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The Application of Metacognitive Strategies in College English Writing Instruction: An Exploration for Engineering Majors

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Abstract: The application of metacognitive strategies in college English writing instruction is explored, specifically for engineering majors with intermediate-to-low proficiency in English. Drawing from key theories in applied linguistics, particularly second language acquisition (SLA) and cognitive psychology, how metacognitive strategies—such as planning, monitoring, and reflection—can improve writing proficiency is examined. The study provides a framework for integrating metacognitive approaches within the writing process to help students manage both linguistic and cognitive demands. It addresses the benefits and challenges of these strategies in the context of preparing for the College English Test Band Four (CET-4) and offers practical pedagogical implications for English instructors teaching engineering majors in China.

Keywords: metacognitive strategies; EFL writing; engineering majors; intermediate-to-low English proficiency; pedagogical implications

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1. Introduction

In China, engineering students—such as those majoring in mechanical design manufacturing and automation, and the Internet of Things—typically have a pragmatic approach to learning English as their first foreign language. One of their primary goals is to pass the CET-4, which is required for graduation in some top-tier universities, and serves as a key to future career or postgraduate opportunities. While these students are often proficient in their technical fields, they may struggle with the writing demands of the CET-4 due to language barriers. Writing in English is particularly challenging for students with intermediate-to-low proficiency, as they must navigate both the linguistic and cognitive complexities of L2 writing.

The use of metacognitive strategies—skills that involve planning, monitoring, and reflecting on one's thinking—has been shown to improve language learners' writing abilities. In this context, these strategies can help students approach writing tasks more systematically, particularly under the constraints of standardized exams. Drawing from applied linguistics theories, particularly SLA and cognitive approaches to language learning, this study explores how these strategies can be applied to the writing instruction of engineering majors.

While there is extensive research on metacognition and language learning, there is a lack of studies focusing

specifically on the use of metacognitive strategies in English writing instruction for Chinese non-English majors in technical fields in private universities with intermediate-to-low English proficiency. This study seeks to fill this gap by examining how applied linguistics theories can inform the integration of metacognitive strategies into the writing process for students preparing for the CET-4. It aims to develop a theoretical framework that aligns SLA principles with metacognitive approaches to enhance writing proficiency.

2. Literature Review

2.1. Theoretical Framework

2.1.1. Applied linguistics theories in writing instruction

SLA theories provide crucial insights into language processing and production, particularly regarding cognitive processes in writing and the role of metacognition in managing language skills and task demands. Metacognition— "thinking about thinking"— enables learners to monitor, control, and plan their learning activities (Flavell, 1979) [1]. In writing instruction, this involves helping students reflect on and regulate cognitive processes for generating, organizing, and revising text.

Flower and Hayes' (1981) Cognitive Process Model positions writing as a dynamic, recursive process involving planning, drafting, and revising [2]. Cognitive load theory (Sweller, 1988) suggests learners' working memory becomes overloaded when handling multiple tasks simultaneously [3]. For L2 learners, managing both linguistic accuracy and content organization is cognitively demanding. Metacognitive strategies can reduce this cognitive load by enabling more effective planning, monitoring, and evaluation of writing processes.

2.1.2. Metacognition in SLA

Self-regulation is central to SLA writing research. Zimmerman (2002) demonstrates that students trained in writing regulation strategies—planning, monitoring, and reflection—achieve superior task performance[4]. Vygotsky's sociocultural theory (1978) emphasizes social interaction and guided learning in cognitive and language development[5]. For engineering majors, who typically favor technical over linguistic content, integrating social feedback (peer reviews, teacher input) enhances metacognitive awareness.

Krashen's Input Hypothesis (1985) positions comprehensible target language input as essential for acquisition[6]. In writing instruction, this involves providing field-relevant writing opportunities (technical subjects) with appropriate language models and scaffolding, aligning with CET-4 tasks that address general topics like university facilities, online education, or community service.

2.2. Key Metacognitive Strategies in College English Writing Instruction

2.2.1. Planning

Planning is a critical strategy in writing, particularly for students with lower English proficiency. According to cognitive writing models, effective planning involves both content planning (deciding what to write about) and language planning (determining how to express ideas clearly). For engineering majors, planning involves selecting relevant vocabulary, organizing technical information, and structuring their ideas logically. Metacognitive strategies encourage students to outline key points and decide on appropriate arguments and examples before beginning to write. This preparatory work not only aids in producing coherent essays but also reduces cognitive overload during the actual writing process.

2.2.2. Monitoring

Monitoring is an active strategy that allows writers to assess the quality of their work as they write. For L2 writers, monitoring includes checking both linguistic accuracy (grammar, vocabulary) and content coherence. This is especially important for engineering majors, who may focus more on technical content and neglect language use. Monitoring strategies could include self-checking for common language errors, verifying that the structure of the essay follows a logical progression, and ensuring that the writing remains focused on the prompt. Teachers can encourage students to

use checklists or rubrics to monitor their progress and guide them to evaluate their work based on language accuracy and logical flow.

2.2.3. Reflection and Evaluation

Reflection, the final stage in metacognitive writing strategies, involves evaluating one's writing after the task is complete. This stage is essential for improvement, as it encourages students to consider what worked well and what needs adjustment. For CET-4 preparation, students can reflect on how well they addressed the prompt, whether their essay is coherent, and whether language issues (e.g., grammar, vocabulary) hinder clarity. Reflection also allows students to recognize their writing strengths and weaknesses, empowering them to set goals for future writing tasks. Teachers can foster reflection through peer feedback, self-assessment, or journaling about the writing process.

2.3. Overview of Relevant Empirical Research

Through thematic analysis, Dong and Zhan (2019) conducted an in-depth study of narrative texts from 56 students and found that students in the experimental group demonstrated superior metacognitive knowledge, experience, and strategies compared to the control group [7]. Their task knowledge, strategic knowledge, and subject knowledge were more diverse, their cognitive experiences were richer, and they possessed an awareness that "writing is thinking." This indicates that the application of metacognitive strategies can significantly improve students' writing abilities.

Zhao and Lv (2019) studied English majors' construct cognition of academic English writing and found that most students had insufficient understanding of the four dimensions defining academic English writing ability, particularly lacking relevant cognition regarding academic genres [8]. This suggests that undergraduates face numerous difficulties in academic writing, which may stem from insufficient metacognition about the nature and constituent elements of writing.

Xu and Han (2020) studied how learners process automated writing evaluation (AWE) feedback, and found that learners' behavioral engagement with AWE feedback showed a non-linear increasing trend, while emotional engagement shifted from positive to negative, and cognitive engagement stabilized in the middle and late stages of the experiment, with certain differences in metacognitive strategies among learners of different proficiency levels [9].

Han and Yang (2021) employed a case study method to track the cognitive engagement of a group of non-English major graduate students across three rounds of peer feedback on the same writing task, finding that students' understanding of peer feedback had deepened but remained insufficient, and the use of metacognitive and cognitive strategies showed distinct individual differences in both synchronic and diachronic dimensions [10].

Pan and Wang (2022) explored the strategy use mechanism in integrated reading-writing tasks in the Test for English Majors Band 4 based on structural equation modeling with 193 English major learners, finding that cognitive strategies—namely discourse generation and source text use strategies—played a dominant role in writing performance, while metacognitive strategies—planning and evaluation—had an indirect effect on writing performance through cognitive strategies [11]. This further demonstrates the importance of metacognitive strategies in the writing process.

Wang (2024) explored metacognitive teaching practice pathways with self-assessment as the primary method through classroom teaching practice and reflection, finding that most students were able to develop metacognitive abilities, which promoted their mastery and application of genre-based formal and rhetorical knowledge [12].

In summary, metacognitive strategies play a significantly positive role in college English writing instruction and can help students improve their writing abilities (e.g., Liu & Zhang, 2025 [13]; Wang, 2019 [14]). However, their effectiveness varies among individuals (e.g., Li, 2022 [15]; Zhang & Gao, 2025 [16]), and further research is needed to determine their specific application effects in particular disciplinary contexts.

3. Critical Analysis of Metacognitive Strategies in Writing Instruction

3.1. Benefits of Metacognitive Strategies

3.1.1. Enhanced Writing Proficiency in Exams

Metacognitive strategies can significantly improve students' writing proficiency, especially when preparing for exams like the CET-4. By promoting self-regulation, students become better at planning their essays, monitoring their language use, and reflecting on the overall quality of their writing. This process is particularly valuable under time constraints, as it helps students stay focused and organized. For example, practicing metacognitive strategies with topics commonly found on the CET-4 (e.g., "how to maintain a friendly relationship with classmates" or "the impact of university sports facilities") allows students to quickly structure and articulate their responses, thereby improving their exam performance.

3.1.2. Promoting Long-Term Self-Regulated Learning

The application of metacognitive strategies promotes autonomy and self-regulation, which are crucial for long-term language learning. Engineering students, who may not always feel confident in their English writing skills, can benefit from learning to reflect on their progress and set realistic goals for improvement. Over time, this promotes a shift from teacher-directed learning to independent, student-centered learning, allowing students to take ownership of their writing development.

3.1.3. Improved Confidence and Reduced Writing Anxiety

For non-English majors, writing in English often induces anxiety, especially when faced with exams or academic tasks. By using metacognitive strategies, students can develop a more systematic approach to writing that reduces uncertainty and anxiety. Knowing they have a clear process (e.g., planning before writing, monitoring progress, and evaluating afterward) boosts their confidence and encourages them to engage more deeply with the writing process.

3.2. Challenges of Metacognitive Strategies

3.2.1. Cognitive Load Within Time Constraints

While metacognitive strategies are beneficial, the strict time limits of exams like the CET-4 (30 minutes for an essay) present challenges. Students may struggle to engage in detailed planning, monitoring, and reflection when under pressure. Teachers can address this challenge by introducing time management strategies that allow students to apply these strategies efficiently within time-limited tasks. Practice sessions with timed writing exercises will help students refine their ability to use metacognitive strategies quickly without sacrificing quality.

3.2.2. Balancing Technical Content and Language Accuracy

For engineering majors, the emphasis on technical content often leads to neglect of language accuracy, which can be a challenge during English writing tasks. While students may excel at organizing and presenting technical ideas, they might struggle to express them clearly in English. Metacognitive strategies can help students strike a balance by encouraging them to monitor both content and language simultaneously. Teachers should emphasize the importance of both content coherence (ensuring that the essay fully addresses the prompt) and language precision (correct grammar, appropriate vocabulary). This can be achieved by using tools such as checklists or rubrics, which guide students to assess both aspects during the writing process.

3.2.3. Overcoming Resistance to Reflective Practices

Some students may initially resist engaging in reflective practices, especially if they are accustomed to formulaic or surface-level writing techniques. Since metacognition requires students to reflect on their writing and learning processes, some may feel it is a time-consuming or unnecessary task. Overcoming this resistance requires careful scaffolding by the teacher, who should provide clear examples of how reflection leads to improvements in writing. Teachers can model the reflective process, show students how to apply self-assessment, and create a classroom environment where reflection is

seen as a natural part of writing development rather than an additional burden.

4. Pedagogical Implications

4.1. Designing a Metacognitive Writing Curriculum

4.1.1. Explicit Teaching of Metacognitive Strategies

Teachers should introduce metacognitive strategies step by step, beginning with simple techniques like brainstorming and outlining, and gradually progressing to more complex activities such as peer review and self-reflection.

4.1.2. Task-Based Writing Practice

Since the CET-4 writing section often focuses on broad, practical topics such as “community service” or “university libraries,” tasks should be designed to mirror these topics. This allows students to practice structuring their essays, generating ideas, and applying metacognitive strategies in familiar contexts.

4.1.3. Incorporating Feedback Loops

Feedback from both peers and instructors plays a crucial role in helping students monitor their progress. Teachers can provide targeted feedback on areas where students can apply metacognitive strategies more effectively, such as how they could have better planned their essay structure or reflected on their language use during revision.

4.2. Supporting Students with Cognitive Load Management

Since engineering students may experience cognitive overload when trying to balance language accuracy with content complexity, instructors can teach strategies for managing cognitive load. For example, they might encourage students to focus on one aspect of the writing task at a time (e.g., first focusing on content planning, then switching to language use). Teachers can also introduce chunking techniques to help students break down the writing task into smaller, more manageable steps. This approach reduces the feeling of being overwhelmed by the writing process and allows students to apply metacognitive strategies more effectively.

4.3. Enhancing Peer Review and Collaborative Learning

Peer review can be an effective strategy for promoting metacognitive awareness, as it encourages students to reflect on both their own writing and that of their peers. By analyzing others’ work, students learn to identify both strengths and weaknesses in writing, which can inform their own writing process. Instructors can structure peer review activities to focus on metacognitive reflection, such as asking students to evaluate whether their peer’s essay clearly addresses the prompt, whether the argument is well organized, and how effectively language is used.

4.4. Integrating Technology for Writing Support

Digital tools in Chinese private universities significantly support metacognitive writing strategies. Platforms including Chaoxing Learning Platform, iWrite Platform, Pigai.org, and Unipus Ziyan AI Assistant enable students to engage actively in writing processes, monitor progress, and refine skills through feedback cycles. The technologies develop metacognitive awareness, helping students regulate writing performance and manage cognitive-linguistic demands effectively while preparing them for real-world tasks through continuous self-assessment and improvement.

4.5. Encouraging Self-Reflection through Journaling and E-Portfolios

Self-reflection journals and e-portfolios serve as valuable pedagogical tools, enabling students to document progress, set writing goals, and evaluate performance. The platforms prompt process reflection, helping students identify improvement areas and development needs. E-portfolios collecting writing samples and reflections also facilitate teacher progress

tracking and ongoing support.

5. Conclusion

Incorporating metacognitive strategies (planning, monitoring, and reflecting) into college English writing instruction significantly benefits engineering majors preparing for the CET-4. Students enhance their writing proficiency, cognitive load management, and self-regulated learning while demonstrating how applied linguistics theories from SLA and cognitive psychology can be effectively integrated into technical writing instruction for non-English majors.

Although challenges, including time constraints, balancing content with language accuracy, and student resistance to reflective practices, exist, these can be addressed through strategic curriculum design, feedback-driven learning, and technology integration. This metacognitive approach, grounded in applied linguistics theory, creates a comprehensive framework that equips science majors with tools for both standardized test success and long-term English writing development in their academic and professional contexts.

Disclosure statement

The author declares no conflict of interest.

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