.2185276

Wele, M. A., Lawe, Y. U., Suparmi, N. W., & Dinatha, N. M. (2024). Improving scientific literacy in primary schools using experimental methods. *Edunesia: Jurnal Ilmiah Pendidikan*, 5(2), 1114–1127. https://doi.org/10.51276/edu.v5i2.931

Zorlu, F., & Sezek, F. (2020). The investigation of the effectiveness of applying group investigation method at different intervals in teaching science courses. *Journal of Theoretical Educational Science*, 13(2), 397–423. https://doi.org/10.30831/akukeg.623066