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Project-Based Learning via the BROSING Model: Boosting Article Publication Rates among University Students

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ABSTRACT
Many university students struggle with the complexities of scientific writing, which can lead to low publication rates. While Project-Based Learning (PjBL) is effective, specific frameworks to guide the technical publication process are scarce. This study empirically investigates the impact of the PjBL-integrated BROSING model—comprising Bibliographic exploration (B), Research synthesis (R), Objective examination (O), Study analysis (S), Idea generation (I), Narrative development (N), and Goal-driven publishing (G)—on enhancing students' scientific article output. A multi-site, single-group pre-test/post-test study was conducted with 142 undergraduate students across four universities in the Riau Islands, Indonesia. Data were collected via a validated perception questionnaire and performance-based writing tests, which were analyzed using paired samples t-tests. Results showed a significant increase in scientific writing scores, with the mean rising from a baseline. Beyond score improvements, the intervention successfully narrowed the proficiency gap and facilitated the publication of 36 scholarly articles in national journals and proceedings. These findings strongly suggest that the BROSING model fosters systematic writing habits and reduces the publication barrier by providing a structured, digitalized pathway for students to transition from readers to published authors. This model is highly recommended for higher-education curricula to boost institutional research productivity and students' academic identity.

KEYWORDS
BROSING model; project-based learning; scientific writing; student publication; higher education; Indonesia.

INTRODUCTION

In today's college environment, the ability for undergraduate students to generate and distribute their own scholarly manuscripts is an essential skill. The growth of this skill set is attributed to the global educational community and to specific requirements for students in Indonesia related to the *Merdeka Belajar* (Independent Learning) curriculum, which incorporates output-based education and twenty-first-century learning competencies (Oktaviani & Marliana, 2021). Despite growing demands from colleges, there remains a significant disparity between what institutions expect in student writing and what students can actually deliver. Students have major challenges with respect to determining research topics based on real-world data or empirical evidence (Oktavia et al., 2023; Wang et al., 2024), and also experience substantial barriers in terms of understanding the structure of science.

The growing issue regarding the misuse of generative AI has been shown within the area of student manuscript production. Research conducted during the 2024-25 academic year found an excessive amount of plagiarism exhibited by students' manuscripts. The results indicate that similarity indexes on students' manuscripts via the use of Turnitin reached as high as 85%. These extreme results were caused by inappropriate "cut-and-paste" methods utilizing platforms such as ChatGPT (Benichou, 2023; Herrera Ortiz, 2023). Although many institutions attempt to address the knowledge gap provided by e-learning systems, most of these systems are either utilized at very low rates or lack sufficient interactivity to establish authentic writing techniques among students (Oktavia et al., 2024). Current educational paradigms often fall short in providing a comprehensive, end-to-end methodology for students to create manuscripts and guide them through each phase from development to submission to a peer-reviewed journal (Li & Yoon, 2024; Raja et al., 2024).

This research identifies the structural issues in the field of publication. In order to resolve these problems, this research used the BROSING model (Oktavia, 2024). Each letter in the term BROSING stands for one step in a comprehensive seven-step process: *Bibliographic exploration (B)*, *Research synthesis (R)*, *Objective examination (O)*, *Study analysis (S)*, *Idea generation (I)*, *Narrative development (N)*, and *Goal-driven publishing (G)*. The BROSING model works as a "bridge", which, unlike other traditional approaches to developing writing skills, utilizes a web-based format, thereby promoting both academic integrity and critical thinking.

Scaffolding is an important tool to help bridge the gap between a student's present level of skill development and the real-world complexity of actual scientific inquiry within a Project-Based Learning (PjBL) environment (Belland et al., 2022; Cortázar et al., 2021). As students are actively engaged in solving problems through PjBL, many novice learners need assistance making the transition from observing phenomena informally to formally expressing their observations through discipline-specific writing. Targeted and interactive scaffolding techniques (e.g., prompts, checklists, guided questions) can be used by educators to assist students in developing their hypotheses and formally articulating their thinking using the vocabulary of science. Research has shown that effective scaffolding does not occur simply through providing

static documents or rubrics but occurs when teachers engage in a dialogue with students about how they think scientifically while working together as co-constructors of knowledge (Bae et al., 2021; Gillies, 2020). This dialogue provides an opportunity for both the teacher-facilitator and students to regulate the meaning of what they are doing during the collaborative discussion and construction of scientific explanations. The ultimate purpose of the scaffolds being developed is to provide cognitive apprenticeships. Cognitive apprenticeships allow students to gradually take on more responsibilities as learners become independent thinkers who can clearly express reasoning and evidence-based claims in their final manuscripts.

Although many studies have demonstrated that PjBL and scaffolding can be useful for improving the quality of students' internal classroom writing, a major research gap exists. The current body of research primarily addresses how PjBL can enhance internal classroom writing but has failed to provide viable instructional models for linking internal classroom assignments to formal academic publication. The main problem for novice researchers is the lack of a structured or methodically organized and digitally enhanced pathway to successfully navigate the demanding process of disseminating their work. What makes this particular research unique is that it will address the identified research void empirically. Using data collected as part of an ongoing longitudinal research study launched in 2014, this study will utilize a new application and evaluation of the BROSING model (Oktavia, 2024; Oktavia et al., 2020) at multiple universities. The BROSING model is based upon a digital platform developed to assist students with navigating the publication process and increase both the quality and number of student-authored publications published in peer-reviewed scientific journals internationally.

The primary purpose of this study is to determine whether the BROSING model, integrated with the PjBL method, can effectively develop university students' scientific writing skills and facilitate the production of professional-standard science articles. To guide this investigation, the study formulates the following research questions (RQs): (1) Does the implementation of the PjBL-integrated BROSING model significantly improve students' scientific writing proficiency? (2) Does the model successfully facilitate the transition of students from readers to authors by yielding tangible scholarly publications?

To address the first research question, this study tests the following hypothesis:

H1: There is a statistically significant improvement in students' scientific writing scores following the BROSING intervention.

By utilizing a single-group pre-test and post-test design, this study assesses these improvements (Krisnawati & Martha, 2023; Saeidnia et al., 2022) and evaluates the model's capacity to improve academic integrity, increase writing clarity (Wibowo, 2021), and ultimately contribute to an overall increase in institutional research activity.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The Gap in Existing PjBL Applications

PjBL is consistently recognized as a student-centered, inquiry-based pedagogy, utilizing projects to contextualize the learning experience for students. In higher education, PjBL has demonstrated great success in developing students' academic and scientific writing competence. Writing activities embedded throughout authentic research projects not only increase the quantity of student writing output but also enhance the quality of that output by encouraging critical thinking, creativity, and discipline-specific communication skills (Mohale, 2025; Peng, 2019; Rahardi et al., 2023). PjBL transforms how we view the process of writing by shifting the focus from writing as a mechanical activity to a dynamic, iterative process of generating ideas, drafting, and peer evaluating (Abdullah et al., 2022). Additionally, incorporating digital tools and Information and Communication Technology (ICT) into PjBL environments has been found to provide considerable scaffolding to the writing process, increasing both student motivation and structural writing achievement (Bilgin & Yıldız, 2024; Ilham, 2022; Karim & Kew, 2024).

Although PjBL is able to develop many foundational writing skills, it leaves a large knowledge gap in providing the framework for transforming those skills into formal academic publishing. While there is substantial evidence supporting the value of undergraduate research experiences as High Impact Educational Practices (HIEPs), students continually face institutional barriers that prevent them from disseminating their research (Nunes et al., 2022; Orton et al., 2025). Transforming students' ability to write a course paper into meeting the stringent requirements of published science requires specific skills that most PjBL frameworks do not include.

Several significant barriers exist that create obstacles for student publication. The first major barrier is severe time constraints created by the curriculum and limited opportunities available for students to improve their research to publishable standards (Nunes et al., 2022; Orton et al., 2025). In addition to time constraints, successful dissemination of research relies heavily upon dedicated mentorship and supervision. Without a structured method of mentoring during all phases of the project, including project design, data analysis, and submitting manuscripts, students will be greatly diminished in their opportunity to publish (Pierszalowski et al., 2021). The absence of structural supports is particularly detrimental for students with less developed self-regulated learning skills. Students who require structure, organization, and instruction will find it difficult to complete the complex higher-order outcomes required of them (Sirih et al., 2025).

In summary, regardless of whether or not undergraduate research produces results of high quality and rigor, both students and institutions usually lack awareness about the multiple venues for publication or the administrative steps required to submit manuscripts to those outlets (Nunes et al., 2022; Orton et al., 2025). Most existing PjBL models stop at the completion of the research project or at the stage where the student presents their research internally. As

such, a clear void exists in current literature regarding PjBL models that serve to integrate students through each step of the scholarly cycle, specifically formal dissemination. Thus, there is a critical need for structured PjBL models that not only scaffold scientific writing but also bridge the divide between students' research conducted in the classroom setting and peer-reviewed journal articles.

Theoretical Foundations of Scientific Writing

The movement of the novice writer toward becoming a published author calls for a multidimensional instructional strategy. This strategy will address the cognitive requirements of scientific writing while simultaneously addressing the social environment in which it takes place. The present study's intervention is grounded in three converging theories: Vygotskian Sociocultural Theory (i.e., scaffolding in the zone of proximal development/ZPD); Cognitive Process Theory; and Metacognitive Self-Regulation.

Vygotsky's (1978) concept of the ZPD forms the central aspect of designing academic writing pedagogy. Learning is seen as a socially constructed process wherein a learner is provided temporary support from a more knowledgeable peer or teacher to reach an independently competent level of performance they would not have reached individually (Beiki, 2022; Chieh & Aun, 2025). In universities, scaffolding typically includes providing models of writing strategies (e.g., step-wise demonstration of drafting and revision) and facilitating collaboration among peers (Brown et al., 2023; Evenddy et al., 2024). Studies indicate that scaffolding among peers in academic writing increases student participation and facilitates peer negotiation of meaning and co-construction of knowledge (Tinggie et al., 2023). Additionally, research has demonstrated that institutions provide significant support when they establish a collaborative scaffold such as a writing center. Such a setting provides students with socialization into rigorous academic discourse and helps to mitigate specific organizational, coherent, and mechanical citation problems (Mdodana-Zide & Mafugu, 2023; Mdodana-Zide & Mukuna, 2023).

While sociocultural theory addresses the educational environment, cognitive process theory identifies the internal mechanisms of writing. Specifically, this theory suggests that writing does not occur as a linear progression of actions (Flower & Hayes, 2016; Alves et al., 2008; Wischgoll, 2016). Rather, writing occurs as a dynamic, recursive system comprised of planning, translating (drafting), and reviewing. Further, each of these sub-processes is subject to ongoing influence by the writer's long-term memory, their familiarity with the topic area, and specific environmental constraints related to the task at hand (Li & Yu, 2023). Since scientific writing necessitates high levels of cognitive load, designs for instruction must deliberately focus on these sub-processes. Research supports that process-oriented instruction results in better argumentative and discipline-specific writing products than product-oriented instruction (Li & Yu, 2023; León et al., 2019).

Students need to employ high levels of metacognition and self-regulation to effectively engage the recursive nature of cognitive processing involved in writing. Consistently,

metacognitive behavior (e.g., planning, monitoring, and evaluating) is associated with higher-quality undergraduate academic writing (Bruning et al., 2013; Wischgoll, 2016). Scientific writing specifically poses unique challenges. Synthesis tasks involve the intentional integration and organization of numerous sources to create a coherent written narrative tailored to a particular audience (Escorcia & Gimenes, 2020; Álvarez, 2024). Writing self-efficacy and the ability to self-regulate directly affect a student's capacity to dedicate sufficient time for comprehensive planning and strategic revisions (Bruning et al., 2013). Therefore, instructional programs that combine cognitive writing strategies with explicit metacognitive regulation result in increased growth in academic writing quality relative to either cognitive-based instructional programming (Wischgoll, 2016). Through the convergence of these conceptual frameworks, it can be clearly observed that an instructional program intended to foster scientific writing must provide substantial structure to reduce cognitive load, provide social scaffolding to assist learners through their respective ZPD, and design instructional content that fosters metacognitive reflection and self-regulation.

The BROSING Model Synthesis

To fill the reported voids in PjBL and create appropriate scaffolding for students at the undergraduate level, a specifically structured writing framework that incorporates all three product-process-genre views of writing in an actualized research environment will need to be created (Belyaeva, 2022). In order to build upon effective writing pedagogy, it is also essential to include formative, low-stakes writing activities as part of the instructional design so that the high levels of writing anxiety that many students experience with respect to both topic knowledge and time constraints may be alleviated (Solangi et al., 2021). Additionally, incorporating those same writing activities into undergraduate research experiences will serve as an important mediating variable of learning by providing opportunities for students to engage in disseminating ideas within real scholarly discourse communities (Pichon et al., 2025; Asif et al., 2023).

At the core of any science writing model is the IMRaD (Introduction-Methods-Results-Discussion) format, which continues to represent the most prevalent organizational format used in scholarly publications throughout the disciplines (Wu, 2011; Bertin et al., 2015). However, pedagogical studies have found that simply using the IMRaD format as a pure mechanical tool is not sufficient. In order to increase the writer's ability to communicate and write rhetorically effectively, narrative modeling and explicit teaching of genre moves should be integrated with the use of IMRaD, allowing writers to find a balance between telling stories and detailing data while utilizing a common format (Mandelbaum & Fuller, 2021; Eriksson, 2023).

The BROSING model (Oktavia et al., 2024) captures the evidence-based practices previously discussed into a comprehensive, seven-stage blended-learning model intended to facilitate transitions from conducting research in classrooms to goal-directed publishing. The model includes the cognitive and sociocultural conditions of academic writing via a sequential, structured progression as follows. Phases one and two consist of Bibliographic Exploration (B)

and Research Synthesis (R), addressing the cognitive burden associated with developing topic familiarity and integrating sources. The model addresses the critical metacognitive skills needed for organizing and managing large amounts of information drawn from multiple interdisciplinary sources through active support of students during literature reviews and syntheses (Álvarez, 2024). Phases three and four consist of Objective Examination (O) and Study Analysis (S), each of which corresponds to the stringent methodological expectations of the "Methods" and "Results" parts of the IMRaD format. This ensures students develop the ability to critically assess and organize their empirical results (Hua et al., 2018). Phases five and six are Idea Generation (I) and Narrative Development (N); these stages are focused on providing socioculturally based scaffolds to support the iterative drafting process. The integration of narrative framing with the IMRaD format provides students with the support they require in creating coherent and targeted arguments for audiences; thus, they are able to move through their ZPD toward self-sufficient competency (Mandelbaum & Fuller, 2021; Beiki, 2022). Finally, phase seven is Goal-Driven Publishing (G), addressing the major void left unaddressed by previous PjBL implementations. Providing students with explicit structural and administrative direction facilitates students' navigation through the publication process, thereby bridging the gap between classroom production and formal dissemination (France & Eaton, 2023; Nunes et al., 2022).

First-stage assessments of the BROSING model show high validity and applicability. Quantitative assessment demonstrates that applying the BROSING model significantly enhances undergraduates' ability to perform scientific writing (Oktavia et al., 2024). Through the inclusion of IMRaD within a well-supported digital platform and a very cognitively demanding process, the BROSING model represents a complete approach to filling the systematic obstacles to undergraduate publication.

METHODS

Research Design

This study used a single-group (pre-post) multi-institutional approach in order to assess the application effects of the BROSING model to improve students' ability to write scientifically. Due to ethical issues related to withholding instruction from a portion of enrolled students and the difficulty in controlling for curriculum differences across multiple institutions, an experimental or quasi-experimental design with a comparison group was not feasible. The application of the BROSING model occurred at four separate institutions within the Riau Islands of Indonesia. The purpose of this study is to examine whether the BROSING model results in quantifiable improvements in students' science writing abilities, as well as in their actual published work.

Participants and Sampling

The sample included 142 undergraduate students of the Riau Islands Province in Indonesia who took part in the BROSING program throughout the 2024-2025 academic term. The selection process utilized a non-randomized stratified design to allow for evaluation of the model's

applicability at different types of educational facilities. The participant pool consisted of four distinct universities: Universitas Maritim Raja Ali Haji (UMRAH), Universitas Internasional Batam (UIB), Universitas Putera Batam (UPB), and Universitas Riau Kepulauan (UNRIKA). The researcher used an intentional total sampling strategy by selecting the entire population of students within the target classes as opposed to randomizing a portion of the student population. Only students who were currently enrolled in the scientific writing modules provided as a component of the BROSING program and who provided their consent to participate in the research would meet inclusion criteria. Students who were no longer participating in the scientific writing module prior to its conclusion, students who had already published a scientific paper, or students who did not complete either the pre-test or post-test assessment tools would be considered excluded.

Table 1.

Students' Characteristics (n = 142)

Demographic Variable	Category	Frequency (n)	Percentage (%)
University	Universitas Maritim Raja Ali Haji (UMRAH)	45	32%
	Universitas Internasional Batam (UIB)	27	19%
	Universitas Putera Batam (UPB)	34	24%
	Universitas Riau Kepulauan (UNRIKA)	36	25%
Study Program	Indonesian Education	1	1%
	Chemistry Education	1	1%
	Biology Education	5	4%
	Mathematics Education	20	14%
	English Literature	34	24%
	English Education	81	57%
Gender	Male	31	22%
	Female	111	78%

As shown in Table 1, there were relatively even numbers of participants at each of the four universities. The largest group came from UMRAH (32%). It is important to note that the sample had an overabundance of language and educational disciplines. In particular, the large majority of students were studying either English Education (57%) or English Literature (24%). A demographic analysis indicated that approximately three-quarters (78%) of the cohort were female. Since it is natural for both academic ability and institutional quality to vary across different university settings and study programs, using a pre-post test design that measures within-subject changes helps to reduce the impact of potential confounders such as differences in academic competency and institutional quality. Further, to help maintain consistency in applying the BROSING model on all four campus sites and to provide a standardized format for implementing the model, a centrally located digital platform was developed

(www.modelbrosing.com) to provide a consistent source for all aspects of the model. To further ensure that all participating educators provided instruction in a manner consistent with one another and used identical grading rubrics when assessing student performance, all educators who participated in this project attended a standardization training session.

The Experimental Intervention

The interventions included a 16-week learning program that employed the BROSING model in its technical syntax, with PjBL serving as an operational framework (see Table 2). In this applied learning environment, PjBL converted the writing process into a science publishing project. While the BROSING model provided the sequential drafting steps, the encompassing PjBL framework provided a social and goal-oriented context. Students were not simply "writing a paper" but working on managing a project with an end product intended as a professionally applicable output (i.e., a journal submission).

Table 2.

Experimental Syntax for the PjBL-BROSING Group

PjBL Phase	BROSING Technical Step	Experimental Activity
1. Essential Question	Bibliographic exploration (B) and Research synthesis (R)	Identifying research gaps and synthesizing 10+ reputable references.
2. Project Design	Objective examination (O) and Study analysis (S)	Collecting field data via linguistic error analysis and group inquiry.
3. Scheduling	Idea generation (I)	Developing a manuscript timeline and conceptualizing the research framework.
4. Monitoring	Narrative development (N)	Drafting the full manuscript with real-time digital feedback.
5. Assessment	Goal-driven publishing (G)	The final "Project Output": Submission to a peer-reviewed journal.

Operational Steps of the BROSING Model

The intervention was delivered via a digital platform (www.modelbrosing.com). The seven steps are operationalized as follows:

- Bibliographic exploration (B): Searching and selecting relevant scientific sources.
- Research synthesis (R): Analyzing literature to establish the research niche.
- Objective examination (O): Identifying and documenting linguistic errors in public media/official documents.
- Study analysis (S): Collaborative debating and revising of documented errors in a classroom setting.
- Idea generation (I): Blended learning sessions for conceptualizing the research paper.
- Narrative development (N): Systematic drafting of the manuscript according to standard academic templates.
- Goal-driven publishing (G): Ensuring a <20% Turnitin similarity score and obtaining a journal submission receipt.

Instruments

Data were collected utilizing two quantitative instruments: an academic writing performance test and a student perception questionnaire. The writing performance test assessed students' ability to write a high-quality manuscript using the standard IMRaD structure ("Introduction", "Methods", "Results", and "Discussion"). The pre-test scores were collected from a baseline diagnostic writing assessment during the first week of classes. To establish this baseline, students were tasked with producing a preliminary scientific draft based on their prior knowledge, attempting to structure a basic introduction, argument, and reference list. This diagnostic draft was evaluated by educators using the 100-point academic writing rubric addressing structure, content, and accuracy of citations (Table 3, see appendix). For the post-test score, each student submitted their fully developed final manuscript at the end of the 16-week BROSING intervention, providing evidence of completing the 7-step syntax cycle and allowing for a direct, equivalent comparison of writing growth.

Before intervention, all four site-based educators attended a standardization training session to ensure consistent ratings. In this session, they individually used the rubric (Table 3) to rate a set of sample papers. Any discrepancies from their individual ratings were addressed and evaluated until a consensus on rating criteria was achieved. As such, inter-rater reliability was determined by calculating the Intraclass Correlation Coefficient (ICC). This resulted in an ICC of 0.82, indicating a very high degree of agreement amongst the raters' evaluations.

Prior to delivery of the structured survey to collect quantitative data assessing how well the BROSING model worked, a survey was created. The surveys were administered to the participants and included Likert scales with five points (from Strongly Disagree = 1 to Strongly Agree = 5), allowing researchers to evaluate the extent to which participants engaged with each component of the BROSING model. Assessments included the BROSING Model (7 items), the PjBL Framework (7 items), and Scientific Writing (9 items). Since the tool was utilized for primary descriptive purposes, validity was established through use of Pearson Product-Moment correlation instead of factor analysis. The findings listed in Table 4 demonstrate that the survey created to establish student perceptions of the effectiveness of the BROSING model is valid and reliable.

Table 4.

Validity and Reliability of the Research Instrument

Metric	Statistical Parameter	Value	Conclusion
Item Validity	Pearson Correlation (r)	0.412–0.885 ($p < 0.05$)	All Items are Valid
Internal Consistency	Cronbach's Alpha	0.944	Highly Reliable

Data Analysis

This study utilized only quantitative statistical methods to measure both the quality of the BROSING model's implementation and its empirically measurable outcomes as an instructional syntax. In that, this research solely depended upon numeric data from Likert scale responses,

rubric scores, and number of publications; no qualitative data were collected; thus, no qualitative-quantitative merging of data was necessary. Two phases of data analysis were conducted. Phase one consisted of descriptive statistics (mean and percent of attainment) assessing respondent attitudes toward the BROSING model through structured questionnaires. Phase two involved the application of inferential statistics to investigate the effectiveness of the BROSING model in enhancing the writing proficiency of students. A paired-samples t-test was used to compare the pre- and post-intervention mean writing scores of the single student group. Thus, the statistical assessment directly assessed the degree of academic growth during the 16-week intervention period. Before performing the inferential statistical analysis, three prerequisite analyses were performed. A Shapiro-Wilk test was administered to assess the normality assumption, and an F-test was administered to assess the homoscedasticity assumption. Both statistical assessments were completed utilizing *Microsoft Excel*, where alpha was set at 0.95 ($p < 0.05$). If the calculated t-statistic (t_{stat}) exceeded the tabulated critical t-statistic (t_{crit}), then it was determined that the treatment was statistically effective.

RESULTS

Student Perception and Engagement with the BROSING Model

Before addressing the primary research questions regarding writing proficiency and publication output, descriptive data were analyzed to evaluate the implementation quality of the intervention. The primary independent variable in this study is the specific BROSING model, which operates utilizing a broader PjBL pedagogical framework. To ensure the fidelity of this intervention, student responses were collected via the digital platform (www.modelbrosing.com) regarding their engagement with the model's steps. As shown in Table 5 (see appendix), students reported excellent levels of engagement across all syntax components, with an average favorability score exceeding 89%, indicating successful implementation of the BROSING model prior to post-testing.

Implementation Process and Digital Integration

The BROSING model was implemented via an integrated digital environment, the www.modelbrosing.com platform and all its associated digital tools; the primary tool utilized in the "monitoring" component of PjBL that provided students with the ability to receive continuous pedagogic scaffolding during writing. An important characteristic of this integration was the immediate feedback loop. The lecturer provided students with instantaneously generated, digital formative feedback on their work, allowing them to revise their manuscript immediately. This digital intervention significantly boosted student motivation and ensured that the project products (the articles) met high academic standards before submission.

The results shown in Table 6 indicate an increase in the level of academic competence displayed by the students in their ability to write at a scientifically acceptable level. Their skills transitioned from an "emerging competency" to a "professional standard". The pre-test (baseline) was taken in the first week of classes. Therefore, the pre-test reflected the students'

abilities prior to any instruction or pedagogy. The post-test was administered after completion of all instructional activities (16 weeks). The post-tests represented the final evaluations of their completed research papers.

Table 6.

Descriptive Statistics of Pre-test and Post-test Writing Scores (n = 142)

Assessment Phase	Min	Max	Mean (μ)	Std. Deviation (σ)	Variance (s^2)
Pre-test (Baseline)	60	84	69.86	6.502	42.28
Post-test (BROSING)	70	92	81.92	5.182	26.85
Mean Difference	-	-	12.06	-	-

The results show an upward trend with a mean difference of 12.06 points. The upward trend from the baseline (pre-test) average of 69.86 to the average of 81.92 on the post-tests shows a movement from functional writing to publication-quality writing. Further evidence of this is the effect the intervention had as an academic equalizer. As seen by the improvement of the performance floor, which rose from 60 to 70, demonstrates that regardless of individual student differences, the intervention provided a common base for understanding what constitutes scientific writing. The results also provide evidence of improved consistency among students as demonstrated by the decrease in variance and standard deviation. These outcomes demonstrate that teaching a structured technical syntax (the BROSING steps), along with an approach to complete a task-oriented project, resulted in a narrowing of the proficiency gap among the students participating in this study.

Prerequisite Analysis (Normality and Homogeneity)

Prior to hypothesis testing, the data were subjected to prerequisite analyses. The Shapiro-Wilk test for normality (Table 7) yielded a value of W_{obs} = 0.989, which exceeded the critical table value (W_{crit} = 0.895), indicating that the sample data followed a normal distribution. Furthermore, the F-test confirmed that the data exhibited homogeneity of variance (F_{obs} = 1.574, p = 0.132), thereby satisfying the assumptions and justifying the use of parametric t-tests for effectiveness evaluation.

Table 7.

Normality and Homogeneity Test Results

Test	Parameter	Value
Normality	W_{obs}	0.989
	W_{crit}	0.895
Homogeneity	F_{obs}	1.574
	p-value	0.132

Effectiveness Results

The primary measure of effectiveness (RQ1) was the improvement in student scientific writing performance. A paired-samples t-test was conducted to compare pre-test and post-test rubric scores. As detailed in Table 8, the analysis revealed a statistically significant improvement in

writing performance following the intervention. The mean score increased from 69.86 at baseline to 81.92 post-intervention, yielding a mean difference of 12.06. The calculated t-statistic (|t|= 16.94) significantly surpassed the critical t-value (t = 1.96), with a p-value well below the 0.05 threshold. Therefore, Hypothesis 1 (H1) is supported. Furthermore, the magnitude of the intervention's impact was evaluated using Cohen's d. The analysis yielded an effect size of d_z = 1.86, which indicates a very large magnitude of improvement in student writing proficiency following the BROSING intervention.

Table 8.

t-Test Results for Student Writing Performance

Statistical Variable	Pre-test	Post-test
Mean Score	69.86	81.92
Variance	42.28	26.85
Observations	142	142
t-Statistic (t_{stat})	-16.94	
t-Critical (two-tail)	1.96	
p-Value (two-tail)	6.71×10^{-45}	

Cohen's d_z = 1.86

Product Outcomes: Student Publication Rates

The BROSING model was able to achieve an overall success rate as it relates to RQ2 by effectively disseminating student research. A transition from N (*Narrative development*) to G (*Goal-driven publishing*) generated a high level of scholarly output in the form of nationally recognized publications. As shown in Table 9, the model has allowed for the publication of 36 scholarly articles. It should be noted that although the 36 students listed were immediately published with their respective institutions, the remaining students are currently at various points within the publishing process. Some have been formally accepted into their institution's journal and are waiting on the production timetable of the journal itself. Others are still going through the peer review or revisions phases. Thus, this result serves as an answer to RQ2, as it clearly illustrates that the BROSING syntax offers a viable method for students to publish and thereby eliminate the publishing barrier.

Table 9.

Summary of Student Publication Outputs via PjBL-Based BROSING Intervention

Students' Affiliations	Total Article Published	Repository Link
Universitas Maritim Raja Ali Haji	4	
Universitas Internasional Batam	10	
Universitas Putera Batam	7	DOI: 10.17605/OSF.IO/VWMGB
Universitas Riau Kepulauan	15	
Total	36	

DISCUSSION

The primary finding of this study provides a direct, affirmative answer to RQ1: the implementation of the BROSING model significantly improves students' scientific writing proficiency. Student writing growth is evident as a result of the substantial score increase, and the significant t-value (16.94) explicitly supports H1, confirming the powerfully combined effect of using the BROSING model within an effective PjBL framework. Although the use of the BROSING model gave the students procedural scaffolding to help guide them through the technology-based steps of completion from their *bibliographic explorations (B)* to *narrative development (N)*, the PjBL framework helped the students make a connection on how to complete each step as a part of creating a science-based publication. It was through this synergy that we were able to bridge the gap between the students' theoretical knowledge and actual application, enabling the students to move from functionally writing at an acceptable level to a publication-ready level.

These results are consistent with current empirical research indicating that PjBL has a strong relationship with producing high-quality products related to project-based design (Lubis & Prihartini, 2024; Suryani et al., 2024) and improving academic writing projects. The results also reflect previous meta-analytic reviews conducted in higher education on intervention length as being a major moderating variable in determining effectiveness, resulting in positive educational outcomes regarding ESL/EFL writing development (Cahyono et al., 2024; Rahayu et al., 2023). By providing planning and organization in the form of structuring the sequential steps of the BROSING model into a project-based lifecycle, this intervention supported the students in overcoming the complexities associated with scientific writing, similar to findings that show PjBL participants tend to outperform participants who received direct instruction on writing quality in post-test measures (Kershaw et al., 2023; Wardani et al., 2020).

The success of the BROSING model has been further supported by its digital ecosystem. The site www.modelbrosing.com is a digital platform that supports the use of real-time pedagogical scaffolding. Students have achieved a high level of engagement, showing the potential of the BROSING web platform to support automation of content delivery and monitoring of student progress over the duration of the project. The key element supporting this digital integration was the ability of lecturers to assess student manuscripts using a real-time feedback loop, thus allowing students to rapidly revise their manuscripts. This enabled them to make the transition from functional writing to professional writing standards, evident in the post-test. Digital tools such as those employed here can assist in improving the efficiency of the writing process through the provision of individualized learning pathways and multiple device access, maintaining instructional momentum (Choi-Lundberg et al., 2023; Zhao et al., 2023).

Additionally, the creation of the BROSING website demonstrates alignment with the emerging trend among research institutions to use Learning Management Systems (LMS) to optimize training processes and to incorporate cross-disciplinary content into these platforms

(Ponnusamy, 2021). In addition, it enables lecturers to host curated materials and student status logs. The BROSING platform provides the structural support for the "monitoring" phase of the PjBL framework, thereby transforming students' approach to manuscript development from being a passive consumer of content to being an active producer of data-driven manuscripts. Furthermore, similar structural support for specialization in training management systems has proven successful in providing aggregated scholarly module and peer feedback activities within large-scale academic environments (Al-Ansi, 2022; Zhao et al., 2023).

Furthermore, the empirical outcomes of this intervention directly answer RQ2 by demonstrating that the model successfully facilitates the transition of students from passive readers to published authors. The transition from *Narrative development (N)* to *Goal-driven publication (G)* has successfully addressed the publication barrier for the BROSING model. It is documented that 36 of the student submissions were published in various journals. Additionally, the post-test was not simply an assignment completed in class; it served as a manuscript ready for submission. Therefore, it changed the focus of teaching toward authentic assessment. Authentic assessment is defined by several researchers who have identified writing as a fundamental form of discipline-specific communication where students complete tasks similar to those they would encounter in the context of professional scientific inquiry and communication (Hoehn & Lewandowski, 2020; McDowell et al., 2022; Pun & Cheung, 2023). As demonstrated by the number of publications generated through the BROSING framework, providing students with a clear path for completing their work while developing awareness of the specific IMRaD genres will ensure that students' work reflects standards of communication that are consistent with expectations for authentic professional scientific communications (Fankhauser & Bhagatwala, 2025).

Additionally, the incorporation of inquiry-based strategies into the BROSING model provided students with opportunities to develop their understanding of how to communicate as part of professional scientific communities. Students participated in peer review, iterative revisions, and finally published their research through the dissemination of their findings. These activities provide students with a true sense of audience awareness, and because these activities were embedded throughout the 16 weeks of the BROSING project, all students who participated in this model understood what types of messages are appropriate to be communicated to whom, and when, using language that accurately represents their data (Fankhauser & Bhagatwala, 2025; McDowell et al., 2022). The scaffolded nature of this model allowed students to begin with pseudo-arguments and move toward valid data-based arguments representative of those found in peer-reviewed journal articles (Gouvea et al., 2022).

Student performance was marked by an increase in identifying research gaps and in being able to support claims with data. Students' new abilities reflect significant advancements in their critical and analytical abilities. The statistical changes reflected in the pre-test mean and the post-test mean indicate that students have developed from producing rote writings to becoming skilled users of a range of cognitive processes, including interpretation, analysis, and

evaluation. As a result of the two phases of the BROSING syntax (*Objective examination*, O and *Study analysis*, S), the students had to analyze actual linguistic situations in which they analyzed data about the situation or evaluated what had already been written on that topic. Analyzing data and evaluating research assumptions are critical elements to developing strong scientific arguments (Murtadho, 2021; Wale & Bishaw, 2020).

The BROSING syntax also functioned as a metacognitive tool enabling students to plan, monitor, and regulate their writing process—abilities that are foundational to converting critical thought into written form. The "monitoring" phase of the PjBL framework was designed to provide students with the needed structure for realizing the analytical skills demonstrated during the analysis of each manuscript through explicit guidance. Research demonstrates that when metacognitive tools, such as monitoring one's own research niche systematically, are utilized, critical thinking occurs at higher levels than when they are not (Rahmah et al., 2019; Teng & Yue, 2023). When students do not utilize a structural syntax to guide their writing, their critical thinking skills rarely lead to improvements in their writing quality (Jumariati et al., 2024; Murtadho, 2021).

CONCLUSION

The use of the BROSING model to assist in developing students' ability to write scientifically and overcome the barriers to publishing their work through scientific writing has been shown to be a highly successful teaching methodology. This study used a structured seven-step syntax, starting at the initial stage of bibliographic exploration and ending at the final stage of goal-driven publication, to show a statistically significant increase in student performance ($|t| = 16.94$; $p < 0.05$), from an average score of 69.86 on a basic level to an average score of 81.92 on a professional level. In addition to increased numerical levels, this model helped close the academic gap and raise the performance ceiling for all students within the four different institutions. The success of this project is clearly seen in that 36 students published their articles in national journals, demonstrating that using a digitalized and scaffolded pathway could transition students from being passive readers to active writers within the science community. Therefore, the BROSING model is suggested to be a strong framework for higher education curriculum development and for increasing institutional research production and developing a professional academic identity in students.

To ensure the continued sustainability and expansion of the results achieved through this research, a number of recommendations have been made to both educational professionals and members of the academic research community. Recommendations to educators include the recommendation that the BROSING model be incorporated into the formal university or college curriculum as a required "scientific writing laboratory," rather than as an additional workshop. BROSING can continue to provide institutions with ongoing opportunities for continuous, real-time feedback through its use within the digital environment. Similarly, it is recommended that institutions encourage students to participate in the *goal-driven publication*

(G) phase of BROSING by creating a link between the assessment of their work and the deadline for journal submissions; this will help shift how students see themselves as participants in higher education (from a passive learner to a published author).

A primary limitation of this study is the single-group pre-test/post-test design. Without a control group, it is impossible to definitively rule out confounding variables such as natural maturation over time, knowledge acquired from other subjects, or the testing effect (student adaptation to repeated testing). While the tangible outcome of 36 published articles demonstrates the practical utility of the BROSING model, the lack of a controlled comparison means the observed statistical improvements should be interpreted as strong associations rather than definitive causation. Future studies should implement randomized controlled trials to isolate the specific causal impact of the model.

In terms of future research projects, although this study has demonstrated significant multisite reliability across four different universities, it will be important to conduct additional research in order to assess whether or not the BROSING model can produce similar results in other areas of academic study, including the hard sciences, social sciences, etc., where technical discourse patterns may vary significantly. Longitudinal studies should also be conducted over time to follow the research productivity of participants who completed the program; it would also be beneficial to know if the 17% improvement in performance produced in the first year would translate into a sustained level of professional publishing activity during the participant's career. Finally, inclusion of AI-assisted drafting tools in the syntax of the BROSING model, either as an experimental variable or as part of the design of the study itself, would allow for evaluation of how modern technology interacts with more traditional forms of scaffolding to lower barriers to entry for novice researchers seeking to publish their research.

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REFERENCES

Abdullah, H., Harun, H., Wahab, N. A., Suo, Y. J., & Ali, M. A. M. (2022). Teaching English for Academic Purposes Through Project-Based Learning Method and Process Writing Approach. *Al-Azkiyaa International Journal of Language and Education, 1*(1), 48–61. https://doi.org/10.33102/alazkiyaa.v1i1.8

Al-Ansi, A. (2022). Investigating Characteristics of Learning Environments During the COVID-19 Pandemic: A Systematic Review. *Canadian Journal of Learning and Technology*, *48*(1). https://doi.org/10.21432/cjlt28051

Álvarez, M. L. O. (2024). Strategic and self-regulated instruction in synthesis tasks in the university context. *Frontiers in Psychology, 15*. https://doi.org/10.3389/fpsyg.2024.1386907

Alves, R. A., Castro, S. L., & Olive, T. (2008). Execution and pauses in writing narratives: Processing time, cognitive effort and typing skill. *International Journal of Psychology, 43*(6), 969–979. https://doi.org/10.1080/00207590701398951

Asif, M. Z., Edison, A. S., & Dolan, E. L. (2023). Postgraduate perspectives on mentoring undergraduate researchers for talent development. *Annals of the New York Academy of Sciences, 1521*(1), 155–162. https://doi.org/10.1111/nyas.14966

Bae, C. L., Mills, D. C., Zhang, F., Sealy, M., Cabrera, L., & Sea, M. (2021). A Systematic Review of Science Discourse in K–12 Urban Classrooms in the United States: Accounting for Individual, Collective, and Contextual Factors. *Review of Educational Research*, *91*(6), 831–877. https://doi.org/10.3102/00346543211042415

Beiki, M. (2022). Review of Writing-Related Theories. *Cultural Arts Research and Development, 2*(1), 27–33. https://doi.org/10.55121/card.v2i1.20

Belland, B. R., Lee, E., Zhang, A. Y., & Kim, C. (2022). Characterizing the most effective scaffolding approaches in engineering and technology education: A clustering approach. *Computer Applications in Engineering Education*, *30*(6), 1795–1812. https://doi.org/10.1002/cae.22556

Belyaeva, E. (2022). Methodological model of teaching academic writing to undergraduate students. *Focus on Language Education and Research, 3*(1), 36–51. https://doi.org/10.35213/2686-7516-2022-3-1-36-51

Benichou, L. (2023). The role of using ChatGPT AI in writing medical scientific articles. *Journal of Stomatology, Oral and Maxillofacial Surgery*, *124*(5), 101456. https://doi.org/10.1016/j.jormas.2023.101456

Bertin, M., Atanassova, I., Gingras, Y., & Larivière, V. (2015). The invariant distribution of references in scientific articles. *Journal of the Association for Information Science and Technology, 67*(1), 164–177. https://doi.org/10.1002/asi.23367

Bilgin, R., & Yıldız, Y. (2024). Fostering EFL Learners' Writing Competence through Problem-Based Learning. *Forum for Linguistic Studies, 6*(3), 574–591. https://doi.org/10.30564/fls.v6i3.6824

Brown, P. P., Baker, H. E., Medlin, D., & Hatch, M. (2023). Scaffolding & Fading: Enhancing Literacy Skills across a Curriculum to Achieve Mastery. *Journal of Education and Practice, 14*(3). https://doi.org/10.7176/jep/14-3-01

Bruning, R., Dempsey, M. S., Kauffman, D. F., McKim, C., & Zumbrunn, S. (2013). Examining dimensions of self-efficacy for writing. *Journal of Educational Psychology, 105*(1), 25–38. https://doi.org/10.1037/a0029692

Cahyono, B. Y., Rika Irawati, Amalia, S. N., & Hidayat, L. E. (2024). Project-based Learning in EFL educational settings: A meta-analysis study in EFL/ESL writing. *Journal of Writing Research*, *16*(1), 105–127. https://doi.org/10.17239/jowr-2024.16.01.04

Chieh, C. C. W., & Aun, W. T. (2025). Unleashing AI in Education: A Comparative Analysis of Malaysian University Student Engagement and Learning Support between Google Gemini and ChatGPT. *Journal of Educational Technology Systems, 54*(2), 310–325. https://doi.org/10.1177/00472395251380292

Choi-Lundberg, D. L., Butler-Henderson, K., Harman, K., & Crawford, J. (2023). A systematic review of digital innovations in technology-enhanced learning designs in higher education. *Australasian Journal of Educational Technology*, 133–162. https://doi.org/10.14742/ajet.7615

Cortázar, C., Nussbaum, M., Harcha, J., Alvares, D., López, F., Goñi, J., & Cabezas, V. (2021). Promoting critical thinking in an online, project-based course. *Computers in Human Behavior*, *119*, 106705. https://doi.org/10.1016/j.chb.2021.106705

Eriksson, D. (2023). The art and science of scholarly writing: Framing symmetry of specificity beyond IMRAD. *European Business Review, 36*(2), 141–153. https://doi.org/10.1108/ebr-01-2023-0004

Escorcia, D., & Gimenes, M. (2020). Metacognitive components of writing: Construction and validation of the Metacognitive Components of Planning Writing Self-inventory (MCPW-I). *European Review of Applied Psychology, 70*(1), 100515. https://doi.org/10.1016/j.erap.2019.100515

Evenddy, S. S., Gailea, N., & Syafrizal, S. (2024). Exploring Scaffolding Approach to Teach English in Higher Education. *Jurnal Visi Ilmu Pendidikan, 16*(1), 215. https://doi.org/10.26418/jvip.v16i1.73541

Fankhauser, S. C., & Bhagatwala, T. (2025). *Writing for identity? Exploring the motivations of pre-college students to participate in science publication*. https://doi.org/10.1101/2025.03.27.645794

Flower, L. S., & Hayes, J. R. (2016). The dynamics of composing: Making plans and juggling constraints. In *Cognitive Processes in Writing* (pp. 31-50). Routledge.

France, P., & Eaton, C. (2023). Not “Just” an Undergrad: Undergraduate Journals as a Portal to Participating in Academic Discourse Communities. *Current Issues in Education, 24*(2). https://doi.org/10.14507/cie.vol24iss2.2188

Gillies, R. M. (2020). Dialogic Teaching during Cooperative Inquiry-Based Science: A Case Study of a Year 6 Classroom. *Education Sciences*, *10*(11), 328. https://doi.org/10.3390/educsci10110328

Gouvea, J., Appleby, L., Fu, L., & Wagh, A. (2022). Motivating and Shaping Scientific Argumentation in Lab Reports. *CBE—Life Sciences Education*, *21*(4). https://doi.org/10.1187/cbe.21-11-0316

Herrera Ortiz, A. F. (2023). Commentary to the article “A CHAT(GPT) about the future of scientific publishing”. *Brain, Behavior, and Immunity*, *111*, 124. https://doi.org/10.1016/j.bbi.2023.04.004

Hoehn, J. R., & Lewandowski, H. J. (2020). Framework of goals for writing in physics lab classes. *Physical Review Physics Education Research*, *16*(1), 010125. https://doi.org/10.1103/PhysRevPhysEducRes.16.010125

Hua, F., Walsh, T., Glenny, A., & Worthington, H. V. (2018). Structure formats of randomised controlled trial abstracts: a cross-sectional analysis of their current usage and association with methodology reporting. *BMC Medical Research Methodology, 18*(1). https://doi.org/10.1186/s12874-017-0469-3

Ilham, I. (2022). Implementing Project-Based Learning for EFL Students’ Writing Achievement at Tertiary Level. *English Review Journal of English Education, 10*(3), 1003–1012. https://doi.org/10.25134/erjee.v10i3.6470

Jumariati, J., Asrimawati, I. F., Mulya, J. N., & Taka, D. D. L. (2024). Measuring Critical Thinking Skills through Performance Assessment: The Profile of EFL Students’ Critical Thinking Skills. *JEES (Journal of English Educators Society)*, *9*(1). https://doi.org/10.21070/jees.v9i1.1791

Karim, M. R., & Kew, S. N. (2024). Impact of Project-Based Learning (PBL) Integrated with Google Classroom on Improving English Writing Skills in a Bangladeshi University. *International Journal of Learning Teaching and Educational Research, 23*(9), 103–120. https://doi.org/10.26803/ijlter.23.9.6

Kershaw, T., Tripathy, S., Liu, H., & Chandra, K. (2023). Setting the Stage for Co-Creation: Using Workshops to Scaffold Interdisciplinary Research, Collaboration, and Community Building. *2023 ASEE Annual Conference & Exposition Proceedings*. https://doi.org/10.18260/1-2--43082

Krisnawati, V., & Martha, N. U. (2023). Peningkatan Kemampuan Menulis Karya Ilmiah Melalui Project-based Learning. *Multiverse: Open Multidisciplinary Journal*, *2*(1), 1–6. https://doi.org/10.57251/multiverse.v2i1.906

León, C., Gervás, P., & Delatorre, P. (2019). Empirical Insights into Short Story Draft Construction. *IEEE Access, 7*, 119192–119208. https://doi.org/10.1109/access.2019.2936919

Li, H., & Yoon, S. J. (2024). Anchoring in the meso-level: Departmental preparation for the adoption of blended learning in tertiary education. *System*, *121*, 103239. https://doi.org/10.1016/j.system.2024.103239

Li, S., & Yu, H. (2023). Effects of topic familiarity on L2 writing processes and behaviors. *International Journal of Applied Linguistics, 34*(1), 348–366. https://doi.org/10.1111/ijal.12497

Lubis, S. I., & Prihartini, S. (2024). Project-based Learning Integrated Padlet and Motivation on Students' Writing Skill. *Jurnal Pedagogi Dan Pembelajaran*, *7*(1), 48–53. https://doi.org/10.23887/jp2.v7i1.68848

Mandelbaum, J., & Fuller, T. J. (2021). What Is the Story You Want to Tell? Utilizing the Narrative Arc as an Academic Writing Framework for Graduate Students in Health Promotion. *Pedagogy in Health Promotion, 7*(2), 144–147. https://doi.org/10.1177/2373379921994600

McDowell, G. S., Fankhauser, S., Saderi, D., Balgopal, M., & Lijek, R. S. (2022). Use of preprint peer review to educate and enculturate science undergraduates. *Learned Publishing*, *35*(3), 405–412. https://doi.org/10.1002/leap.1472

Mdodana-Zide, L., & Mafugu, T. (2023). An interventive collaborative scaffolded approach with a writing center on ESL students' academic writing. *Journal of Culture and Values in Education, 6*(2), 34–50. https://doi.org/10.46303/jcve.2023.7

Mdodana-Zide, L., & Mukuna, K. (2023). Enhancing the academic writing skills of first-year English second language students at a South African university. *Journal of Curriculum Studies Research, 5*(2), 206–222. https://doi.org/10.46303/jcsr.2023.27

Mohale, N. (2025). Podcasts or Vodcasts? Exploring First-Year Students' Preferences for Enhancing Academic Writing Skills. *Research in Social Sciences and Technology, 10*(1), 97-118. https://doi.org/10.46303/ressat.2025.6

Murtadho, F. (2021). Metacognitive and critical thinking practices in developing EFL students' argumentative writing skills. *Indonesian Journal of Applied Linguistics*, *10*(3). https://doi.org/10.17509/ijal.v10i3.31752

Nunes, G. S., Adami, S. L., Pellenz, M. M., Rigo, D., Estivalet, R. A., Diel, A. P., Benincá, I. L., & Haupenthal, A. (2022). Toward scientific dissemination of undergraduate thesis in physical therapy programs – A cross-sectional study. *BMC Medical Education, 22*(1). https://doi.org/10.1186/s12909-021-03087-8

Oktavia, Y. (2024). Development of the BROSING Model in Scientific Article Writing Learning. *International Journal of Information and Education Technology*, *14*(8), 1078–1089. https://doi.org/10.18178/ijiet.2024.14.8.2136

Oktavia, Y., Atmazaki, A., Zaim, M., Susanto, A., & Marpuah, S. (2024). Need Analysis of the Model for Writing Scientific Articles. *International Journal of Language Pedagogy*, *4*(2), 107–115. https://ijolp.ppj.unp.ac.id/index.php/ijolp/article/view/80

Oktavia, Y., Atmazaki, & Zaim, M. (2020). Development of discovery guided learning module based on character education and competitive education. *Journal of Physics: Conference Series*, *1511*(1), 012044. https://doi.org/10.1088/1742-6596/1511/1/012044

Oktavia, Y., Atmazaki, & Zaim, M. (2023). Development of a learning model for writing scientific articles based on blended learning integrated creative problem solving.

KEMBARA Journal of Scientific Language Literature and Teaching, *9*(1), 239–250. https://doi.org/10.22219/kembara.v9i1.22787

Oktaviani, R., & Marliana, N. L. (2021). Pengembangan Model Pembelajaran Project Based Learning pada Mata Kuliah Penyuntingan Bahasa Indonesia Berbasis Teknologi Informasi dan Komunikasi. *Jurnal Pendidikan Bahasa Dan Sastra Indonesia Metalingua*, *6*(2), 85–92. https://doi.org/10.21107/metalingua.v6i2.11771

Orton, G., Barnes, M. A., Syed, S. B., Reid, J. W., & Smith, A. C. (2025). Challenges for activating undergraduate research: a summary from the 2021 American Society for Microbiology Conference for Undergraduate Educators. *Journal of Microbiology and Biology Education, 26*(1). https://doi.org/10.1128/jmbe.00099-24

Peng, Y. (2019). Integrating Project-based Learning into Academic English Writing Class: A Case Study on Doctoral Candidates of Engineering. In *2019 2nd International Conference on Education, Economics and Social Science (ICEESS 2019)* (pp. 98-100). Atlantis Press. https://doi.org/10.2991/iceess-19.2019.26

Pichon, H. W., Way, S., & Arnett, S. M. (2025). Understanding the "Why" of STEM Faculty Mentors and How They Engage in High Context Teaching and Mentoring Strategies. *Journal of Hispanic Higher Education, 25*(3), 234–257. https://doi.org/10.1177/15381927251356595

Pierszalowski, S., Bouwma-Gearhart, J., & Marlow, L. (2021). A Systematic Review of Barriers to Accessing Undergraduate Research for STEM Students: Problematizing Under-Researched Factors for Students of Color. *Social Sciences, 10*(9), 328. https://doi.org/10.3390/socsci10090328

Ponnusamy, P. (2021). Parental Encouragement towards the Academic Achievement of Students at Higher Secondary School Level. *International Journal of Educational Sciences*, *34*(1–3). https://doi.org/10.31901/24566322.2021/34.1-3.1200

Pun, J., & Cheung, K. K. C. (2023). Developing and validating a genre awareness questionnaire for writing scientific reports. *Frontiers in Psychology*, *14*. https://doi.org/10.3389/fpsyg.2023.1210240

Rahardi, P., Hernanda, R., Panuntun, E. B., Indriani, L., & Wulansari, A. (2023). Project-Based Learning in Developing English Language Skills and 21st Century Skills: Students' Voices in Academic Writing Course. *Metathesis Journal of English Language Literature and Teaching, 7*(2), 198–215. https://doi.org/10.31002/metathesis.v7i2.801

Rahayu, R., Sutikno, & Indriyanti, D. R. (2023). Ethnosains Based Project Based Learning Model with Flipped Classroom on Creative Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 348–355. https://doi.org/10.29303/jppipa.v9i8.3051

Rahmah, N. A. L., Munir, A., & Anam, S. (2019). Rationale as an Innovative Learning Application to Improve Students' Critical Thinking in Argumentative Writing. *International Journal for Educational and Vocational Studies*, *1*(7). https://doi.org/10.29103/ijevs.v1i7.1745

Raja, H., Munawar, A., Mylonas, N., Delsoz, M., Madadi, Y., Elahi, M., Hassan, A., Abu Serhan, H., Inam, O., Hernandez, L., Chen, H., Tran, S., Munir, W., Abd-Alrazaq, A., & Yousefi, S. (2024). Automated Category and Trend Analysis of Scientific Articles on Ophthalmology Using Large Language Models: Development and Usability Study. *JMIR Formative Research*, *8*, e52462. https://doi.org/10.2196/52462

Saeidnia, H. R., Kozak, M., Ausloos, M., Herteliu, C., Mohammadzadeh, Z., Ghorbi, A., Karajizadeh, M., & Hassanzadeh, M. (2022). Development of a Mobile App for Self-Care Against COVID-19 Using the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) Model: Methodological Study. *JMIR Formative Research*, *6*(9), e39718. https://doi.org/10.2196/39718

Sirih, M., Munir, A., & Sabilu, M. (2025). Enhancing analytical thinking in biology through project-based learning and self-regulated learning: The moderating role of prior knowledge. *Journal of Curriculum Studies Research, 7*(2), 352–372. https://doi.org/10.46303/jcsr.2025.25

Solangi, A. A., Memon, S., & Lohar, S. A. (2021). Figuring out the Levels, Types, and Sources of Writing Anxiety Among Undergrad ESL Students in Pakistan. *International Journal of Linguistics Literature & Translation, 4*(10), 73–78. https://doi.org/10.32996/ijllt.2021.4.10.10

Suryani, I., Priyanto, P., & Izar, J. (2024). Examining the Impact of Problem-Based and Project-Based Learning on University Students' Self-Confidence and Writing Skills. *AL-ISHLAH: Jurnal Pendidikan*, *16*(2). https://doi.org/10.35445/alishlah.v16i2.4910

Teng, M. F., & Yue, M. (2023). Metacognitive writing strategies, critical thinking skills, and academic writing performance: A structural equation modeling approach. *Metacognition and Learning*, *18*(1), 237–260. https://doi.org/10.1007/s11409-022-09328-5

Tinggie, T. L. G., Tan, K. H., Muslim, N., & Keng, L. K. (2023). Peer Scaffolding among Primary ESL Learners' Writing Task: Learners' Behaviors and Triggering Factors. International *Journal of Learning Teaching and Educational Research, 22*(3), 191–208. https://doi.org/10.26803/ijlter.22.3.12

Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Harvard University Press.

Wale, B. D., & Bishaw, K. S. (2020). Effects of using inquiry-based learning on EFL students' critical thinking skills. *Asian-Pacific Journal of Second and Foreign Language Education*, *5*(1), 9. https://doi.org/10.1186/s40862-020-00090-2

Wang, Z., Zhang, H., Chen, J., & Chen, H. (2024). An effective framework for measuring the novelty of scientific articles through integrated topic modeling and cloud model. *Journal of Informetrics*, *18*(4), 101587. https://doi.org/10.1016/j.joi.2024.101587

Wardani, D. S., Fauzi, M. R., Zafira, R., & Kurniawati, D. (2020). Creating Props: Improving Writing Skills of Teaching Materials of Elementary Teacher Education Students through

Project-Based Learning Model. *Mimbar Sekolah Dasar*, *7*(2), 216–234. https://doi.org/10.17509/mimbar-sd.v7i2.26334

Wibowo, A. E. (2021). *Metodologi Penelitian: Pegangan untuk Menulis Karya Ilmiah* (A. Kurniawan, L. Forsia, & H. Hery Nuraini, Eds.). Insania.

Wischgoll, A. (2016). Combined Training of One Cognitive and One Metacognitive Strategy Improves Academic Writing Skills. *Frontiers in Psychology, 7*. https://doi.org/10.3389/fpsyg.2016.00187

Wu, J. (2011). Improving the writing of research papers: IMRAD and beyond. *Landscape Ecology, 26*(10), 1345–1349. https://doi.org/10.1007/s10980-011-9674-3

Zhao, Y., Liu, Y., & Wang, R. (2023). A Study on Improving Continuing Education in Scientific Organizations through Information Technology. *International Journal for Infonomics*, *16*(1), 2152–2163. https://doi.org/10.20533/iji.1742.4712.2023.0226

APPENDIX

Table 3.

Scoring Rubric for the Academic Writing Performance Test

Category	Excellent (85–100%)	Proficient (70–84%)	Developing (55–69%)	Needs Work (< 55%)	Max. Points
Content: Introduction and Gap	Clear problem statement, robust background, and precise research objectives. (Score: 17–20)	Gap and objectives are stated but lack depth or strong justification. (Score: 14–16)	Vague problem statement or unclear research objectives. (Score: 11–13)	Missing clear problem statement, gap, or objectives. (Score: 0–10)	20
Content: Methodology	Highly appropriate, feasible design with clear data collection and analysis plans. (Score: 17–20)	Adequate design, but lacks specific details on data collection or analysis. (Score: 14–16)	Flawed design or missing major methodological steps. (Score: 11–13)	Unclear, inappropriate, or missing methodology. (Score: 0–10)	20
Content: Expected Outcomes	Logical anticipated results and discussion points closely linked to objectives. (Score: 9–10)	Plausible outcomes, but weakly connected to the research goals. (Score: 7–8)	Vague or highly unrealistic expected outcomes. (Score: 6)	No clear expectations or discussion points provided. (Score: 0–5)	10

Structure: IMRaD Alignment	Framework flawlessly aligns with the IMRaD format. (Score: 13–15)	Follows IMRaD generally, with minor deviations or blended sections. (Score: 11–12)	Weak alignment with the required IMRaD structure. (Score: 8–10)	Does not follow the required structural sections at all. (Score: 0–7)	15
Structure: Logical Flow	Seamless transitions, excellent paragraph cohesion, and logical progression of ideas. (Score: 13–15)	Good overall flow with only occasional disjointed ideas or abrupt shifts. (Score: 11–12)	Poor transitions making the framework difficult to follow. (Score: 8–10)	Ideas are scattered, unorganized, and lack logical sequencing. (Score: 0–7)	15
Citations: Accuracy and Quality	Flawless formatting (e.g., APA), highly relevant, and credible academic sources. (Score: 13–15)	Minor formatting errors; mostly credible and relevant sources. (Score: 11–12)	Noticeable citation errors; reliance on weak or outdated sources. (Score: 8–10)	Missing citations, incorrect formatting, or signs of plagiarism. (Score: 0–7)	15
Citations: Academic Tone	Professional, objective tone with excellent grammar and appropriate vocabulary. (Score: 5)	Mostly clear with minor grammatical issues or slightly informal tone. (Score: 4)	Frequent grammatical errors that impede reading comprehension. (Score: 3)	Unprofessional tone, highly subjective language, or major errors. (Score: 0–2)	5
			TOTAL		100

Table 5.

Student Perception of the PjBL-BROSING Integration (n = 142)

Category	Indicator	Percentage (%)
BROSING Model	Reading relevant references within the field of study.	89.85%
	Conducting relevant literature reviews.	87.50%
	Conducting observations.	88.03%
	Carrying out case studies.	88.73%
	Identifying information and creative ideas.	92.81%
	Writing scholarly articles for publication.	90.14%
	Promoting the publication of research papers.	89.71%

PjBL Framework	Formulating the primary topic or research problem for a scholarly article.	90.56%
	Developing a systematic plan to complete the research paper writing project.	90.42%
	Searching for and analyzing relevant scholarly references to support the article.	90.00%
	Drafting a scholarly article in accordance with academic structures and conventions.	89.85%
	Revising the article based on feedback from professors or peers.	89.29%
	Submitting the research article to a journal for publication.	87.46%
	Reflecting on the writing process to improve future research efforts.	88.02%
Scientific Writing	Organizing according to the systematic structure of scholarly writing.	90.09%
	Presenting facts and data.	92.81%
	The introduction presents the problem, phenomena, and social context.	90.14%
	Presenting the research novelty and identifying the research gap.	89.71%
	Employing sound and valid research methods.	90.56%
	Explaining the research findings.	90.42%
	Providing a relevant discussion of the results.	90.00%
	Presenting conclusions and recommendations.	89.85%
	Citing appropriate references.	89.29%

Note: Data were collected via a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The percentage score (P) for each indicator was calculated using the formula $P = \left(\frac{\sum s}{S_{max}}\right) x100$, where $\sum s$ represents the total empirical score and S_{max} is the maximum ideal score (142 × 5 = 710). Scores between 81%–100% are categorized as "very high/excellent."