

A Data-Driven Iterative Approach to Teaching Vocational English Writing: A Case Study Using the CSMS+ System

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Abstract: This study addresses the persistent challenges in vocational English writing instruction, such as varying student proficiency, low engagement, and subjective assessments, by developing a data-driven iterative teaching model using the CSMS+ system. Guided by the Flanders Interaction Analysis System (FIAS), Kolb's experiential learning theory, and the 4-Wh questioning framework, the research explores how real-time multimodal data can enhance teaching methodologies. Conducted over two cycles of action research at a secondary vocational school in China, the study focuses on 36 first-year Early Childhood Care students. Results reveal significant improvements in classroom interaction quality, writing performance, and student participation, particularly through the use of targeted questioning techniques and style-sensitive task designs. Notably, teacher talk time decreased, while complex questioning sequences and student engagement increased. Writing proficiency improved markedly in structural completeness, formality, vocabulary precision, grammatical accuracy, and workplace relevance. These findings underscore the effectiveness of integrating educational analytics with pedagogical theories to achieve precision teaching and foster professional language competence in vocational education.

Keywords: vocational English, writing instruction, CSMS+, classroom analytics, learning styles, FIAS, Kolb, questioning strategy

1. Introduction

China's vocational education has undergone a digital transformation, driven by policies like the Action Plan for Enhancing Vocational Education Quality (2020-2023). These focus on integrating technology into teaching, shifting from teacher-centered to learner-focused, data-driven models. In this context, English writing is critical for students' career readiness. However, despite policy support, teaching English writing in vocational education remains challenging, with students facing issues like limited vocabulary, weak grammar, and low confidence in extended writing. Many students prefer interactive learning but struggle with structured assignments, hindering their professional communication skills.

Traditional teaching models lack continuous, data-driven insights for diagnosing challenges and improving effectiveness. Early childhood education students must master formal writing, balancing linguistic accuracy with professionalism. CSMS+ analyses reveal low participation, limited questioning strategies, and poor-quality interactions, highlighting gaps between current teaching methods and professional communication standards. This study addresses three key questions:

- (1) How can the CSMS+ system capture and analyze multimodal data in vocational English writing instruction?
- (2) How can frameworks like FIAS and the "4-WH" questioning model enhance teaching strategies?
- (3) How can instruction be optimized to engage learners and improve writing outcomes?

This research contributes both theoretically and practically. It applies interaction analysis and learning style theories to vocational English writing and provides a replicable model for improving teaching, increasing accuracy, supporting digitalization, and enhancing students' communication skills.

2. Theoretical Framework

This study employs three key theoretical frameworks to guide a data-driven iterative approach to vocational English writing instruction:

2.1 Flanders' Interaction Analysis System (FIAS)

FIAS categorizes classroom verbal interactions into specific codes, facilitating the analysis of interaction quality and patterns. In this study, FIAS was utilized to identify areas for enhancing student engagement and reducing teacher dominance, promoting a more interactive and student-centered environment (Amatari, 2015)[1].

2.2 Kolb's Experiential Learning Theory and Learning Styles

Kolb's model proposes four learning styles—Diverging, Assimilating, Converging, and Accommodating—based on a

cycle of experiential learning. This theory guided instructional design by matching learning activities with students' cognitive preferences, such as role-playing for Accommodating learners and structured analysis for Assimilating learners (Kolb, 1984; Kolb, A. Y., & Kolb, D. A., 2005)[2][3].

2.3 The 4-WH Question Framework

The 4-WH framework includes What, Why, How, and What if questions, each designed to engage students at different cognitive levels. Incorporating these varied questions into instructional tasks and classroom discussions effectively broadened cognitive engagement and creativity, addressing previous imbalances in questioning patterns (Chin, 2006)[4].

3. Related Literature

3.1 Data-Driven Instruction in Vocational English

Incorporating learning analytics into vocational education enhances both instructional quality and feedback effectiveness. While data-driven methods are common in STEM education, their application in vocational English, especially in traditional Chinese contexts, remains limited. This study fills this gap by using the CSMS+ system to assess and improve vocational writing tasks.

3.2 Classroom Interaction and FIAS

Classroom interaction quality is crucial for effective learning. The Flanders Interaction Analysis System (FIAS) is a proven tool for evaluating teacher-student communication patterns. This study uses FIAS to improve interaction quality and encourage student participation in vocational writing instruction (Amatari, 2015)[1].

3.3 Learning Styles and Kolb's Experiential Learning

Kolb's Experiential Learning Theory emphasizes aligning instructional strategies with students' learning preferences to boost engagement. Although it has been widely applied in general education, its use in vocational writing remains limited. This research integrates Kolb's learning styles to better engage students and cater to their cognitive needs (Kolb, 1984; Kolb, A. Y., & Kolb, D. A., 2005)[2][3].

3.4 Pedagogical Questioning and the 4-WH Framework

Effective questioning strategies can stimulate higher-order thinking. The 4-WH framework, though commonly used in general education, has limited application in vocational English. This study employs the 4-WH model to explore its impact on student engagement and writing outcomes (Chin, 2006)[4].

3.5 Synthesis and Research Gap

Existing studies have explored interaction analysis, learning styles, and questioning separately. However, few have combined these approaches in a unified model for vocational English writing. This study addresses this gap by integrating FIAS, Kolb's ELT, and the 4-WH framework within the CSMS+ system, offering a data-driven model for instructional improvement.

4. Methodology

4.1 Research Design

This study used a two-cycle action research design to optimize vocational English writing instruction with CSMS+-driven insights. Each cycle followed the plan-implement-observe-reflect sequence, integrating FIAS interaction analysis, Kolb's learning styles, and the 4-Wh framework. Mixed methods were employed: quantitative data from CSMS+ metrics informed diagnostic evaluation, while qualitative data from interviews and journals contextualized instructional strategies.

4.2 Participants and Context

The study involved 36 first-year Early Childhood Care students (93.6% female, aged 15-17) from a vocational school in China. Pre-test diagnostics showed significant variance in writing proficiency, with a mean score of 61.06/100. Ethical approval was obtained from all relevant stakeholders.

4.3 Data Sources and Instruments

Data were collected using CSMS+ to track classroom interaction, engagement, and questioning patterns. Verbal behavior was coded using FIAS to assess interaction types and structures. Kolb's learning styles were applied to inform task design through the CSMS+ Knowledge-Action Style Module. Question distributions and student writing samples were analyzed

to evaluate improvements in writing proficiency, while video recordings and teacher notes offered qualitative insights into classroom behavior.

4.4 Intervention Design

The intervention involved two lessons on writing formal sick leave notes. Cycle 1 focused on template-based drafting, while Cycle 2 integrated critical-thinking "What if" scenarios, role-playing tasks, and reduced teacher talk time to foster student engagement and improve writing performance.

5. Results

5.1 Classroom Interaction and Questioning Patterns

Teacher talk time decreased significantly from 23 minutes in Cycle 1 to 18 minutes in Cycle 2, leading to a marked increase in student participation. The frequency of complex questioning sequences (IRIRE and IDRE), particularly open-ended "What if" questions, increased by 66.7%, thereby enhancing cognitive engagement and the quality of interactions.

5.2 Writing Performance Improvements

Post-intervention writing samples showed marked progress across key indicators (4-point scale):

Metric	Structural Completeness	Formality	Vocabulary Precision	Grammatical Accuracy	Workplace Relevance
Cycle 1	2.4	2.1	2.3	2.6	2.8
Cycle 2	3.5	3.4	3.2	3.1	3.7
Δ Change	+1.1	+1.3	+0.9	+0.5	+0.9

Scenario-based writing prompts effectively strengthened students' use of contextual and professional language.

5.3 Learning Style Responsiveness

Tasks designed to align with Kolb’s learning styles significantly boosted learner engagement. Notably, Diverging and Accommodating learners demonstrated high completion rates (89%) in interactive tasks, while Assimilating and Converging learners showed marked improvements in structural coherence and formal accuracy.

6. Conclusion

This study underscores the efficacy of data-driven instructional strategies in vocational English writing instruction using the CSMS+ system. Based on the findings, the following clear and actionable teaching strategies are proposed:

Firstly, optimize classroom interaction by minimizing teacher dominance and enhancing student engagement through targeted questioning techniques, particularly by incorporating "What if" questions to stimulate critical thinking and authentic discussion.

Secondly, adopt style-sensitive task designs. Use role-play and scenario simulations to engage Diverging and Accommodating learners, thereby significantly improving participation rates. Concurrently, implement structured activities such as genre analysis and peer critique sessions for Assimilating and Converging learners to deepen their understanding of formal written communication.

Thirdly, integrate workplace-aligned scaffolding into writing tasks. Providing realistic and professionally relevant prompts, such as drafting workplace communications, effectively narrows the gap between classroom exercises and professional competence.

Overall, combining interaction analysis (FIAS), learning styles (Kolb), and structured questioning (4-WH framework) within a CSMS+-enhanced environment significantly enhances the quality of vocational English teaching. These strategies provide a replicable and practical framework for educators aiming to cultivate precise, engaging, and professionally relevant writing skills among vocational students.

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