JAMBURA GEO EDUCATION JOURNAL
P-ISSN: 2721-7000 | E-ISSN: 2721-7019
Volume 6 Number 2, September 2025, 101-115
Journal Homepage: http://ejurnal.ung.ac.id/index.php/jgej

Transformation of Geography Education Through Research-Based Learning: From Indonesia for A Global Pedagogical Model

Yuli Ifana Sari[1], Ika Meviana[1], Ravinesh Rohit Prasad[2], Linda Maulidiah[3]

[1]*Geography Education, Universitas PGRI Kanjuruhan Malang, Malang, Indonesia*
[2]*Fiji National University, Natabua Campus, Lautoka, Fiji*
[3]*Nanjing Normal University, Nanjing, China*

ARTICLE INFO

Article History:
Received: 2025-03-28
Accepted: 2025-08-09
Published: 2025-09-30

Keywords:
Academic Scientific Writing; Geography Pedagogy; Research-Based Learning

Corresponding author:
Yuli Ifana Sari
Email: ifana@unikama.ac.id
DOI: 10.37905/jgej.v6i2.31074

ABSTRACT

Although Research-Based Learning (RBL) is recognized for enhancing student competencies, empirical studies testing its specific efficacy on scientific writing skills within geography education, particularly in developing countries like Indonesia, remain scarce. This gap hinders the development of pedagogical models that can effectively prepare geography students to meet their academic and professional demands. Therefore, this study evaluated the impact of an RBL model on the scientific writing skills of undergraduate geography students at an Indonesian university. Using a quasi-experimental pre-test-post-test control group design, this study involved 55 undergraduate geography students. Scientific writing ability was evaluated using an analytical rubric, and supplementary data on critical thinking and motivation were collected to enrich the analysis of the results. The analysis revealed that the experimental group that received RBL treatment demonstrated a statistically significant improvement in scientific writing skills ($p < 0.05$) compared to the control group. This finding proves that RBL is effective in enhancing students' competence in formulating arguments, analyzing data, and presenting findings systematically. This study presents robust empirical evidence to support the integration of RBL into higher education geography curricula. The findings imply that RBL can serve as a global pedagogical model to bridge the gap between theoretical knowledge and practical application, thereby producing more competent graduate.

How to cite: Sari, Y. I., Meviana, I., Prasad, R. R., & Maulidiah, L. (2025). Transformation of Geography Education Through Research-Based Learning: From Indonesia for A Global Pedagogical Model. Jambura Geo Education Journal, 6(2), 101–115. https://doi.org/10.37905/jgej.v6i2.31074

1. Introduction

Geography education is undergoing a significant transformation owing to rapid advancements in scientific and technological domains. The integration of digital tools, such as Geographic Information Systems (GIS), remote sensing, and the utilization of extensive geospatial data, has revolutionized the study of geographic phenomena (Dritsas and Trigka, 2025). This transformation necessitates a shift in pedagogical approaches to facilitate the development of students' analytical, critical, and problem-solving skills (Rahimi and Oh, 2024). Traditional concept-based instruction is inadequate for equipping students to effectively address contemporary geographical challenges (Tsehay et al., 2024). Consequently, it is imperative to implement innovative pedagogical strategies to bridge the gap between theoretical comprehension and practical application of the subject matter.

In response to this requirement, numerous educators have adopted RBL as an instructional strategy that is both student-centered and inquiry driven. RBL facilitates student engagement with authentic research problems and the application of scientific methods in structured academic environments (Čubela et al., 2023). This model facilitates knowledge construction by learners through active exploration and reflection, thereby enhancing the meaningfulness of the learning process (Al-Thani and Ahmad, 2025b). Engaging in the research process affords students the opportunity to develop proficiency in data collection, analysis, and interpretation, which are essential to scientific reasoning (Adebisi, 2022). The acquisition of these competencies is intrinsically connected to the capacity to generate coherent and rigorous academic writing skills.

In various international contexts, RBL has been demonstrated to substantially enhanced student engagement, critical thinking, and academic writing skills. For example, in the United States, RBL implementation has bridged the gap between theoretical knowledge and practical application, encouraging students to take responsibility for their learning (Shohel et al., 2024). In Germany, empirical studies have indicated that students enrolled in courses utilizing RBL methodologies exhibit enhanced motivation and academic achievement, particularly in STEM disciplines (Thiem et al., 2023). The effectiveness of these implementations is attributed to their capacity to foster not only academic competencies but also personal

accountability in the learning process, as students become more proactive in influencing their educational outcomes (Yermekbayeva et al., 2024).

Scientific writing transcends language proficiency and encompasses the articulation of research findings with logical, methodological and theoretical precision. Students must effectively present their arguments within established academic frameworks to ensure transparency and validity in the research process (Toma et al., 2023). However, acquiring these writing skills typically requires structured mentorship and consistent practice (Oxford et al., 2023). Optimal learning is facilitated when students receive feedback, guidance, and support from instructors who serve as academic mentors (Afzaal et al., 2023). Academic apprenticeship is crucial for enhancing students' proficiency in scientific writing and critical thinking.

Despite the growing demand for 21st century skills, geography education worldwide continues to rely predominantly on traditional pedagogical models. These teacher-centered methodologies frequently prioritize rote memorization and theoretical abstraction, thereby constraining students' capacity to engage critically with real-world spatial phenomena (Burgos-Videla et al., 2025; Putra et al., 2023). Consequently, students often lack opportunities for experiential investigation, empirical analysis, and reflective thinking, which are critical skills for addressing complex geographic issues (Zhu et al., 2023). This stagnation in pedagogical approaches diminishes students' ability to learn meaningfully and authentically (Pokhrel and Chhetri, 2024). The gap between theoretical instruction and practical application continues to pose a significant challenge in geography education.

In Indonesia, the situation reflects these global trends but is further exacerbated by systemic limitations in curriculum design, academic mentorship, and institutional resources. Geography education is predominantly characterized by textbook-based instruction and standardized assessments, offering limited opportunities for research-oriented learning (Putra et al., 2023; Rasimin et al., 2024). Numerous students complete their education with limited experience in conducting and composing scientific research (Okochi et al. 2023). Moreover, scientific writing is infrequently incorporated as a fundamental element of geography curricula, leading to inadequacies in academic communication (Kim et al., 2023). Specific contextual constraints highlight the pressing need to implement pedagogical models such as RBL to address these gaps and enhance the quality of geography education in Indonesian universities (Utami et al., 2024).

Although the benefits of RBL have been acknowledged in general education, its specific application and impact on scientific writing in geography remain unknown. A significant research gap exists regarding the empirical validation of how RBL enhances scientific writing competence in the context of geography education. To address this gap, the present study examined the effectiveness of an RBL model implemented among geography students at an Indonesian university. The analysis also aimed to identify the challenges and opportunities of applying this model to higher-education settings. These findings are expected to inform the development of globally relevant pedagogical strategies for improving geography education in schools.

2. Method

The methodology describes the stages of research conducted in a structured manner to achieve the research objectives. Research methods must provide complete information about various aspects of the research process. The research method briefly and densely explains the research methods used, including the specifications of materials and tools, sampling techniques, measurement procedures, research designs, stages of work methods, parameters, and data analysis.

This study employed a quantitative methodology to investigate the effects of a research-based geography learning model on students' academic writing skills, utilizing a quasi-experimental pretest–post-test control group design (as illustrated in Figure 1). The selection of this design was motivated by the objective of evaluating the comparative impact of the RBL model, in contrast to traditional teaching methods (Anugraheni et al., 2025). This design facilitated a systematic comparison between an experimental group exposed to the RBL model and a control group that received traditional instruction (Leasa et al., 2025).

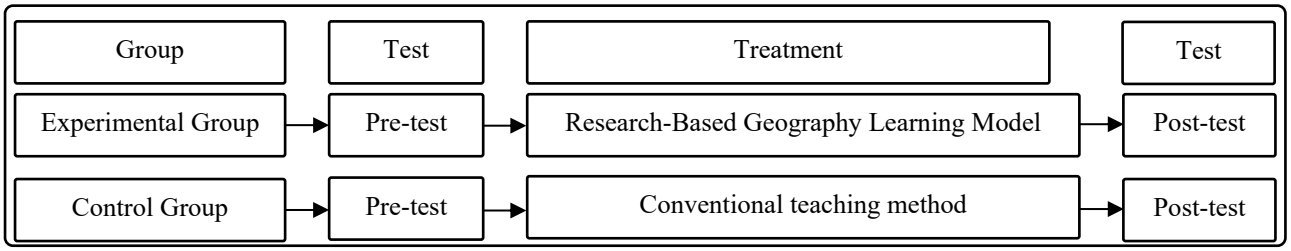

Figure 1. Research design

This study was conducted with a cohort of 55 undergraduate geography students enrolled at Universitas PGRI Kanjuruhan Malang, an Indonesian institution of higher education. The participants were allocated to two groups: an experimental group comprising 27 students and a control group comprising 28 students. Both groups were selected through purposive sampling to ensure comparability in terms of their academic background and enrollment in the same geography course. This sampling strategy was employed to minimize selection bias by ensuring that both groups had similar characteristics before the intervention commenced. All participants were informed of the study objectives and procedures, and written informed consent was obtained from each student to maintain ethical standards. Ethical approval for the study was obtained from the university's research ethics board prior to data collection, and the study adhered to the university's ethical guidelines for conducting research involving human participants.

The study was organized into three primary phases: planning, implementation, and evaluation (Figure 2). The study was conducted over a single academic semester, providing sufficient time for implementing and assessing the RBL intervention.

Figure 2. RBL framework phase

2.1. Planning phase

During the planning phase, instructional materials aligned with the RBL framework were developed to guide the learning process of the experimental group. The materials were designed to enhance student engagement through activities that promote inquiry, critical thinking and scientific writing. The materials included specific activities related to research formulation, data collection, data analysis, and scientific writing, each crafted to reflect the stages of an academic research project. In addition to the instructional content, the measurement tools were also finalized. The scientific writing rubric used for the pre- and post-assessments was meticulously designed to evaluate students' writing across several dimensions, including argumentation, methodology, data interpretation, and coherence. Furthermore, observation protocols for classroom engagement and semi-structured interview guidelines were established to ensure consistency in data collection. Prior to the study, the instruments were piloted with a small group of students to ensure clarity, reliability, and validity.

2.2. Implementation phase

The implementation phase comprised eight structured sessions conducted throughout the semester, each dedicated to a distinct component of the RBL process. The sessions encompassed the following elements: 1) research formulation, in which students were introduced to research questions and hypotheses pertinent to geography and guided through the process of designing a research proposal; 2) data collection, during which students engaged in data collection activities, including fieldwork and secondary data acquisition relevant to the geographical topics under study; 3) data analysis, where students were instructed to analyze their collected data using both qualitative and quantitative methodologies; and 4) scientific writing, which provided guidance on composing scientific papers, with an emphasis on structuring arguments, presenting findings, and adhering to academic conventions in geography.

Periodic monitoring was conducted throughout the implementation phase to ensure instructional consistency and to assess the level of student engagement. This monitoring also verified that the students in the experimental group actively participated in the RBL activities, whereas the control group received traditional lecture-based instruction focused on conceptual understanding without applying the research process.

2.3. Evaluation phase

The concluding phase of the study, the evaluation, focused on examining the intervention outcomes. Both the experimental and control groups underwent pre- and post-assessments using a standardized scientific writing rubric. These assessments evaluated the enhancement of students' academic writing skills, particularly in structuring research arguments, analyzing data, and formulating evidence-based conclusions. Classroom

observations were conducted to evaluate student engagement during the learning process. The observational data focused on factors such as participation in discussions, curiosity levels, and critical thinking during the sessions. Semi-structured interviews were conducted with a selected sample of students from the experimental group to obtain qualitative insights into their experiences with the RBL process. The interviews explored the students' perceptions of the RBL model, challenges they encountered, and their overall satisfaction with the learning method.

The quantitative data obtained from the pre- and post-tests were analyzed using paired-sample t-tests and independent-sample t-tests to ascertain the statistically significant differences between the two groups. A paired-samples t-test was used to evaluate changes within the experimental and control groups, whereas an independent-samples t-test was used to compare the performance of both groups after the intervention. Statistical analyses were performed using the SPSS software to derive robust conclusions regarding the efficacy of the RBL model. In addition to the quantitative analysis, qualitative data from semi-structured interviews and classroom observations were analyzed using a thematic analysis. This method involved coding interview transcripts and observation notes to identify recurring themes related to students' learning experiences, challenges, and perceptions of the RBL model (Marsidi et al., 2024). A thematic analysis was conducted using NVivo software to systematically organize and code the data, thereby yielding deeper insights into students' academic development and engagement throughout the RBL intervention. To ensure the validity and credibility of the findings, triangulation was employed by integrating the quantitative and qualitative data.

3. Results and discussion

3.1. Results

3.1.1 Quantitative profile of scientific writing skills: a comparative descriptive analysis of writing skills

The descriptive statistics presented in Table 1 offer significant insights into the pre- and post-test performances of both the experimental and control groups. For the experimental group, the pre-test scores had a mean of 65.33 (SD = 0.92), reflecting a moderate initial level of scientific-writing skills. Following the RBL intervention, the post-test mean increased to 85.67 (SD = 1.39), indicating substantial improvement. The larger standard deviation in the post-test (1.39) compared to the pre-test (0.92) suggests increased variability in post-test scores, implying that while most students demonstrated improvement, there was also greater divergence in the extent of their progress. These results underscore the effectiveness of RBL in enhancing students' writing skills, with notable growth in individual performance within the experimental group.

Table 1. Descriptive statistics result

	Pre-test Experiment	Post-test Experiment	Pre-test Control	Post-test Control
Valid	27	27	28	28
Missing	83	83	82	82
Mean	65.333	85.667	64.393	74.821
Std. Error of Mean	0.177	0.267	0.195	0.212
Std. Deviation	0.920	1.387	1.031	1.124
Coefficient of variation	0.014	0.016	0.016	0.015
Shapiro-Wilk	0.865	0.951	0.876	0.917
P-value of Shapiro-Wilk	0.002	0.223	0.003	0.029
Minimum	64.000	83.000	63.000	73.000
Very Steep	67.000	89.000	66.000	77.000

Source: Analysis Results

In the control group, the pre-test mean was 64.39 (SD = 1.03), which was marginally lower than that of the experimental group but remained within a comparable range. The post-test mean for the control group increased to 74.82 (SD = 1.12), indicating improvement, albeit less pronounced than that observed in the experimental group. The standard deviation for the control group post-test was also higher than the pre-test value, suggesting a slight increase in the score variability. Nevertheless, the overall increase in the control group was smaller than that in the experimental group, implying that the traditional teaching methods employed in this group were less effective in enhancing students' scientific writing skills. This finding reinforces the conclusion that RBL has a substantial impact on improving students' writing performance.

The Shapiro-Wilk test for normality provided additional insights into the data distributions within both groups. In the experimental group, the pre-test data did not satisfy the assumption of normality ($p = 0.002$), indicating a departure from normal distribution. Conversely, the post-test data for the experimental group were normally distributed ($p = 0.223$), which enhanced the reliability of the post-test results for the subsequent

statistical analyses. Similarly, in the control group, the pre-test data exhibited a significant deviation from normality ($p = 0.003$), whereas the post-test data approached normality ($p = 0.029$). Despite these deviations, the application of parametric tests, such as the paired-samples t-test, remains appropriate, as these tests are robust against minor deviations from normality, facilitating meaningful comparisons between pre- and post-test scores.

A comparative analysis of the mean improvements between the two groups revealed the differential effects of the interventions. The experimental group exhibited a mean improvement of 20.34 points, increasing from 65.33 in the pre-test to 85.67 in the post-test, indicating a significant enhancement in writing skills. Conversely, the control group experienced a modest improvement, with a mean increase of 10.43 points (from 64.39 to 74.82). This substantial disparity in improvement underscores the assertion that RBL is more effective than traditional teaching methods in cultivating critical academic skills, such as scientific writing. The larger effect size observed in the experimental group suggests that the RBL intervention resulted in not only statistically significant but also practically meaningful improvements.

The data derived from both the experimental and control groups highlighted the efficacy of RBL in enhancing students' academic writing skills. The experimental group demonstrated a significant improvement in terms of mean scores and variability, indicating that RBL facilitated a more substantial development of scientific writing skills than the traditional methods employed in the control group did. The Shapiro-Wilk test confirmed that, despite minor deviations from normality in the pre-test data, the post-test results were reliable and normally distributed. The greater mean improvement and effect size observed in the experimental group further underscore that RBL is an effective pedagogical tool for enhancing scientific writing skills (Sari et al. 2021). The findings offer significant insights into the effective implementation of RBL in geography education, facilitating the integration of theoretical knowledge with practical applications and enhancing students' preparedness for both academic and professional endeavors.

3.1.2 Analytical shifts in scientific writing: insights from the experimental group

The Shapiro-Wilk test for normality (Table 2), which evaluates whether the data conform to a normal distribution, yielded noteworthy results for both pre- and post-test scores. For the post-test experimental group, the Shapiro-Wilk statistic was 0.759, with a p-value < 0.001, indicating a significant deviation from normality in the post-test data. This suggests that, although the distribution of the post-test scores was not perfectly normal, the deviation was likely to be minor. Despite this violation of normality, the paired-samples t-test, which is robust to slight deviations from normality, remains appropriate in this context because it effectively accommodates such discrepancies. Furthermore, this finding indicates that while the post-test scores may not fully adhere to a normal distribution, the intervention's impact on the experimental group remains statistically significant, and non-normality does not undermine the conclusions drawn from subsequent analyses.

In the pre-test data, the deviation from normality was significant ($p < 0.001$). This indicates that the pre-test scores for the experimental group did not follow a normal distribution, potentially because of the variability in students' initial writing skills. It is common for pre-test data to display a non-normal distribution, particularly when evaluating heterogeneous groups of students across various academic levels. Nevertheless, this issue was addressed in the statistical analysis using parametric tests, which are generally robust to such deviations when the sample sizes are sufficiently large, as in this study.

Table 2. Test of normality (shapiro-wilk)

	W	p
Pretest Experiment - Posttest Experiment	0.759	< .001

Note: Significant results suggest a deviation from normality
Source: Analysis Results

Levene's test for the equality of variances (Table 3), which evaluates whether the variances between the two groups are equivalent, yielded an F-value of 3.316 and a p-value of 0.074. This indicates that there was no statistically significant difference in the variances between the pre- and post-test scores of the experimental group, as the p-value surpassed the 0.05 threshold. Therefore, we can conclude that the assumption of homogeneity of variances is upheld, thereby justifying the application of parametric tests in the further analyses. The assumption of equal variances is crucial for the validity of paired-samples t-tests and further substantiates the argument that the observed improvements in scientific writing skills were attributable to the RBL intervention.

Table 3. Test for equality of variances (levene's)

F	df1	df2	p
3.316	1.000	52.000	0.074

Source: Analysis Results

The paired-samples t-test (Table 4) yielded a t-value of -170.364 with a p-value < 0.001, signifying a statistically significant difference between the pre- and post-test scores. The mean score for the experimental group significantly increased from 65.33 (SD = 0.92) to 85.67 (SD = 1.39), indicating a mean improvement of 20.34 points. This enhancement underscores the substantial positive impact of the RBL model on students' scientific writing abilities. The large effect size, calculated using Cohen's d (d = 32.787), far exceeded the threshold of 0.8, which is typically considered to be indicative of a large effect. This finding suggests that the observed improvement in scientific writing skills within the experimental group was not only statistically significant but also practically meaningful, further corroborating the efficacy of the RBL approach in facilitating significant advancements in students' academic writing capabilities (Hanun et al., 2025).

Table 4. Paired samples t-test result

Measure 1	Measure 2	T	df	p	Cohen's d	SE Cohen's d
Pretest Experiment	Posttest Experiment	-170.364	26	<.001	-32.787	1.614

Note: Student's t-test.
Source: Analysis Results

The substantial effect size underscored the remarkable and consistent improvement in students' writing skills across participants, indicating that the RBL intervention facilitated significant academic advancement. The pronounced difference between the pre- and post-test scores further corroborates the efficacy of RBL as a pedagogical tool for enhancing scientific writing, which necessitates the critical organization and presentation of research findings (Sharma and Sharma, 2024). Given the significance of these skills in both academic and professional contexts, the data strongly indicate that RBL constitutes an effective approach to enhance students' capacity to write in a scientific and systematic manner. The improvements observed are essential for equipping students to undertake more complex academic and professional tasks that demand advanced analytical and writing skills.

The results of the paired-samples t-test, in conjunction with effect size and normality assessments, substantiate the hypothesis that RBL significantly enhances students' scientific writing ability. These findings are consistent with prior research, which suggests that active, research-oriented learning environments can promote academic development and enhance critical thinking and problem-solving skills, both of which are crucial in geography (Adhami and Taghizadeh, 2024; Thiem et al., 2023). The significant advancements in writing and large effect sizes underscore the practical significance of RBL as an effective model for enhancing academic writing in higher education.

3.1.3 Assessing learning efficiency using N-Gain in RBL context

To further assess the efficacy of the RBL intervention, an N-Gain score was calculated to provide a clearer understanding of the improvement in students' scientific writing skills (Table 5). The mean N-Gain score for the experimental group was 0.59, which falls within the medium effectiveness range ($0.3 \leq g \leq 0.7$), indicating a moderate-to-substantial enhancement in learning. The N-Gain percentage of 58.72%, as presented in Table 5, suggests that nearly 60% of the potential improvement in students' writing performance was achieved through the RBL intervention. This serves as a robust indicator of the effectiveness of the RBL model in enhancing students' academic writing skills, as the score aligns with the practical application of the intervention.

Table 5. N-gain score analysis

N-Gain	N	Minimum	Maximum	Mean	Std. Deviation	Description
N-Gain Score	27	0.53	0.67	0.59	0.02	Medium
N-Gain Percen	27	52.78	66.67	58.72	2.96	Effective enough

Source: Analysis Results

Although the paired-samples t-test confirmed that the RBL intervention significantly enhanced students' writing skills, the N-gain score offered further insight into the practical implications of these findings. The N-gain score serves as a valuable metric by contextualizing the effect size in terms of real-world academic performance, thereby providing a deeper understanding of the extent to which potential improvements were realized. The moderate to substantial N-Gain value indicates that the RBL model was not only statistically significant but also practically meaningful in enhancing students' writing abilities. This finding reinforces the

argument that the RBL approach has a notably positive impact, resulting in tangible improvements in students' skills.

The N-Gain analysis results bridge the gap between statistical significance and practical applicability. While the t-test confirmed the statistical reliability of the RBL model, the N-gain score quantified the actual improvement, offering a more comprehensive evaluation of the intervention's effectiveness. This 58.72% improvement suggests that RBL exerts a moderate-to-high impact on students' ability to articulate their thoughts clearly and coherently in scientific writing. These findings are particularly significant in the context of geography education, where the capacity to synthesize data, present coherent arguments, and draw evidence-based conclusions is essential for academic and professional success.

Furthermore, the N-gain percentage offers valuable insights into the potential scalability of the RBL model across diverse institutions and contexts in Indonesia. If widely implemented, RBL could result in comparable enhancements in scientific writing across various academic environments, thereby improving student performance and elevating the overall standard of academic writing in geography. Consequently, the N-gain score underscores the efficacy of RBL as a pedagogical tool capable of enhancing academic competencies, particularly in geography education. This finding is consistent with prior research that has demonstrated the effectiveness of active RBL in bolstering students' academic skills and critical-thinking abilities (Sherazi and Khan, 2025).

3.1.4 Comparative analysis of writing skill gains between rbl and conventional groups

The analysis of the experimental group's pre- and post-test scores demonstrated a significant enhancement in students' scientific writing skills following their engagement with the RBL model. The Shapiro-Wilk test for normality (Table 6) indicated that the post-test data were normally distributed ($p = 0.223$), whereas the pre-test data did not satisfy the normality assumption ($p = 0.002$). Nevertheless, given that the paired-samples t-test is recognized for its robustness against minor deviations from normality, particularly with sample sizes of 27 (as in this instance), the test remains valid for evaluating the differences in pre- and post-test scores. This underscores the reliability of the statistical analysis and confirms that the observed results are meaningful, despite the slight non-normality of the pre-test data.

Table 6. Test of normality (shapiro-wilk)

		W	p
Result	Experiment	0.951	0.223
	Control	0.913	0.028

Source: Analysis Results

Further statistical analysis of the variances between the pre- and post-test scores, conducted using Levene's test ($F = 1.431$, $p = 0.237$, Table 7), indicated that the variances were equivalent across the two datasets. This equivalence is a critical assumption for parametric tests, such as the paired-samples t-test, which ensures that the analysis does not violate any underlying statistical assumptions related to the variance distribution. Consequently, the results of the paired-samples t-test can be deemed valid, providing a robust foundation for confirming the effectiveness of RBL in enhancing students' academic-writing skills.

Table 7. Test of equality of variances (levene's)

	F	df1	df2	p
Result	1.431	1	52	0.237

Source: Analysis Results

Although the post-test data for the control group did not satisfy the assumption of normality (Shapiro-Wilk $p = 0.028$), Levene's test for equality of variances confirmed homogeneity between the variances of the two groups ($p = 0.237$), thereby justifying the application of parametric tests for this analysis. Although the control group exhibited some improvement in writing performance, it was markedly inferior to the experimental group, underscoring the superior efficacy of the RBL intervention in enhancing scientific writing skills. The significant disparity in post-test scores between the two groups further underscores the effectiveness of RBL in bridging the gap between theoretical understanding and practical application of the knowledge acquired (Yermekbayeva et al., 2024). The experimental group's engagement with active research tasks, data analysis, and systematic scientific writing significantly enhanced their capacity to present coherent and well-structured academic arguments.

An independent samples t-test was conducted to compare the post-test writing scores of the experimental and control groups (Table 8). The results indicated that the experimental group significantly outperformed the control group, with a t-value of 31.375, degrees of freedom (df) of 52, and a p-value of $< .001$, indicating a

highly significant difference between the two groups. This substantial statistical difference underscores the effectiveness of the RBL intervention in enhancing scientific writing skills. The experimental group, which was exposed to the RBL model, demonstrated a markedly stronger improvement in academic writing skills than the control group, which underwent conventional teaching. The large effect size, calculated using Cohen's d (8.539), reinforces the strength of the RBL intervention, far exceeding the commonly accepted threshold of 0.8 for a large effect. This highlights the practical significance of RBL, not only in a statistical sense but also in real-world academic improvement, suggesting that the RBL model has a substantial impact on students' learning outcomes and academic performance.

Table 8. Independent samples t-test result

	T	df	p	Cohen's d	SE Cohen's d
Result	31.375	52	<.001	8.539	1.193

Note: Student's t-test.
Source: Analysis Results

A comparative analysis of the two groups indicated that the RBL approach conferred significant educational benefits compared to traditional methods that frequently emphasize passive learning, such as textbook study and lectures. These results align with the extant literature advocating for student-centered learning models that prioritize active engagement and research-based methodologies (Hanun et al., 2025; Sharma and Sharma, 2024). The experimental group, which had increased opportunities for hands-on research, was more adept at developing writing skills through consistent practice in constructing arguments, interpreting data, and engaging in scholarly communication. In contrast, despite receiving traditional instruction, the control group did not exhibit the same level of engagement or development of essential academic skills.

The findings further emphasize the significance of experiential learning and its efficacy in enhancing writing proficiency, as evidenced by the considerable disparity in performance between the experimental and control groups in the post-test results. R RBL not only facilitates the acquisition of theoretical knowledge but also augments students' ability to apply this knowledge effectively through research tasks, resulting in substantial improvements in academic writing (Yermekbayeva et al., 2024). This finding indicates that RBL can be extensively implemented as an effective pedagogical approach, especially in disciplines such as geography education, where the development of practical research skills is essential for achieving success in both academic and professional contexts.

3.2. Discussion

3.2.1 Enhancing higher-order thinking skills through rbl implementation

The implementation of RBL has been shown to significantly enhance students' critical and analytical thinking skills. Through RBL, students are encouraged to actively engage with research problems, thereby developing their ability to formulate clear research questions and organize their findings into coherent and evidence-based arguments (Nicholus et al., 2023). This approach is consistent with the fundamental objectives of geography education, which emphasizes inquiry-based learning and comprehension of spatial phenomena through empirical evidence (Ardiansyah et al., 2024). Engaging in the resolution of real-world problems enhances students' writing proficiency and capacity for critical thinking and evidence evaluation (Nam et al., 2024). Cognitive abilities are fundamental to students' academic development and are crucial for addressing complex geographical challenges.

In addition to theoretical instruction, RBL requires students to actively engage in the application of research methodologies. This experiential approach enhances students' ability to synthesize information from diverse sources and apply it to practical situations. This approach fosters the integration of theoretical knowledge with practical applications, thereby promoting a more profound understanding of how data and evidence can be used to address geographical challenges (Paul et al., 2024). Through participation in real-world research, students develop the ability to critically analyze data, discern patterns and formulate conclusions based on empirical evidence (Mansilla et al., 2024). Engagement in practical experiences not only enhances students' academic competencies but also equips them to navigate the professional challenges they will encounter post-graduation. The capacity to analyze complex data and articulate well-substantiated arguments is highly esteemed in disciplines such as urban planning, environmental conservation, and disaster management.

Critical thinking and analytical skills cultivated through RBL are transferable across various disciplines, rendering them indispensable in both academic and professional contexts. Students who participate in RBL acquire problem-solving abilities applicable to a broad spectrum of professions, particularly in geography and related fields. The capacity to evaluate data, construct logical arguments, and draw evidence-based conclusions is fundamental to professional success in domains such as policy-making, urban planning, and environmental

research (Sherazi and Khan, 2025). Therefore, RBL not only enhances academic writing but also equips students with the exigencies of the contemporary workforce, where critical thinking, data analysis, and effective communication are essential for addressing global challenges (Yemini et al., 2025). Incorporating these competencies ensures that students are adequately prepared for academic and professional development.

3.2.2 Comparative synthesis: linking study outcomes to prior evidence

The results of this study are consistent with previous research, underscoring the efficacy of RBL in enhancing students' academic writing skills across various disciplines. For example, An et al. (2023) demonstrated that students who participated in structured research tasks exhibited notable enhancements in writing clarity, argumentation, and critical thinking. These skills are essential for producing high-quality academic work. Similarly, Zhang et al. (2023) found that students participating in RBL not only demonstrated improved writing performance but also achieved a deeper understanding of the subject matter by applying research methodologies to real-world problems. These studies consistently highlight the importance of experiential learning in enhancing students' ability to produce well-structured academic texts through problem solving and evidence-based reasoning.

This study contributes to the field of geography education by offering empirical evidence from Indonesia, demonstrating how RBL enhances the scientific writing skills of geography students (Hawa et al., 2021). In contrast to conventional methodologies that emphasize theoretical instruction, RBL engages students in practical applications, facilitating the development of both discipline-specific competencies and transferable critical thinking skills. This study not only supports the conclusions of prior research but also underscores the potential of RBL to bridge the divide between theoretical knowledge and practical application in fields such as geography, where students are tasked with analyzing spatial data, synthesizing information, and formulating evidence-based conclusions (Oktavianto et al., 2022).

Moreover, the applicability of RBL as an educational model has been substantiated by its implementation across various disciplines and cultural contexts. As demonstrated in prior research, the beneficial effects of RBL extend beyond academic writing, encompassing the broader enhancement of problem-solving, data analysis, and research skills (Bowyer et al., 2022). The demonstrated success of RBL in enhancing academic writing in geography education, as evidenced by this study, indicates that the model can be adapted to address educational challenges across disciplines in the future. This study contributes to the expanding body of literature on pedagogical innovation and posits that RBL is a promising model for promoting active learning and critical thinking not only within geography but also across a range of other academic contexts.

3.2.3 Theoretical perspectives informing rbl practices

The efficacy of RBL in this study is robustly supported by several well-established educational theories. From the perspective of constructivist learning theory, students are regarded as active participants in their learning process, constructing knowledge through direct experience and interaction with their environments. RBL offers a structured framework that encourages students to engage in hands-on research, thereby enabling them to engage meaningfully and contextually (Nurhuda et al., 2023). This theory underscores the fact that learners do not passively assimilate information; rather, they actively construct their understanding by interpreting real world phenomena. This is particularly pertinent in the field of geography, where the application of theoretical concepts to spatial data and environmental issues is essential. The emphasis of RBL on active learning aligns seamlessly with the principles of constructivism, as students acquire knowledge through direct engagement with content and through problem-solving tasks.

Vygotsky's sociocultural theory, particularly the concept of the Zone of Proximal Development (ZPD), offers a robust theoretical framework for RBL. According to Vygotsky, learners can attain a more profound understanding when guided through complex tasks by knowledgeable peers or mentors (Taber, 2025). This instructional support, commonly called scaffolding, facilitates students' progression beyond their existing capabilities, enabling them to attain higher levels of proficiency. Within the framework of this study, lecturer guidance serves as a crucial scaffold, empowering students to exceed their initial abilities and effectively engage in research and in academic writing. This process is vital for developing critical thinking and academic skills, as it challenges students to acquire knowledge and apply it in a structured and analytical way (Xue, 2023). In the field of geography, this implies that students are more adept at analyzing complex data sets, interpreting spatial phenomena, and generating robust research findings.

Moreover, experiential learning theory provides a significant framework for understanding RBL effectiveness. According to Kolb's experiential learning cycle, optimal learning occurs when students engage in a four-stage process: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Hung et al., 2023). RBL exemplifies this cyclical process by offering students the opportunity

to engage in authentic research experiences (concrete experience), reflect on their findings (reflective observation), integrate theoretical knowledge with practical applications (abstract conceptualization), and pursue further inquiry (active experimentation) (Yu et al., 2024). Through engagement in this iterative process, students can enhance their comprehension of geographical concepts and improve their academic writing skills, which require continuous practice and reflection. This alignment between RBL and experiential learning theory highlights the holistic approach of RBL in fostering students' cognitive, analytical, and writing abilities.

The integration of constructivism, Vygotsky's sociocultural theory, and experiential learning theory forms a robust theoretical framework underpinning the efficacy of RBL in advancing scientific writing and critical thinking skills. The amalgamation of active participation, guided support, and real-world experience ensures that students meaningfully acquire and apply their knowledge (Tan and Huet, 2021). These theoretical foundations are particularly significant in geography education because they enable students to integrate theoretical concepts with practical applications, thereby equipping them to address complex global challenges.

3.2.4 Implementation barriers in rbl pedagogy

Although RBL offers numerous advantages, its implementation is accompanied by considerable challenges. The primary difficulty reported by students was time management, particularly in balancing the demands of research projects with other academic responsibilities. Many students find it challenging to allocate sufficient time for the extensive data collection and analysis required for RBL tasks (Ahel and Schirmer, 2022). Moreover, students frequently encounter difficulties in accessing pertinent academic literature, particularly when institutional resources, such as access to databases and journals, are constrained. These obstacles can impede the research process and potentially delay project completion, thereby adversely affecting students' capacity to fully engage with the RBL model.

Another significant challenge is the insufficient instructional support during the pivotal stages of the research process, particularly during the data analysis and interpretation phase. Although RBL promotes autonomous learning, students may still require guidance from lecturers to effectively navigate complex research tasks. The role of lecturers as facilitators is crucial to ensure that students not only complete their projects but also acquire requisite research skills (Sjølie et al., 2021). Structured mentorship and academic scaffolding are essential for enabling students to surpass their initial capabilities, particularly when confronted with complex tasks such as formulating research questions, analyzing data, and drawing evidence-based conclusions (Copper and Bolger, 2024). In the absence of sufficient support, students may experience feelings of being overwhelmed and uncertainty regarding the quality of their work, which may diminish the efficacy of RBL overall.

Furthermore, the insufficiency of resources, including access to advanced research tools such as Geographic Information System (GIS) software and data analysis programs, exacerbates these challenges. Numerous institutions continue to encounter financial and logistical constraints that restrict students' access to technological tools essential for conducting high-quality research. To overcome these obstacles, it is imperative to ensure that future RBL programs are supported by improved resource allocation and faculty development initiatives. By equipping lecturers with the necessary training and resources, institutions can ensure that they are adequately prepared to support students throughout the RBL process (Leasa et al. 2025). Moreover, improving access to academic literature and research tools could significantly enhance the overall quality and efficacy of RBL, thereby establishing it as a more successful pedagogical model for teaching and learning.

3.2.5 RBL-Driven insights for educators and academic program development

The findings of this study have substantial implications for educators and curriculum developers. This study underscores the essential role of incorporating authentic research activities into the curriculum to enhance students' academic writing skills and critical thinking abilities. By engaging students in real-world research, educators can facilitate the development of practical skills such as data analysis, problem-solving, and evidence-based argumentation, which are crucial for academic success and professional advancement (Al-Thani and Ahmad, 2025a). These findings underscore that active participation in research facilitates deeper learning, encourages independent thought, and equips students to address complex issues that transcend theoretical concepts of the curriculum. To accomplish this, educators must be provided with the necessary tools and strategies to support student-centered learning, which can be realized through well-structured RBL activities (Hidayanto et al., 2025).

Institutions should prioritize the professional development of faculty by investing in training programs designed to prepare lecturers for the effective implementation of RBL. These programs should focus on equipping instructors with essential pedagogical skills, including the ability to provide meaningful mentorship and academic scaffolding throughout the research process (Uzorka et al. 2023). Equipping lecturers with the

necessary resources and support is essential for effectively guiding students and ensuring the successful implementation of RBL in the curriculum. This approach enables students to maximize their educational experience. Additionally, faculty development programs should incorporate training in the assessment of RBL outcomes, as these activities require distinct evaluation techniques compared with traditional teaching methods. Such targeted support can ultimately facilitate the seamless integration of RBL into university curricula, thereby enhancing the quality of education and ensuring that students acquire transferable skills essential for the workforce.

At the policy level, higher education authorities must consider the broader promotion of RBL by integrating it into curriculum design and allocating resources for instructional innovation (Sanders and Mukhari, 2023). It is essential to develop curricular frameworks that explicitly incorporate RBL activities across disciplines. Furthermore, policymakers should advocate for increased funding to ensure that institutions have access to the necessary technological resources and research tools, such as GIS software and academic databases, which are crucial for conducting high-quality research. By fostering an institutional culture that values and supports RBL, higher education systems can enhance not only academic outcomes but also graduates overall competence. As the global demand for critical thinkers and problem solvers continues to rise, universities must equip students with the skills and knowledge required to succeed in a rapidly evolving world.

3.2.6 Institutional and policy recommendations for scaling RBL

To ensure the sustained success of RBL, it is imperative for educational institutions to systematically integrate this model into their curricula. This integration begins with the development of modules that incorporate research tasks aligned with real-world issues, particularly in disciplines such as geography, where students are required to apply theoretical knowledge to practical challenges such as urban planning or environmental management. By embedding research-based assignments into core courses, institutions can provide students with opportunities to engage in problem-solving and critical thinking within structured learning environments (Copper and Bolger, 2024). This will not only enhance students' writing and analytical skills but also equip them with the capacity to apply their knowledge to effectively address real-world challenges.

In addition to curriculum design, targeted training of educators is imperative to ensure the successful implementation of RBL. Educators must be equipped with the necessary skills to facilitate RBL, including guiding students through the research process, offering constructive feedback, and providing academic scaffolding to support the progressive development of their skills (Uzorka et al., 2023). Faculty development initiatives should prioritize enhancing instructors' competencies to evaluate research outputs effectively and provide continuous support throughout the research process. These training programs should also encompass the integration of digital tools and research methodologies, ensuring that faculty members are proficient in contemporary technologies and pedagogical strategies to optimize the impact RBL on student learning outcomes (Zhang and Yan, 2023).

At the policy level, institutions must collaborate closely with policymakers to secure institutional support for the expansion of RBL across various departments. This support should encompass sufficient funding for research tools, the integration of technology, and the provision of library resources necessary for students to conduct high-quality research (Sanders and Mukhari, 2023). Institutions should prioritize fostering an environment that supports collaborative learning by establishing partnerships with local communities, businesses and government agencies. Such collaborations can offer students access to real-world data and field-based research opportunities, thereby enhancing the relevance of their research (Khuvasanond and Chitradub, 2025). Regular assessment of RBL implementation is crucial to ensure adaptability and ongoing enhancements. This process may involve gathering feedback from both students and faculty members and evaluating the effectiveness of RBL interventions across various educational settings to refine and adjust the model.

By implementing these systemic recommendations, RBL can evolve into a sustainable and scalable model that enhances academic quality not only in geography education but also across various academic disciplines. Ultimately, these initiatives empower students to become independent thinkers and adept problem solvers, equipping them to address the challenges of a rapidly changing world. Consequently, RBL has the potential to play a pivotal role in shaping the future of higher education by producing graduates who are better prepared to contribute to global challenges and succeed in professional environments.

4. Conclusion

This study unequivocally demonstrated the efficacy of RBL as a pedagogical strategy for enhancing scientific writing skills among geography students in higher education institutions. The incorporation of authentic research tasks, ranging from the formulation of research questions to data analysis and drafting of research articles, has been shown to catalyze the development of essential academic skills, including critical thinking, analytical reasoning, and academic communication. By directly engaging students in real-world research processes, RBL facilitates a deeper comprehension of geographic theories and their practical applications. This experiential learning approach is instrumental in bridging the gap between theoretical knowledge and practical output, thereby making academic learning more relevant and aligned with real-world challenges in the field.

The influence of the RBL model extends beyond cognitive and academic enhancement, significantly augmenting students' motivation and engagement. Observational data and semi-structured interviews indicated that students engaged in the RBL model exhibited increased confidence in their academic capabilities, particularly in terms of scientific writing. This confidence, which is essential for academic success and persistence, was positively affected by the student-centered nature of RBL, which enabled students to explore topics of personal and academic interest in their projects. This improvement in motivation and engagement is a critical factor in promoting sustained academic performance, especially in disciplines such as geography where problem-solving and critical analysis are paramount.

This study offers significant empirical evidence supporting the integration of RBL in geography education, affirming its potential to enhance academic quality and equip students for future professional challenges. The findings underscore RBL as a holistic educational approach that not only enhances students' writing proficiency but also cultivates essential professional skills, such as data analysis, research methodologies, and evidence-based decision-making. By fostering an environment in which students actively engage in research, RBL promotes deeper learning that transcends rote memorization and passive learning. This approach enables students to construct knowledge through inquiry and reflection, which are crucial for developing their capacity to address complex geographic issues within an interdisciplinary framework.

This study makes a significant contribution to the existing body of literature by addressing a notable gap in the role of RBL in geography education. While the majority of the literature on RBL emphasizes general academic enhancement, there is a paucity of research specifically examining its application within geography, a field that necessitates both theoretical comprehension and practical implementation. The findings of this study are adaptable to analogous educational contexts, particularly in disciplines that prioritize research and data-driven decision-making. Moreover, this study advocates for the systematic integration of RBL into university curricula to ensure sustained success. For such integration to be effective, it is imperative to provide adequate resources, including access to technology, research tools, and academic databases. Additionally, faculty development programs are crucial for equipping instructors with the necessary skills to guide students effectively through the research process.

At the policy level, educational authorities should prioritize RBL by advocating its integration into curriculum design and supporting the infrastructure necessary for its effective implementation. This entails allocating funding for instructional innovation, ensuring access to digital tools, and promoting faculty development programs to enhance instructors' capacity to support RBL initiatives. The widespread adoption of RBL across higher-education institutions would not only enhance students' academic performance but also equip them to address the global challenges of the future. By emphasizing research-driven learning, students are endowed with critical thinking skills that are essential for success in rapidly evolving professional environments.

Future research should investigate the longitudinal effects of RBL to evaluate its efficacy over time and across various educational levels. Additionally, it would be beneficial to examine the applicability of RBL in disciplines beyond geography, particularly those that emphasize critical thinking, research, and writing. Exploring the potential for interdisciplinary RBL is a valuable area for further investigation. Finally, future studies should address the challenges and limitations that institutions encounter when implementing RBL, and offer recommendations for overcoming these obstacles.

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