

Effectiveness of Small Group Discussion in Improving Geography Students' Learning Outcomes at Lambung Mangkurat University: A Study on Air Quality Course

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Abstract: Higher education requires learning approaches that encourage students to actively engage with concepts, exchange ideas, and develop higher-order thinking. In Geography education, these needs are particularly relevant to environmental courses such as Air Quality, which require students to understand environmental processes, analyze problems, and evaluate appropriate responses. Small group discussion provides opportunities for students to actively participate, exchange perspectives, and construct knowledge collaboratively. **Objective:** This study aimed to examine changes in student learning outcomes following the implementation of the small group discussion method in the Air Quality course of the Geography Study Program at Lambung Mangkurat University. **Methods:** A quantitative approach with a pre-experimental one-group pretest–posttest design was employed. The participants consisted of 52 students selected through total sampling. Data were collected using pretests and posttests to measure cognitive learning outcomes, supported by questionnaires assessing students' perceptions of the learning process. Data were analyzed using a paired-samples t-test and normalized gain (N-Gain) analysis. **Findings:** The mean score increased from 58.8 in the pretest to 83.1 in the posttest, with a statistically significant difference between the two measurements ($p = 0.003$). The N-Gain value of 0.59 indicated a moderate level of learning improvement across cognitive indicators, including conceptual understanding, application, analysis, and evaluation. Furthermore, 81.1% of students reported positive perceptions, particularly regarding engagement, collaboration, and understanding of course material. **Implications:** The findings suggest that small group discussion can support learning improvement and positive learning experiences when implemented through structured tasks, clear guidance, and continuous lecturer facilitation. **Originality:** This study provides empirical evidence on the application of small group discussion specifically in an undergraduate Air Quality course, extending discussion-based learning research within Geography education.

Keywords: Small Group Discussion; Learning outcomes; Student Engagement

INTRODUCTION

The changing social, technological, and environmental context has increased attention to broader competencies in higher education, including critical thinking, communication, collaboration, and the ability to apply knowledge to real-world contexts (OECD, 2021). This orientation has strengthened the emphasis on student-centered and active learning, in which students actively construct and apply knowledge rather than primarily receive information from instructors (Ribeiro-Silva et al., 2022). Evidence from higher education indicates that active learning can improve learning achievement compared with traditional lecture-based instruction, including in the humanities and social sciences (Kozanitis & Nenciovici, 2023). Meaningful active learning involves cognitive engagement through activities such as explaining ideas, exchanging perspectives, generating responses, and reflecting on understanding (Chi & Wylie, 2014; Doolittle et al., 2023).

Small group discussion is one form of active learning that facilitates student interaction and cognitive engagement. Through discussion, students can articulate ideas, respond to alternative perspectives, explain their reasoning, and reconsider their interpretations. The ICAP framework indicates that activities involving explanation, idea generation, and interaction can promote deeper cognitive engagement than passive information reception (Chi & Wylie, 2014). However, empirical findings on small group discussion are not uniform. Some studies have reported improvements in learning outcomes and participation (Putriawati, 2019; Yousaf et al., 2023), whereas others have found limited differences compared with alternative

instructional approaches (Jordan et al., 2021; Linneman, 2019). The effectiveness of discussion may therefore depend on its structure, purpose, and the quality of student interaction (Wotring et al., 2024).

The approach has been applied in various higher education settings, including geography education. Small group discussion supported by mobile learning has been used to engage students in geographical learning activities (Amaliya & Dewi, 2022). Its relevance is particularly evident in environmental geography, where students need to examine relationships among physical processes, human activities, environmental conditions, and spatial patterns. Air quality is an important topic in this context because it requires students to understand pollution sources and atmospheric processes while interpreting environmental information and considering environmental and health impacts. In geographical education, GIS-based instruction on air pollution has also been associated with improved learning outcomes related to application and analysis (Yang et al., 2024), while air-quality issues have important educational relevance in the Indonesian context, including Kalimantan (Sulaeman et al., 2020).

In the Geography Study Program at Lambung Mangkurat University, the Air Quality course addresses sources of air pollution, atmospheric processes, environmental and health impacts, air-quality monitoring, and pollution-control strategies. These topics require students to connect theoretical concepts with real-world environmental conditions. Small group discussion provides opportunities to examine air-pollution cases, compare explanations, evaluate pollution-control strategies, and communicate evidence-based reasoning. Although previous studies have examined active learning and small group discussion in higher education, research in geography and environmental education has focused more extensively on active learning in general or specific approaches such as GIS-based learning than on small group discussion as the principal strategy in a university-level Air Quality course (Amaliya & Dewi, 2022; Yang et al., 2024).

Empirical evidence concerning the effectiveness of small group discussion in an Air Quality course within an Indonesian Geography Study Program therefore remains limited. This study aims to analyze the effectiveness of small group discussion in improving student learning outcomes in the Air Quality course of the Geography Study Program at Lambung Mangkurat University. The study contributes context-specific empirical evidence on the application of small group discussion to environmental geography education in Indonesian higher education.

RESEARCH METHOD

This study employed a quantitative approach with a pre-experimental one-group pretest–posttest design to examine changes in student learning outcomes following the implementation of small group discussion. The same participants were assessed before and after the intervention (Campbell & Stanley, 1963; Creswell & Creswell, 2018). The study involved 52 students enrolled in the Air Quality course of the Geography Study Program, Lambung Mangkurat University, using total sampling (Sugiyono, 2019). The research instrument was a 20-item multiple-choice test developed based on the course learning outcomes, covering air pollution sources, atmospheric processes, environmental impacts, air-quality monitoring, and pollution-control strategies. The items were reviewed by experts to assess their relevance, clarity, and representativeness of the intended content domain (Beck, 2020; Russell, 2022; Setiawan et al., 2024). The research location is presented in the research site map.

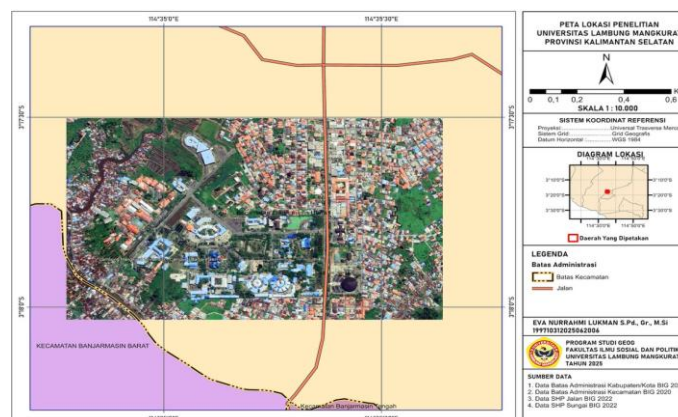


Figure 1. Research Location
Source: Author Analysis, 2025

Data collection consisted of three stages: pretest, small group discussion intervention, and posttest. During the intervention, students worked collaboratively to discuss environmental issues, analyze cases, exchange ideas, and present their conclusions, supporting cognitive engagement and knowledge construction (Chi & Wylie, 2014; Doolittle et al., 2023). Data were analyzed using descriptive and inferential statistics. Mean, minimum, maximum, and standard deviation were calculated for the pretest and posttest scores. The normality of the paired score differences was assessed using the Shapiro–Wilk test. When the normality assumption was met, a paired-samples t-test was conducted at $\alpha = 0.05$ to examine the difference between pretest and posttest scores (Field, 2018; Mishra et al., 2019). Learning improvement was additionally measured using normalized gain (N-Gain) (Hake, 1998):

$$\text{N-Gain} = \frac{\text{Posttest} - \text{Pretest}}{\text{Maximum Score} - \text{Pretest}}$$

N-Gain values were categorized as low ($g < 0.30$), medium ($0.30 \leq g \leq 0.70$), and high ($g > 0.70$). N-Gain was interpreted as a descriptive indicator of learning improvement because gain estimates may be influenced by initial scores (Westphale et al., 2022). The research workflow can be seen in the image below.

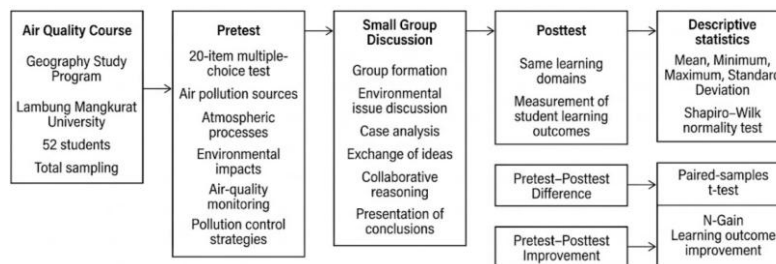


Figure 2. Research Workflow Source: Author Analysis, 2025

RESULT AND DISCUSSION

RESULTS

N-Gain Analysis

The N-Gain calculation was conducted to determine the extent of improvement in student learning outcomes after implementing the group discussion method. The study involved 52 students. The learning outcome assessment included four main indicators: understanding basic concepts, applying concepts, problem analysis, and evaluation and synthesis. The results of the pretest and posttest along with the N gain analysis can be seen in table 1 below.

Table 1. Average pretest, posttest, and N-Gain calculation based on each indicator

No	Learning Outcome Indicator	Mean Pretest	Mean Posttest	N-Gain	Category
1	Basic Concept Understanding	59.1	82.3	0.57	Medium
2	Concept Application	60.4	85.7	0.64	Medium
3	Problem Analysis	56.8	81.2	0.56	Medium
4	Evaluation and Synthesis	58.9	83.2	0.59	Medium
Average		58.8	83.1	0.59	Medium

Source: Primary Data Processing in 2025

The results show that students' learning outcomes improved across all indicators after the implementation of the discussion method. The average pretest score was 58.8, which increased to 83.1 in the posttest. This indicates a clear improvement in student performance after the learning intervention. Based on the N-Gain analysis, all indicators fall into the medium category, with an overall average N-Gain of 0.59. Among the four indicators, the highest improvement was observed in concept application ($g = 0.64$), followed by evaluation and synthesis ($g = 0.59$), basic concept understanding ($g = 0.57$), and problem analysis ($g = 0.56$). These findings suggest that the discussion method was particularly effective in enhancing students' ability to apply concepts, while also contributing to improvements in higher-order thinking skills such as analysis and evaluation. Although all indicators show improvement, the results indicate that students still require further strengthening in analytical skills development, as reflected in the relatively lower gains in problem analysis compared to other indicators. Overall, the consistent improvement across all indicators demonstrates that the discussion-based learning approach had a positive impact on student learning outcomes in the Air Quality course.

Paired-Sample Test Results

The paired-samples t-test is a parametric statistical technique used to examine whether the mean difference between two related measurements from the same participants is statistically significant (Field, 2018). In this study, the test was used to compare students' pretest and posttest scores following the implementation of small group discussion.

Table 2. Descriptive Statistics and Paired Sample t-Test Results

Statistics	Mean	N	Standard Deviation	Sig. (2-tailed)
Pretest	58.8	52	8.45	–
Posttest	83.1	52	7.88	0.003

Source: Primary Data Processing in 2025

Based on Table 2, the mean score increased from 58.8 in the pretest to 83.1 in the posttest, with a mean improvement of 24.3 points. The standard deviation decreased slightly from 8.45 to 7.88. The paired-samples t-test produced a significance value of 0.003, which is lower than the 0.05 significance level, indicating a statistically significant difference between the pretest and posttest scores. These findings indicate an improvement in students' learning outcomes following the implementation of small group discussion in the Air

Quality course.

Effectiveness Based on Student Perception

Student learning experience is an important indicator of instructional quality in higher education because it reflects students' engagement with and perceptions of the learning process. Students' responses to instructional activities provide valuable information on how teaching strategies are experienced in practice and can inform efforts to improve the quality of learning. Therefore, examining students' learning experiences can complement learning outcome measures in evaluating instructional implementation.

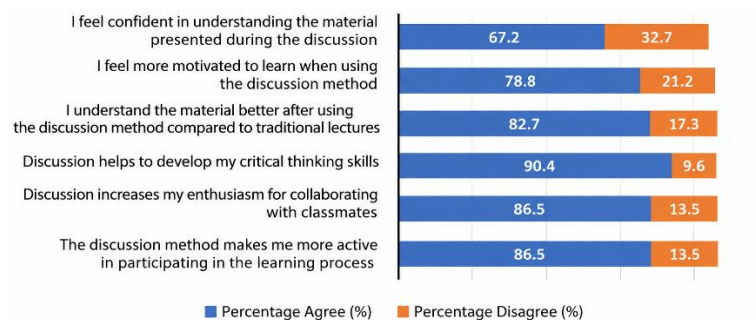


Figure 3. Student perceptions based on questionnaire recapitulation

Source: Primary Data Source, 2025

Based on the questionnaire results and the diagram presented, the findings indicate that students generally have a positive perception of the group discussion method. The majority of students (81.1%) agreed that this learning approach increased their engagement during the learning process, encouraged collaboration among peers, and helped them better understand the course material. This suggests that the discussion-based learning environment was perceived as more interactive and supportive compared to conventional learning approaches, allowing students to actively participate in constructing their understanding of the topics discussed.

DISCUSSION

The findings indicate an improvement in students' learning outcomes following the implementation of small group discussion (SGD) in the Air Quality course. The mean score increased from 58.8 in the pretest to 83.1 in the posttest, with a mean gain of 24.3 points. The paired-samples t-test also indicated a statistically significant difference between the two measurements ($p = 0.003$), while the N-Gain value of 0.59 was classified as moderate. These results suggest that students demonstrated meaningful learning improvement after participating in SGD. However, because the study employed a one-group pretest–posttest design without a comparison group, the observed improvement should be interpreted as a change following the intervention rather than definitive evidence of a causal effect. The improvement is consistent with the broader evidence that active learning can support student achievement in higher education. Active learning

provides opportunities for students to engage with learning materials through discussion, explanation, questioning, and problem solving rather than primarily receiving information through lectures (Chi & Wylie, 2014; Doolittle et al., 2023). A meta-analysis of active learning in humanities and social sciences also reported higher learning achievement under active-learning approaches than under traditional lecturing, although the magnitude of improvement varied across contexts and instructional designs (Kozanitis & Nenciovici, 2023). From this perspective, the increase observed in the present study may be related to the opportunity for students to actively process and articulate concepts during group discussion.

The findings are also supported by evidence from Indonesian higher education, particularly within Geography education. Amaliya and Dewi (2022) reported the implementation of small group discussion through mobile learning in Geography instruction, demonstrating the applicability of group-based discussion to Geography learning. Similarly, Firmantika et al. (2023) developed Geography disaster-learning materials incorporating the SGD model for students in a higher-education context and found the resulting materials to be highly feasible according to expert and student evaluations. These studies provide contextual support that discussion-based learning can be incorporated into Geography education, while the present study extends this context to the Air Quality course and examines changes in students' test performance before and after the intervention.

The moderate N-Gain value ($g = 0.59$) is particularly important for interpreting the magnitude of improvement. The result indicates that the intervention was associated with a moderate level of learning improvement rather than a uniformly high gain among students. This finding is plausible because the effectiveness of collaborative learning depends not only on placing students into groups but also on how interaction within those groups is structured. Productive discussion requires students to explain ideas, respond to others, evaluate information, and construct shared understanding. Research on small-group interaction similarly indicates that student talk does not automatically become cognitively productive merely because students are working together (Wotring et al., 2024). Therefore, the moderate gain may reflect differences in participation, quality of interaction, and students' ability to use discussion for conceptual processing.



Figure 3. Classroom Learning Process (small group discussion)

Source: Documentation 2025

The role of instructional structure is particularly relevant in the present study. Collaborative learning can involve cognitive and socio-emotional challenges, including unequal participation, difficulties in coordinating ideas, and differences in students' engagement (Näykki et al., 2021; Poort et al., 2023). Socially shared regulation and appropriate scaffolding can help students coordinate their activities and maintain productive collaboration (Hogenkamp et al., 2021). In the context of the Air Quality course, these considerations are important because the subject involves interconnected concepts such as pollution sources, atmospheric processes, environmental impacts, monitoring, and pollution-control strategies. Group discussion can provide opportunities to connect these concepts through case analysis and peer explanation, but the quality of the learning process may depend on clear tasks, guiding questions, and lecturer facilitation.

The students' questionnaire results further support this interpretation. The overall positive response of 81.1% suggests that most students perceived SGD as a supportive learning approach, particularly in relation to engagement, collaboration, and conceptual understanding. Positive perceptions are consistent with literature describing active learning as an approach that can promote student participation and engagement

in higher education (Ribeiro-Silva et al., 2022). However, students' positive perceptions should not be interpreted as equivalent to maximal cognitive learning. Perceived engagement and learning outcomes represent related but distinct dimensions of the learning process. Thus, the questionnaire results complement rather than replace the evidence provided by the pretest–posttest scores.

The use of SGD may also be particularly appropriate for Geography courses because geographical learning frequently requires students to interpret environmental phenomena from multiple perspectives. In the Air Quality course, students may need to connect physical environmental processes with human activities, health implications, spatial conditions, and management responses. Discussion provides a setting in which these dimensions can be examined collectively. Evidence from Geography education in Indonesia supports the use of small-group discussion as a means of facilitating student participation, while the present findings indicate that such an approach can also be associated with measurable improvement in learning outcomes.

Nevertheless, the findings should be interpreted within the methodological limitations of the study. First, the one-group pretest–posttest design does not allow the improvement to be separated completely from other factors that may have influenced students' performance during the study period. Second, the N-Gain value should be interpreted descriptively because gain calculations can be affected by students' initial achievement levels (Westphale et al., 2022). Third, the questionnaire captures students' perceptions rather than direct evidence of the quality of interaction within each group. Future studies could therefore employ a quasi-experimental design with a comparison group, larger samples across different Geography courses, and additional observations of group interaction. Such designs would provide stronger evidence regarding how the structure, facilitation, and quality of SGD contribute to learning outcomes.

Overall, the findings indicate that SGD was followed by a substantial increase in students' Air Quality test scores, accompanied by a moderate normalized gain and predominantly positive student perceptions. The results support the use of small-group discussion as one active-learning strategy in Geography higher education, particularly when discussion is supported by clear tasks, meaningful environmental cases, guiding questions, and lecturer facilitation. The contribution of the present study lies in documenting this learning change specifically within an Air Quality course in a Geography Study Program, while also highlighting that the quality of implementation remains an important consideration when interpreting the learning outcomes.

CONCLUSION AND SUGGESTIONS

Conclusion

This study concludes that the implementation of the small group discussion method was followed by an improvement in students' learning outcomes in the Air Quality course. The mean score increased from 58.8 in the pretest to 83.1 in the posttest, with the paired-samples t-test indicating a statistically significant difference ($p = 0.003$). The N-Gain value of 0.59 indicated a moderate level of learning improvement, suggesting meaningful progress in students' learning across cognitive levels, including understanding, application, analysis, and evaluation. Students' perceptions of the learning process were also predominantly positive, with 81.1% of responses indicating favorable experiences related to engagement, collaboration, and conceptual understanding. Overall, the findings suggest that small group discussion can serve as an active-learning strategy for supporting learning improvement and positive learning experiences among Geography students in higher education, particularly when supported by structured activities and appropriate lecturer facilitation.

Suggestions

Based on the findings of this study, several recommendations are proposed. First, lecturers are encouraged to implement small group discussion in a structured manner by providing clear learning objectives, guided discussion tasks, and defined student roles to support active participation and cognitive engagement. Second, continuous facilitation and monitoring are recommended to help students engage in meaningful discussion and higher-order thinking rather than superficial interaction. Third, future studies should consider comparing small group discussion with other active-learning approaches, such as problem-based learning or debate-based instruction, using quasi-experimental or experimental designs with comparison groups to provide stronger evidence regarding learning outcomes. Finally, qualitative or mixed-methods research is recommended to examine student interaction, participation patterns, and group processes in greater depth.

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