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Original Article

DEVELOPMENT OF DIFFERENTIATED LEARNING MODELS FOR SCIENTIFIC WRITING SKILLS IN HIGHER EDUCATION

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Abstract

The mastery of scientific writing is a critical academic competence for university students, yet conventional instructional approaches often fail to address the diverse learning needs within higher education settings. This study aims to develop a differentiated learning model tailored to enhance students' scientific writing skills. Employing a design-based research methodology, the model was iteratively tested and refined in undergraduate classrooms. The findings indicate that differentiated instruction—by accommodating students' readiness levels, learning preferences, and interests—significantly improves engagement, self-efficacy, and the quality of academic writing. The study contributes to pedagogical innovation by offering a structured and adaptable framework for writing instruction in diverse academic environments.

Keywords: differentiated learning, scientific writing, higher education, instructional model, academic literacy

1. Introduction

Scientific writing is a fundamental academic skill, integral not only to knowledge dissemination but also to the development of critical thinking and scholarly identity. However, higher education institutions frequently adopt uniform teaching strategies that disregard students' diverse cognitive abilities, learning styles, and prior knowledge. The lack of individualized support in writing instruction has led to varied student outcomes, ranging from disengagement to poor academic performance (Smith & Hu, 2021).

The increasing demand for publication-based academic requirements such as undergraduate theses, research articles, and conference papers places scientific writing as a central competency in modern higher education. Yet, many students exhibit low confidence and limited mastery of academic writing conventions, particularly in non-English speaking countries. These challenges are further exacerbated in multidisciplinary classrooms where students' writing abilities and epistemological backgrounds vary significantly (Hyland, 2016).

Current writing instruction practices in universities tend to be prescriptive, focusing on rigid templates and grammar correction rather than nurturing students' rhetorical thinking, creativity, and adaptability. Consequently, students often perceive writing tasks as technical and mechanical rather than as opportunities for intellectual inquiry. A more responsive and inclusive approach is needed one that accommodates variation in learning needs while still promoting high academic standards.

Differentiated instruction has emerged as a promising pedagogical paradigm for addressing such diversity. Unlike traditional instruction, which treats learners as a homogeneous group, differentiated teaching intentionally modifies content, process, product, and learning environment to match individual student profiles (Tomlinson, 2017). While extensively applied in primary and secondary education, its integration into higher education especially within the context of scientific writing remains underutilized and under-researched.

In light of these issues, this study seeks to design and develop a differentiated learning model specifically for scientific writing instruction in higher education. The model aims to respond to the heterogeneity of learners by embedding flexibility, choice, and scaffolding into the instructional process. This research not only contributes to theory-building in differentiated pedagogy but also offers practical solutions to enhance writing pedagogy in university contexts.

2. Theoritical review

2.1. Scientific Writing in Higher Education

Academic writing encompasses the ability to articulate complex ideas clearly, coherently, and systematically. Scientific writing, in particular, requires adherence to discipline-specific conventions, rigorous argumentation, and evidence-based reasoning. Yet many students struggle with structuring their ideas and using appropriate academic language (Hyland, 2016).

2.2. Differentiated Instruction: Concept and Principles

Differentiated instruction is defined as a teaching approach that proactively modifies curriculum elements—content, process, product, and learning environment—to accommodate individual learners (Tomlinson, 2014). Central to this approach is the recognition of student diversity in readiness, interests, and learning profiles. Studies in other domains have shown its effectiveness in improving academic engagement and performance (Hall et al., 2011).

2.3. Gaps in the Current Pedagogical Models

Although various instructional models exist for teaching writing, most adopt a one-size-fits-all approach. There is limited empirical research on models that integrate differentiation strategies into the teaching of scientific writing in higher education. This study aims to fill this gap by developing a differentiated learning model that is both theoretically grounded and practically viable.

3. Research methods

This research employs a Design-Based Research (DBR) approach, which combines iterative design, implementation, and refinement of instructional interventions in real-world settings (Anderson & Shattuck, 2012).

3.1 Participants

The participants consisted of 64 undergraduate students enrolled in an academic writing course at a public university in Indonesia. The sample included students from various academic disciplines with different levels of prior writing experience.

3.2 Procedures

The research was conducted in three phases:

Needs Analysis: Identifying students' writing challenges and learning preferences through surveys and diagnostic tests.

Design and Implementation: Developing differentiated learning modules, including tiered assignments, flexible grouping, and choice boards.

Evaluation and Revision: Assessing students' writing progress and refining the model based on feedback and performance data.

3.3 Instruments

Data were collected using a mix of qualitative and quantitative instruments: pre- and post-tests of writing quality, student reflection journals, peer review checklists, and classroom observations.

4. Research Results and Discussion

4.1. Research result

Improvement in Scientific Writing Competence

The implementation of the differentiated learning model resulted in measurable improvement in students' scientific writing performance. Pre-test scores averaged 62.3, while post-test scores increased to an average of 78.4. The most significant gains were observed in students' ability to construct logical arguments, structure paragraphs coherently, and apply proper citation and referencing techniques. These results suggest that instructional differentiation effectively supports the development of foundational and advanced writing skills.

Enhanced Student Engagement and Motivation

Observation data and student reflection journals indicated a noticeable increase in learner engagement and motivation. Students expressed a greater sense of ownership over their writing, particularly when given the opportunity to select topics aligned with their academic interests or disciplinary background. The use of choice boards and flexible grouping strategies encouraged participation and fostered a sense of agency.

Responsiveness to Diverse Learning Profiles

The model proved effective in accommodating varying levels of readiness and learning preferences. Students who previously struggled with academic writing reported improved understanding through scaffolded instruction, such as tiered assignments and targeted peer feedback. Meanwhile, more advanced students benefited from enrichment tasks and open-ended research prompts, which allowed them to deepen their analytical skills.

Formative Assessment and Writing Feedback

Formative assessment played a critical role in the model's success. Regular peer reviews, self-assessment rubrics, and instructor feedback enabled students to monitor their own progress. These mechanisms also cultivated a reflective learning habit, as students learned to critique their drafts constructively and revise based on substantive feedback rather than surface-level edits.

Qualitative Indicators of Learning Progress

In-depth analysis of students' final manuscripts revealed improved cohesion, clarity, and argument quality. Students were better able to articulate their research questions, justify their methodological choices, and present evidence-based conclusions. This qualitative enhancement was confirmed through inter-rater reliability checks conducted by two independent academic reviewers.

Student Perception of Learning Environment

Survey results revealed high student satisfaction with the differentiated approach. Over 85% of participants reported that the model helped them feel more supported and confident in their writing. The perceived flexibility and relevance of assignments were particularly appreciated. Students also highlighted the benefits of peer collaboration and thematic writing workshops introduced in the course design.

4.2. Discussion

Improved Writing Performance

Statistical analysis of pre- and post-test results revealed a significant improvement in students' ability to structure arguments, use academic language, and cite sources properly. The average score increased from 62.3 (pre-test) to 78.4 (post-test), indicating a substantial gain in scientific writing competence.

Increased Student Engagement

Qualitative data from observation and student reflections indicated higher levels of engagement, particularly when students were allowed to choose topics aligned with their interests and learning modalities (visual, auditory, kinesthetic).

Pedagogical Implications

The differentiated model was effective in addressing diverse student needs without compromising academic rigor. It facilitated active learning and provided scaffolding that enabled students to progress at their own pace.

5. Conclusion

The development of a differentiated learning model for scientific writing in higher education addresses the pressing need for inclusive and effective pedagogy. The model not only improves writing skills but also fosters autonomy and motivation among students. Future research should focus on adapting the model across different disciplines and institutions to test its generalizability and scalability.

This study demonstrates that differentiated learning models offer a promising solution to improve scientific writing skills in higher education. By accommodating students' diverse readiness levels, learning preferences, and academic backgrounds, the model successfully enhances both the quality of student writing and their engagement with the writing process. The improvement in post-test scores, reflective writing, and peer feedback indicates that differentiation supports not only academic competence but also fosters learner autonomy and motivation.

Moreover, the integration of formative assessment, scaffolding, and student choice within the instructional framework proved instrumental in promoting deeper cognitive engagement. The differentiated approach allowed students to develop a clearer understanding

of writing conventions, argumentation logic, and evidence-based reasoning—all essential components of academic literacy in higher education.

Although the model requires thoughtful planning and institutional support for broader implementation, it has the potential to transform writing instruction in university settings, particularly in interdisciplinary and multilingual classrooms. Future efforts should focus on scaling the model across various disciplines and exploring its integration with digital technologies and adaptive learning platforms.

In conclusion, differentiated instruction in academic writing represents not just a pedagogical innovation, but also a strategic response to the growing demand for high-level scientific communication skills in the knowledge-based economy. As higher education increasingly values publication and research output, equipping students with adaptable, personalized writing strategies becomes both an educational imperative and a scholarly responsibility.

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