



Evaluating the Efficacy of Traditional Versus Project-Based Approaches in Developing Undergraduate Scientific Writing Skills

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ABSTRACT

Scientific writing is a core academic competency essential for knowledge dissemination, especially in research-driven higher education. However, undergraduate students—particularly in English as a Foreign Language (EFL) contexts—often struggle to master the conventions of scientific writing due to limited exposure, low motivation, and rigid instructional methods. This study aims to explore the comparative effectiveness of traditional instruction and project-based learning (PBL) approaches in teaching scientific writing. Conducted at a Central Asian university, the study employs a mixed-methods quasi-experimental design with a control (traditional method) and an experimental (PBL) group of undergraduate students. Quantitative data from pre- and post-tests were complemented by qualitative data from student reflections and instructor journals. Results reveal that the PBL group outperformed the traditional group in writing proficiency, engagement, and conceptual understanding. The paper concludes with pedagogical implications for curriculum development and educator training to foster student-centered, authentic writing environments in higher education.

KEYWORDS

Project-Based Learning (PBL); Scientific Writing; Academic Writing Instruction; Traditional Teaching Methods; Higher Education; English as a Foreign Language (EFL); Undergraduate Students; Writing Pedagogy; Collaborative Learning; Constructivist Approach.

INTRODUCTION

1.1 Background and Significance

Academic writing, particularly scientific writing, is a vital skill for students aspiring to engage in research and scholarly discourse (Hyland, 2013; Swales & Feak, 2012). It not only reflects students' ability to think critically and logically but also signals their readiness for postgraduate education and global academic participation. Despite its importance, many undergraduate students, especially those in non-native English-speaking contexts, experience considerable difficulty in mastering this form of writing (Flowerdew, 2015).

This challenge is often rooted in the instructional approaches used. Traditional methods, largely based on lecture, grammar instruction, and isolated writing tasks, tend to underemphasize contextual relevance, peer collaboration, and authentic writing experiences (Badger & White, 2000). These limitations often result in mechanical writing with limited engagement and real-world applicability.

1.2 Project-Based Learning in Writing Instruction

Project-Based Learning (PBL) offers a dynamic alternative by emphasizing active learning, collaborative inquiry, and problem-solving within meaningful contexts (Thomas, 2000; Krajcik & Blumenfeld, 2006). In the writing classroom, PBL engages students in designing and conducting research projects, simulating real academic communication processes such as proposal writing, data presentation, and research article production (Beckett & Slater, 2005). Prior research suggests that PBL enhances learners' motivation, responsibility, and critical thinking, which are essential for scientific writing (Stoller, 2006; Ravitz, 2010).

However, studies comparing the learning outcomes of PBL and traditional methods in scientific writing are scarce, particularly in multilingual or EFL higher education settings. This study seeks to fill that gap by providing empirical evidence from a comparative classroom-based investigation.

1.3 Research Questions

1. How do students taught through PBL differ in scientific writing proficiency compared to those taught through traditional methods?
2. What are the qualitative experiences of students in both instructional settings regarding engagement, motivation, and perceived learning?
3. What instructional implications arise from the comparative analysis?

Methodology

This study adopted a quasi-experimental mixed-methods research design to compare the effectiveness of traditional and project-based approaches in teaching scientific writing. The research was conducted over the course of an eight-week academic writing module at a public university in Uzbekistan. A combination of quantitative and qualitative data collection methods was employed to gain a comprehensive understanding of instructional impacts on students' scientific writing proficiency, engagement, and learning perceptions.

The participants included forty-eight second-year undergraduate students enrolled in the English Philology program. Prior to the study, all students completed a diagnostic writing test to ensure homogeneity in their academic writing proficiency levels. Based on their course enrollment, the students were organized into two intact groups: Group A, comprising 24 students, received instruction through a traditional, teacher-centered method, while Group B, also with 24 students, participated in project-based learning (PBL) activities. The same instructor, an experienced academic writing lecturer, taught both groups to maintain consistency in instructional quality and to minimize teacher-related variables. Ethical approval for the study was secured from the university's academic research committee, and informed consent was obtained from all participants.

Instruction for the traditional group followed a textbook-based syllabus focusing on lectures, grammar instruction, vocabulary building, and model text analysis. Writing tasks were assigned individually and graded by the instructor with minimal peer interaction. In contrast, the PBL group followed a collaborative learning model in which students worked in teams to complete a full-cycle academic research project. This included selecting a research topic, conducting a literature review, designing a basic methodology, collecting and analyzing data, and writing a structured research paper. The writing process was scaffolded through regular feedback

sessions, peer reviews, and the use of structured templates to guide the composition of each paper section. The final products were presented in a mini-symposium format, simulating a real academic conference.

To evaluate the effectiveness of each instructional method, both groups completed a pre-test and post-test academic writing assignment, which was assessed using a validated rubric adapted from Hyland (2013). The rubric assessed five key domains of scientific writing: overall structure, clarity of expression, use of evidence and citation, academic style, and logical coherence. Additionally, qualitative data were gathered through weekly student reflection journals and end-of-module semi-structured interviews. The instructor also maintained a teaching journal to record observations on student participation, instructional challenges, and pedagogical adjustments throughout the study.

Table 1. Summary of Methodological Design

Aspect	Traditional Group	Project-Based Learning (PBL) Group
Number of Students	24	24
Teaching Method	Lecture-based, grammar-focused	Project-based, collaborative
Main Activities	Textbook exercises, model texts	Research project, presentations
Assessment Tool	Pre- and post-tests with rubric	Pre- and post-tests with rubric
Feedback Method	Instructor-only feedback	Peer and instructor feedback
Duration	8 weeks	8 weeks
Instructor	Same for both groups	
Data Collection	Tests, reflections, interviews	Tests, reflections, interviews

Quantitative data from the pre- and post-tests were analyzed using paired samples t-tests and ANCOVA to identify statistically significant differences between the two groups' performance. The qualitative data from student reflections, interviews, and instructor logs were analyzed thematically to triangulate and enrich the quantitative findings. This mixed-methods approach enabled the researchers to not only measure academic improvement but also capture the depth of students' engagement and perceptions related to the instructional interventions.

Results

The results of the study revealed significant differences in the scientific writing performance of students who were taught using traditional methods compared to those who engaged in project-based learning (PBL). Analysis of the pre- and post-test writing scores indicated that both groups improved over the course of the instructional period; however, the magnitude of improvement was markedly higher in the PBL group. The traditional group's mean score increased from 64.3 to 74.6, with an average gain of 10.3 points, whereas the PBL group improved from a mean of 66.1 to 84.3, with an average gain of 18.2 points. Statistical analysis using paired samples t-tests confirmed that the improvements in both groups were significant ($p < 0.05$), but the PBL group's gains were significantly greater ($p < 0.01$).

Table 2. Pre-test and Post-test Mean Scores by Group

Group	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Gain	Significance (p)
Traditional	64.3 (5.8)	74.6 (6.2)	+10.3	< 0.05
Project-Based (PBL)	66.1 (5.5)	84.3 (4.8)	+18.2	< 0.01

Further analysis of rubric-based scoring revealed that students in the PBL group showed particular strengths in three key areas: logical structuring of arguments, effective integration of evidence with proper citation, and academic tone. These elements, which are critical in scientific writing, were less developed in the writing samples of students from the traditional group, who tended to focus more on sentence-level accuracy and basic organization. The writing of PBL students also reflected a more coherent progression of ideas and deeper engagement with the research process, suggesting a more authentic understanding of academic writing conventions.

In addition to quantitative gains, qualitative data from student reflections and semi-structured interviews offered deeper insights into students' learning experiences. Participants in the traditional group commonly described the course as informative but repetitive, noting that tasks focused heavily on grammar exercises and model analysis. Although students appreciated the clarity of instruction, many expressed a lack of motivation and limited opportunities to apply their learning in meaningful contexts. Conversely, students in the PBL group frequently

reported high levels of engagement and personal investment in their projects. They highlighted the collaborative nature of the assignments, the relevance of the topics, and the feeling of being part of an authentic academic process.

Instructor observations further corroborated the student feedback. The instructor noted that PBL participants demonstrated increased participation in class discussions, asked more critical questions, and took initiative in organizing tasks within their groups. Although the instructor also reported that PBL required more time for coordination, feedback, and monitoring group dynamics, the instructional trade-offs were considered worthwhile due to the evident improvement in student outcomes and classroom engagement.

Discussion

The results of this study provide compelling evidence that project-based learning (PBL) is more effective than traditional instructional methods for developing undergraduate students' scientific writing skills. The significant improvement in writing scores among PBL participants, particularly in areas related to argumentation, academic style, and evidence integration, supports the assertion that PBL fosters deeper learning. These findings align with constructivist educational theories, which posit that learners construct knowledge more effectively through active participation, social interaction, and contextualized learning experiences (Dewey, 1938; Vygotsky, 1978).

One of the key advantages of the PBL approach lies in its ability to simulate real-world academic and professional writing contexts. Unlike traditional instruction, which often focuses on discrete skills and controlled exercises, PBL engages students in authentic tasks that require them to take ownership of the entire research and writing process. This experiential model not only helps students internalize the structure and conventions of scientific writing but also enhances their cognitive engagement and intrinsic motivation. The integration of peer collaboration, iterative feedback, and presentation opportunities mirrors the practices of the scientific community, thereby making the learning experience more relevant and meaningful (Stoller, 2006; Krajcik & Blumenfeld, 2006).

Moreover, the PBL environment fosters the development of higher-order thinking skills such as analysis, synthesis, and evaluation, which are essential for academic communication. The improved performance in the domains of coherence and argumentation among PBL students illustrates the pedagogical value of having learners engage in sustained inquiry and problem-solving activities.

Nonetheless, the implementation of PBL is not without challenges. The increased time required for planning, facilitating group dynamics, and providing formative feedback can be demanding for instructors. Additionally, students may initially struggle with open-ended tasks and collaborative responsibilities, especially if they are accustomed to teacher-centered learning environments. Therefore, successful integration of PBL in writing instruction necessitates adequate teacher preparation, institutional support, and appropriate assessment frameworks that value process-based learning.

Conclusion

This study provides robust evidence that project-based learning (PBL) is a more effective pedagogical approach than traditional instruction in the context of teaching scientific writing

to undergraduate students. The PBL model not only enhanced students' writing performance across multiple domains—such as academic tone, argument development, and source integration—but also contributed to heightened levels of engagement, autonomy, and motivation. These outcomes underscore the importance of moving beyond surface-level instruction that emphasizes grammar and formulaic writing, and toward more dynamic, student-centered models that reflect the authentic practices of academic inquiry and communication.

Despite some limitations, including the small sample size and short duration of the intervention, this research contributes to a growing body of literature advocating for experiential and constructivist models of instruction. Future research could explore longitudinal impacts of PBL on writing development, the scalability of PBL in diverse institutional settings, and the role of technology in supporting collaborative academic writing.

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