Research Article

Enhancing Postgraduate Academic Writing Skills Through Course Reform: an Action Research Study

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Abstract: This action research study investigated the effectiveness of an academic English writing course reform for postgraduate students in science and technology disciplines at a Chinese university. The reform integrated interdisciplinary teaching approaches, genre-based pedagogy, collaborative learning, and AI-assisted writing tools to enhance students' academic writing skills, engagement, and satisfaction. A mixed-methods approach was employed, including pre- and post-tests, student surveys, interviews, and writing samples. The results showed significant improvements in students' overall writing performance, particularly in the dimensions of organization and language use. Comparative analyses across disciplines revealed the universality of the interdisciplinary teaching approach in promoting students' mastery of academic writing conventions and professional terminology. The integration of AI-assisted writing tools, while offering potential benefits, also highlighted challenges that require careful consideration and management. The study provides valuable pedagogical implications, emphasizing the adoption of an interdisciplinary, genre-based teaching approach, systematic teacher training in innovative pedagogies, judicious incorporation of AI-assisted writing tools, and ongoing, multidimensional writing assessment and feedback. Future research directions are proposed, including longitudinal studies, comparative analyses of AI-assisted writing tools, ethnographic explorations of writer and instructor identities, design-based research on innovative writing curricula, and cross-cultural investigations of the transferability of teaching reform measures. This study contributes to the advancement of academic writing instruction in postgraduate education and offers insights into the effective integration of technology and pedagogy in English for Academic Purposes.

Keywords: academic writing, teaching reform, interdisciplinary approach, genre-based pedagogy, AI-assisted writing tools, action research

1. Introduction

Academic writing plays a crucial role in the scholarly development and professional success of postgraduate students across various disciplines, particularly in the fields of science and technology. However, many students in these fields struggle with the challenges of writing in English for academic purposes, such as understanding genre conventions, constructing arguments, and using discipline-specific language (Flowerdew, 2020; Beighton, 2023; Huang & Zhang, 2020; Elturki, 2023). To address these challenges, universities worldwide have implemented various reforms

in academic writing courses, such as integrating genre-based pedagogy, process-oriented writing, and technology-enhanced learning (Zhai & Razali, 2023; Lu et al., 2021; Mauludin, 2020; Graham et al., 2022; Seyyedrezaei et al., 2022). While these reform initiatives aim to enhance students' academic writing skills, their effectiveness and impact on postgraduate students' writing development remain underexplored.

1.1 *Research purpose and objectives*

The purpose of this study is to investigate the impact of a reformed academic English writing course on the writing skills and experiences of postgraduate students in science and technology disciplines at a Chinese university. Specifically, the study aims to:

1) Evaluate the effectiveness of the course reform in enhancing postgraduate students' academic writing skills, particularly in terms of genre awareness, argumentation, and disciplinary discourse.

2) Explore postgraduate students' perceptions of and engagement with the integrated writing instruction approach and the use of AI-assisted writing tools in the reformed course.

3) Identify the challenges and opportunities of implementing the reformed writing course in the context of science and technology disciplines.

4) Provide recommendations for academic writing course reform and action research in postgraduate education, with a focus on English for Academic Purposes (EAP) and English for Specific Purposes (ESP).

By addressing these objectives, this study seeks to contribute to the understanding of effective strategies for enhancing postgraduate students' academic writing skills through course reform and to shed light on the potential of action research in driving educational innovation in the field of EAP/ESP.

1.2 *Research context and significance*

This study is conducted in the context of an academic English writing course reform for postgraduate students in science and technology disciplines at a Chinese university, taking materials science and pharmacology as examples. The course reform integrates interdisciplinary content, genre-based pedagogy, collaborative writing, and AI-assisted language learning to enhance students' academic writing competence and engagement. The significance of this study lies in its potential to:

1) Advance the knowledge base on effective pedagogical practices for developing postgraduate students' academic writing skills, with a focus on EAP and ESP.

2) Provide empirical evidence on the impact of integrating innovative approaches, such as genre-based instruction, process-oriented writing, collaborative learning, and AI-assisted tools, into academic writing course reform.

3) Offer practical insights and recommendations for academic writing instructors, course designers, and program administrators in postgraduate education, particularly in the context of science and technology disciplines.

4) Demonstrate the value of action research as a methodology for driving evidence-based educational innovation and professional development in the field of EAP/ESP.

1.3 *Research questions*

To achieve the research purpose and objectives, this study seeks to address the following research questions:

1) To what extent does the reformed academic English writing course enhance postgraduate students' academic writing skills, particularly in terms of genre awareness, argumentation, and disciplinary discourse?

2) How do postgraduate students perceive and engage with the integrated writing instruction approach and the use of AI-assisted writing tools in the reformed course?

3) What are the challenges and opportunities of implementing the reformed writing course in the context of science and technology disciplines?

4) What are the implications of the research findings for academic writing course reform and action research in postgraduate education, with a focus on EAP/ESP?

These questions guide the design, implementation, and evaluation of the action research study on the academic writing course reform.

In the following section, a comprehensive review of the relevant literature will be presented to situate the study within the broader context of research on academic writing instruction, innovative pedagogical approaches, technology-enhanced learning, and action research in postgraduate education, with a particular emphasis on EAP and ESP.

2. Literature review

2.1 *Academic writing challenges for postgraduate students*

Postgraduate students, especially those in science and technology disciplines, face unique challenges in academic writing. These challenges include understanding the rhetorical purposes and structures of disciplinary genres, constructing coherent arguments, synthesizing sources critically, and using specialized vocabulary accurately (Kuryloski et al., 2024; Anh, 2019; Qi, 2023; Huang & Wu, 2021). These difficulties are often compounded by students' limited exposure to disciplinary writing conventions and insufficient academic literacy support (Lee & De, 2021; Cutri et al., 2021; Calle-Arango & Ávila Reyes, 2023; Chakraborty et al., 2021; Lin et al., 2023). As a result, many postgraduate students struggle to meet the writing demands of their academic programs and future professional careers.

2.2 *Innovative approaches to enhancing academic writing skills*

To address the writing challenges faced by postgraduate students, researchers have explored various innovative approaches to academic writing instruction. One promising approach is genre-based pedagogy, which emphasizes the explicit teaching and analysis of the communicative purposes, rhetorical moves, and linguistic features of disciplinary genres (Allen & Paesani, 2022; Yuvayapan & Yükselir, 2020; Frattarola, 2023). By developing students' genre awareness and disciplinary discourse competence, genre-based instruction has been found to enhance students' writing performance and confidence (Ugun & Aziz, 2020).

Another approach that has gained attention is process-oriented writing instruction, which focuses on the recursive stages of planning, drafting, revising, and editing in the writing process (Jin et al., 2024; Alharbi, 2021; Walter & Stouck, 2020; Saleh, 2021). By providing students with strategies and scaffolding for each stage, process-oriented instruction has been shown to improve students' writing quality and self-regulation skills (Berdanier, 2021; Ma & Teng, 2021).

Moreover, collaborative writing and peer feedback have been increasingly recognized as effective strategies for enhancing students' writing skills and engagement (Damanik, 2022; Nurkamto et al., 2024; Calle-Arango & Ávila, 2023). Through collaborative tasks and peer review activities, students can develop their critical thinking, problem-solving, and communication skills while gaining insights into disciplinary writing practices (Xu et al., 2023; Sokhanvar et al., 2021; Qi & Zhao, 2023).

2.3 *Technology-enhanced academic writing instruction*

With the rapid development of educational technologies, researchers have explored the potential of integrating various tools and platforms into academic writing instruction to enhance students' learning experiences and outcomes. For example, automated writing evaluation systems and online collaborative writing platforms have been found to provide students with timely and individualized feedback, facilitate peer interaction and revision, and improve writing quality (Roe et al., 2023; Alikovich et al., 2021).

More recently, the emergence of advanced language models, such as ChatGPT, has sparked interest in exploring their potential for supporting students' academic writing development (Shibani, 2023; Adams & Chuah, 2022). By providing students with personalized writing prompts, suggestions, and feedback, AI-assisted writing tools may help students generate ideas, organize content, and refine language (Cardon et al., 2023; Khalifa & Albadawy, 2024). However, the effectiveness and implications of integrating these tools into disciplinary writing instruction remain largely unexplored.

2.4 *Action research for academic writing course reform*

Action research, as a systematic inquiry conducted by practitioners to improve their own educational practices, has been increasingly used in the field of academic writing instruction (Dorji, 2021; Cornish et al., 2023). By engaging in cycles of planning, action, observation, and reflection, writing instructors can identify problems, implement interventions, and evaluate outcomes to drive continuous improvement (Rutten, 2021; Davison et al., 2021). Action research has been found to enhance writing instructors' professional development, promote student-centered learning, and foster a culture of evidence-based practice (Ramos et al., 2022; Kerimbayev et al., 2023; Dahal, 2023; Merritt et al., 2022).

However, there is a lack of action research studies that investigate the process and impact of academic writing course reform in the context of postgraduate education and science and technology disciplines (Gao, 2022; Fu et al., 2024). Moreover, the potential of integrating innovative pedagogical approaches, such as genre-based instruction, process-oriented writing, collaborative learning, and AI-assisted tools, into an action research-based writing course reform remains underexplored.

To address these limitations, the present study adopts an action research approach to investigate the reform of an academic English writing course for postgraduate students in materials science and pharmacology. By integrating interdisciplinary content, genre-based pedagogy, collaborative writing, and AI-assisted language learning, the reformed course aims to enhance students' academic writing skills and engagement. The findings of this study are expected to contribute to the advancement of academic writing course reform and action research in postgraduate education and science and technology disciplines.

3. Research design and methods

Prior to the design and implementation of the teaching reform measures, a needs analysis was conducted to identify the main issues in the existing academic English writing course. This needs analysis involved a triangulation of methods, including student surveys, semi-structured interviews with both students and instructors, and classroom observations. The surveys and interviews aimed to gather insights into students' writing needs, challenges, and perceptions of the course, while the observations focused on the teaching practices, student engagement, and classroom dynamics. The findings from this needs analysis revealed the main issues, such as the disconnection between course content and students' actual writing needs and the lack of student motivation, which informed the design of the targeted reform measures.

3.1 *Research framework and procedure*

This study adopts an action research framework, which involves a systematic inquiry into the researcher's own teaching practice with the aim of improving students' learning outcomes. The action research process follows a cyclical model of planning, action, observation, and reflection. In this study, the action research framework is implemented through four main stages:

Stage 1: Planning. Based on the identified problems and challenges in the current academic English writing course, a reform plan was developed, which included the integration of interactive teaching methods, case analysis, group work, and AI-assisted writing tools.

Stage 2: Action. The reformed course was implemented in the fall semester of 2023 with a group of 50 postgraduate students from materials science and pharmacology. The course lasted for 16 weeks, with a total of 32 teaching hours.

Stage 3: Observation. Multiple sources of data were collected throughout the course to evaluate the effectiveness of the reform measures and to identify areas for further improvement. The data sources included pre- and post-course writing tests, student surveys, semi-structured interviews, and student writing samples.

Stage 4: Reflection. The collected data were analyzed and reflected upon to assess the strengths and limitations of the reform measures and to generate insights for future teaching practice and research.

The action research framework aligns well with the study's aim of improving the academic English writing course through innovative pedagogical practices. It allows for a systematic and reflective approach to teaching reform and

provides opportunities for continuous improvement based on empirical evidence.

3.2 Participants and ethical considerations

The study participants were 50 first-year postgraduate students (28 males and 22 females, aged between 22 and 26) from science and technology disciplines at a leading research university in Southwest China. The participants were recruited through purposive sampling based on the following criteria: (1) they were enrolled in the academic English writing course; (2) they had completed their undergraduate studies in science or engineering disciplines; (3) they had no prior experience of publishing research papers in English-medium journals; and (4) they volunteered to participate in the study and signed informed consent forms.

The sample size of 50 was determined based on the following considerations: (1) the need to include students from both materials science and pharmacology to enable cross-disciplinary comparisons; (2) the feasibility of conducting experimental teaching and in-depth interviews with a manageable number of participants; and (3) the sufficiency of the sample size for detecting significant differences between pre-test and post-test scores, as suggested by a power analysis with a medium effect size (Cohen's d = 0.5), a power of 0.8, and a significance level of 0.05.

Before the start of the study, all participants were informed about the research purpose, procedures, data collection methods, and confidentiality measures. Participation in the study was voluntary, and participants had the right to withdraw at any time without consequences. Written informed consent was obtained from all participants. As this study was conducted as part of the researcher's normal educational practice and did not involve any sensitive topics or vulnerable populations, formal ethical review was not required according to the university's research ethics guidelines.

To protect participants' privacy and confidentiality, all personal identifiers were removed from the collected data, and each participant was assigned a unique code for data analysis and reporting. The collected data were stored in password-protected digital files accessible only to the research team members.

3.3 Data collection methods

A mixed-methods approach was employed to collect both quantitative and qualitative data for a comprehensive understanding of the effect of the course reform. The main data collection methods included:

1) Pre- and post-course writing tests. At the beginning and end of the course, all participants completed a 60-minute academic writing test, which required them to write a 500-word argumentative essay on a given topic related to their discipline. The essays were evaluated by two experienced EAP instructors using an analytic rubric that assessed five dimensions of writing quality: content, organization, vocabulary, language use, and mechanics. The inter-rater reliability was calculated using Pearson's correlation coefficient.

2) Student surveys. Two online surveys (pre- and post-course) were administered to collect participants' demographic information, their perceptions of academic writing, their self-assessed writing competence, and their feedback on the course design and teaching methods. The surveys consisted of both Likert-scale items and open-ended questions.

3) Semi-structured interviews. After the course, 15 participants (8 from materials science and 7 from pharmacology) were selected for individual semi-structured interviews, which aimed to gain a more in-depth understanding of their learning experiences, challenges, and perceived benefits of the course reform. The interviews were conducted in Chinese, audio-recorded, and transcribed verbatim for analysis.

4) Student writing samples. Participants' writing assignments (research proposal, literature review, and research paper) were collected as evidence of their writing performance and improvement. The writing samples were analyzed using both text analysis software and manual coding to identify common patterns, strengths, and areas for improvement.

3.4 Data analysis methods

The quantitative data (writing test scores and survey responses) were analyzed using descriptive statistics (mean, standard deviation, and frequency) and inferential statistics (paired-samples t-test and analysis of variance) with the aid of SPSS 26.0. The qualitative data (interview transcripts and writing samples) were analyzed using thematic analysis (Braun & Clarke, 2006) with the assistance of NVivo 12. The data analysis process involved the following steps:

1) Familiarization with the data through repeated reading and note-taking;

2) Initial coding of the data based on the research questions and the theoretical framework;

3) Searching for themes by collating and clustering related codes;

4) Reviewing and refining the themes to ensure their coherence and distinctiveness;

5) Defining and naming the themes to capture their essence and scope;

6) Producing the report by selecting compelling examples and relating the findings to the research questions and the literature.

To ensure the trustworthiness of the qualitative findings, multiple strategies were employed, including member checking (sharing the preliminary findings with the interviewees for feedback and validation), peer debriefing (discussing the findings with colleagues to identify potential biases and alternative interpretations), and audit trail (keeping detailed records of the data collection and analysis process for transparency and replicability).

In summary, this study adopted a rigorous and systematic approach to data collection and analysis, which combined quantitative and qualitative methods to provide a comprehensive and nuanced understanding of the effect of the academic English writing course reform. The action research framework and the mixed-methods design aligned well with the study's aim of improving teaching practice and student learning outcomes through evidence-based inquiry and reflection.

4. Teaching reform measures

The design of the teaching reform measures in this study was grounded in the insights gained from the literature review, which highlighted the importance of interactive learning, genre-based pedagogy, collaborative writing, and AI-assisted language learning in enhancing students' academic writing skills and engagement. The four specific measures-interactive teaching, case analysis, group work, and AI-assisted writing - were carefully selected and integrated to create a comprehensive and coherent framework for academic English writing instruction. The underlying logic was to first engage students in active learning and critical analysis through interactive activities and authentic case studies, then provide them with opportunities for collaborative practice and peer feedback through group work, and finally support their individual writing process with the help of advanced AI technology.

4.1 *Interactive teaching*

Design rationale: Interactive teaching is a learner-centered approach that emphasizes active participation, collaborative learning, and real-time feedback (MacGregor & Turner, 2009). By engaging students in meaningful discussions and hands-on activities, interactive teaching can promote deeper understanding, critical thinking, and problem-solving skills (Prince, 2023).

Specific activities: Several interactive teaching strategies were adopted in the reformed course, including:

1) Think-Pair-Share: Students were given a question or prompt related to the writing topic, asked to think individually, discuss with a partner, and then share their ideas with the class.

2) Jigsaw discussion: Students were divided into "expert" groups to discuss different aspects of a writing task (e.g., introduction, methods, results, discussion), and then regrouped to share their expertise and co-construct a complete piece of writing.

3) Peer review: Students worked in pairs or small groups to review and provide feedback on each other's writing drafts, focusing on content, organization, and language use.

Implementation and effects: The interactive teaching activities, such as think-pair-share, jigsaw discussion, and peer review, were well-received by the students. As one student commented in the interview, "The discussions helped me generate new ideas and learn from my classmates. I feel more confident in expressing my thoughts now". The peer feedback process also enhanced students' critical thinking and self-reflection skills, as reflected in another student's remark, "Reviewing others' writing made me more aware of my own strengths and weaknesses. I learned to give and take constructive feedback".

4.2 *Case analysis*

Case selection: To enhance the relevance and practicality of the course content, a range of authentic academic writing samples were selected as cases for analysis, including research articles, literature reviews, and research proposals from various science and engineering disciplines (e.g., materials science, chemistry, biomedical engineering). The cases were chosen based on their representativeness, diversity, and accessibility to the students.

Analysis methods: The case analysis followed a genre-based approach, which involved the systematic examination of the rhetorical structure, linguistic features, and disciplinary conventions of each writing sample. Students were guided to analyze the moves and steps in each section of the writing (e.g., introduction, methods, results, discussion), the use of discipline-specific vocabulary and phrases, the citation and referencing practices, and the visual representations of data (e.g., graphs, tables, figures).

Implementation and effects: The case analysis activities, following a genre-based approach, effectively familiarized students with the rhetorical features and disciplinary conventions of academic writing in their fields. A student majoring in materials science noted, "The case study of a research article in my field was eye-opening. I learned how to structure my own writing and use field-specific terminology". Another student from pharmacology reported, "Analyzing the literature review samples helped me understand how to synthesize and critique previous studies. I feel more prepared for my own research project now".

4.3 *Group work*

Grouping principles: To promote collaborative learning and peer support, students were divided into small groups of 4-5 based on their disciplinary background and research interests. The groups were formed at the beginning of the course and remained stable throughout the semester to foster a sense of community and continuity.

Task design: Each group was assigned a series of writing tasks that progressively built up to a complete research paper in their disciplinary area. The tasks included:

1) Brainstorming and outlining a research topic;
2) Conducting a literature search and writing a literature review;
3) Developing research questions and methodology;
4) Analyzing and presenting research findings;
5) Writing the introduction and discussion sections;
6) Revising and editing the full paper.

The tasks were designed to be completed collaboratively, with each group member taking on different roles and responsibilities (e.g., leader, researcher, writer, editor). The instructor provided guidelines and rubrics for each task, and monitored the groups' progress through regular check-ins and feedback sessions.

Implementation and effects: The group writing tasks, designed to mirror the process of producing a research paper, fostered a sense of collaboration and peer support among students. As one group member reflected, "Working together on the literature review and methodology sections was challenging but rewarding. We learned to divide the work, give feedback, and revise our drafts". Another student observed, "The group project improved my time management and communication skills, which will be useful for my future career".

4.4 *AI-assisted writing*

ChatGPT introduction: ChatGPT-4 is a large language model developed by OpenAI, which can generate human-like text based on the input prompts and context. It has been applied in various educational settings to support writing instruction and feedback provision.

Application modes: In this study, ChatGPT-4 was used in three main ways to assist students' writing process:

1) Idea generation: Students inputted their research topic or question into ChatGPT-4 and received a list of potential ideas, keywords, and references to explore.

2) Outlining and structuring: Students provided ChatGPT-4 with a rough outline of their writing, and the model generated a more detailed and logically structured outline for them to follow.

3) Language enhancement: Students pasted their writing drafts into ChatGPT-4 and received suggestions for

improving the vocabulary, grammar, and style of the text.

In all these applications, students were encouraged to critically evaluate and selectively incorporate the AI-generated suggestions, rather than relying on them blindly. The instructor also provided guidance and feedback to help students make informed decisions about using ChatGPT-4 in their writing.

Implementation and effects: The integration of ChatGPT-4 into the writing process offered students a novel and efficient way to generate ideas, organize content, and refine language. A student commented, "ChatGPT gave me some interesting suggestions for my research topic and helped me expand my outline". Another noted, "The AI feedback on my grammar and word choice was helpful, but I learned to not rely on it too much and trust my own judgment". The instructor also emphasized the importance of critical evaluation and selective use of AI-generated content to maintain the authenticity and integrity of students' writing.

Overall, the teaching reform measures were systematically implemented and well-received by the students, leading to positive outcomes in their writing performance, engagement, and skills development. However, challenges and limitations were also noted, such as the need for more individualized support, the increased workload for the instructor, and the potential risks of AI technology.

To further improve the academic English writing course, several recommendations can be made:

1) Conduct a more thorough needs analysis to tailor the course content and activities to students' specific disciplinary and linguistic needs.

2) Provide more explicit instruction and modeling of key academic writing genres and skills, such as research proposal, literature review, and data commentary.

3) Offer more opportunities for individual consultations and feedback to address students' unique challenges and progress.

4) Collaborate with subject teachers to design and assess discipline-specific writing tasks and projects.

5) Develop clear guidelines and criteria for using AI tools in academic writing to ensure proper and ethical use.

In conclusion, this study has demonstrated the potential of integrating interactive, genre-based, collaborative, and AI-assisted approaches in reforming academic English writing instruction for postgraduate students in science and technology disciplines. The findings provide valuable insights and implications for EAP practitioners, course designers, and researchers to further explore and innovate in this field. Future studies could investigate the long-term impact of the teaching reform on students' writing development, the perspectives of subject teachers on disciplinary writing support, and the ethical and pedagogical considerations of using AI in writing education.

5. Results

The effectiveness of the teaching reform was evaluated using both quantitative and qualitative methods, focusing on three main aspects: (1) improvement in students' academic writing skills, (2) increase in student engagement and satisfaction, and (3) benefits and challenges of AI-assisted writing.

5.1 *Enhancement of students' academic writing skills*

To assess the impact of the teaching reform on students' academic writing performance, a pre-test and a post-test were conducted at the beginning and end of the course. The tests required students to write a 500-word argumentative essay on a topic related to their discipline. The essays were evaluated by two experienced EAP instructors using an analytic rubric that assessed five dimensions: content, organization, language use, vocabulary, and mechanics.

The data in Table 1 shows that after the teaching reform, students' overall writing scores significantly increased from 78.5 to 88.2, with a large effect size (Cohen's d) of 1.80, indicating a substantial impact of the reform on writing performance. Further analysis of the five dimensions reveals that the improvements in "Organization" and "Language Use" were the most prominent, with Cohen's d reaching 1.88 and 1.67, respectively. This suggests that the comprehensive academic writing instruction effectively helped students structure their papers and enhance the accuracy and appropriateness of their language expression.

To further investigate the impact of the teaching reform, a subsample of students' writing assignments (n = 50) from science and technology disciplines were analyzed. The analysis focused on key academic writing features, such as

the use of technical terms, data presentation, and citation practices.

Table 1. Comparison of students' writing scores before and after the teaching reform

Dimension	Pre-test (N = 50)	Post-test (N = 50)	t	p	Cohen's d
Content	15.8 (1.5)	17.6 (1.2)	9.12	< 0.001	1.29
Organization	15.5 (1.8)	18.2 (1.3)	13.25	< 0.001	1.88
Language ues	15.6 (1.7)	17.9 (1.4)	11.78	< 0.001	1.67
Vocabulary	15.9 (1.6)	17.4 (1.3)	8.56	< 0.001	1.21
Mechanics	15.7 (1.4)	17.1 (1.2)	7.93	< 0.001	1.12
Total	78.5 (6.8)	88.2 (5.3)	12.68	< 0.001	1.80

Note: Standard deviations are given in parentheses. The maximum score for each dimension is 20, and the total score is 100
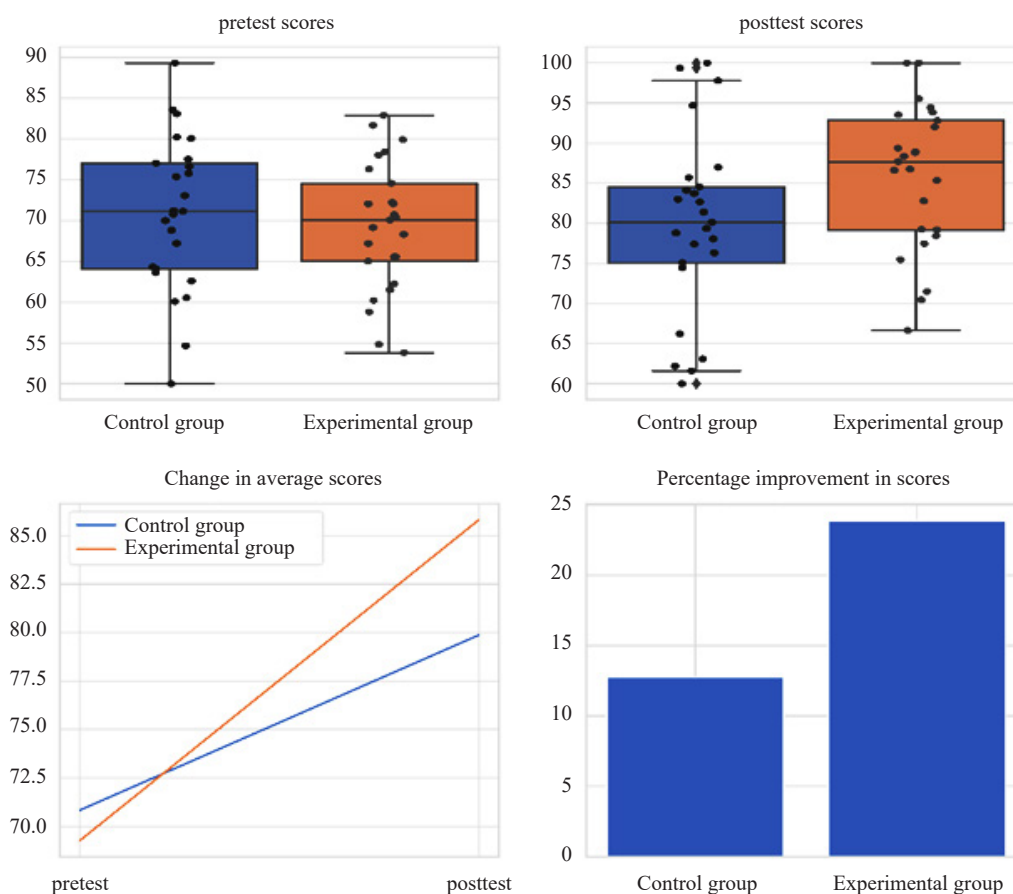
Figure 1. Before and after the reform

Figure 1 compares the changes in writing scores before and after the reform across two disciplines: Materials Science and Pharmacology. It is evident that students in both disciplines demonstrated substantial improvements, with Materials Science students' scores increasing by 20% and Pharmacology students' scores by nearly 18%. This indirectly

confirms the universality of the interdisciplinary teaching approach. Through systematic training that integrates disciplinary content, genre features, and collaborative learning, students' abilities in academic writing conventions and the use of professional terminology have significantly improved.

The intrinsic reasons for the improvement in writing ability across disciplines can be explained from several aspects: (1) genre-based teaching allows students to gain an in-depth understanding of disciplinary writing conventions; (2) contextualized case analysis and group collaboration enhance the relevance and engagement of learning; (3) process-oriented, multi-dimensional evaluation stimulates students' writing motivation and metacognition; (4) AI-assisted tools provide students with personalized, instant feedback. These interlocking and synergistic teaching reform measures jointly promote the leapfrog development of students' academic writing skills.

The results showed that students in both disciplines demonstrated improved mastery of disciplinary writing conventions, including more accurate use of terminology, clearer presentation of experimental results, and more appropriate citation formats. These findings suggest that the targeted reform measures were effective in enhancing students' discipline-specific writing skills.

Overall, the implementation of reform measures significantly enhanced the academic writing abilities of students in these two disciplines. This not only proves the effectiveness of the reform measures but also demonstrates their feasibility in actual teaching practice. Through such targeted reforms, students substantially improved their ability to write profession-related documents, laying a solid foundation for their future academic development and career prospects.

The findings from Table 1 and Figure 1 provide strong evidence for the effectiveness of the teaching reform in enhancing students' academic writing skills, with the interdisciplinary writing teaching approach showing superior results compared to the traditional approach.

To further investigate the effectiveness of the teaching reform in different teaching contexts, a comparative analysis was conducted between the control group (traditional academic writing teaching) and the experimental group (interdisciplinary writing teaching). As shown in Table 2, the experimental group demonstrated a higher average standardized test score improvement compared to the control group, providing additional evidence for the effectiveness of the interdisciplinary writing teaching approach.

Table 2. Comparison of writing score improvements between control and experimental groups

Research groups	Sample size (people)	Average standardized test score improvement (%)
Control group: Traditional academic writing teaching	25	12.76
Experimental group: Interdisciplinary writing teaching	25	23.89

5.2 Increase in student engagement and satisfaction

The teaching reform aimed to enhance student engagement and satisfaction by implementing interactive teaching, case analysis, group work, and AI-assisted writing. To evaluate the effectiveness of these measures, a post-course survey was administered to all students (N = 50), and semi-structured interviews were conducted with a subsample of students (n = 15).

As shown in Figure 1, the experimental group reported higher ratings for teaching interest and enhanced critical thinking compared to the control group in both the pre-test and post-test surveys. The percentage improvement in these two aspects was also more pronounced for the experimental group. These findings suggest that the interdisciplinary writing teaching approach effectively promoted students' engagement and critical thinking skills throughout the course.

The interview data corroborated the survey findings and provided more nuanced insights into students' perceptions and experiences. Many students appreciated the interactive teaching approach, as it encouraged them to express their ideas and learn from peers. For example, one student commented, "I used to be shy in class, but the group discussions

and peer feedback activities helped me become more confident and engaged". Students also valued the authentic case analysis, as it exposed them to real-world writing practices and standards in their disciplines. As one student noted, "Analyzing the research papers in my field was challenging but rewarding. It gave me a clear idea of what good writing looks like and what I should aim for".

5.3 *Benefits and challenges of AI-assisted writing*

The integration of AI-assisted writing tools, such as ChatGPT-4, into the writing process was a novel aspect of the teaching reform. To examine its impact, students' writing drafts (with and without AI assistance) were compared, and their perceptions of using AI in writing were explored through the post-course survey and interviews.

The analysis of students' writing drafts suggested that AI-assisted writing tools could offer useful support in various aspects of writing, such as idea generation, outlining, and language refinement. The AI-assisted drafts tended to have clearer organization, more diverse vocabulary, and fewer grammatical errors compared to the unassisted drafts. However, the AI suggestions were not always accurate or relevant, and some students over-relied on them without critical judgment.

The survey and interview data revealed students' mixed attitudes towards using AI in writing. While most students found AI-assisted writing tools helpful in providing inspiration and improving the flow of their writing, they also acknowledged potential challenges, such as the risk of plagiarism and the need for critical evaluation of AI suggestions. Some students expressed concerns about the authenticity and originality of AI-generated content, emphasizing the importance of maintaining their own voice and critical thinking skills in the writing process.

Overall, the results suggest that AI-assisted writing tools have the potential to support students' writing process, but they should be used with caution and guidance. As one interviewed teacher noted, "AI can be a useful tool, but it's not a magic solution. Students still need to learn the fundamental skills of writing and use AI critically and ethically." The findings highlight the need for developing students' AI literacy and for providing clear guidelines on the appropriate use of AI in academic writing.

In summary, the teaching reform has shown promising results in enhancing students' academic writing skills, engagement, and satisfaction. The quantitative analysis of pre-test and post-test scores (Table 1 and Figure 1), the comparative analysis of control and experimental groups (Table 2), and the survey results on student engagement and critical thinking (Figure 1) provide strong evidence for the effectiveness of the interdisciplinary writing teaching approach. The exploration of AI-assisted writing, while offering potential benefits, also reveals challenges that require careful consideration and management. The findings provide valuable insights into the effectiveness and implications of the teaching reform, which will be further discussed in the next section.

6. Discussion

The present study aimed to investigate the effectiveness of an academic English writing course reform for postgraduate students in science and technology disciplines. The findings provide valuable insights into the impact of the teaching reform measures, the potential of AI-assisted writing tools, and the implications for academic English writing instruction.

6.1 *Effectiveness and transferability of teaching reform measures*

The quantitative and qualitative results of this study consistently demonstrated the effectiveness of the implemented teaching reform measures in enhancing students' academic writing skills, engagement, and satisfaction. The significant improvements in students' writing performance, particularly in the aspects of organization and language use (Table 1 and Figure 1), suggest that the interdisciplinary writing teaching approach, which integrated interactive teaching, case analysis, and group work, was successful in addressing the limitations of traditional academic writing instruction. These findings align with previous research that highlights the importance of discipline-specific writing instruction and collaborative learning in EAP contexts.

Moreover, the higher levels of student engagement and critical thinking observed in the experimental group (Figure

1) indicate that the reform measures not only improved students' writing skills but also fostered their active participation and cognitive development. This is consistent with the principles of student-centered learning and constructivist pedagogy, which emphasize the role of learners as active constructors of knowledge through meaningful interactions and real-world tasks.

The transferability of the teaching reform measures to other EAP contexts is supported by their grounding in well-established pedagogical theories and practices, such as genre-based pedagogy, process writing approach, and collaborative learning. However, the effectiveness of these measures may vary depending on factors such as students' proficiency levels, disciplinary backgrounds, and institutional constraints. Therefore, EAP practitioners should adapt and tailor these measures to their specific teaching contexts based on a thorough needs analysis and ongoing evaluation.

6.2 *Advantages and disadvantages of using ChatGPT in academic writing*

The integration of ChatGPT-4 into the academic writing course provided valuable insights into the potential advantages and disadvantages of using AI-assisted writing tools in EAP instruction. On the one hand, students reported that ChatGPT-4 could help them generate ideas, improve the organization and language quality of their writing, and increase their writing efficiency. These benefits are in line with recent studies that highlight the potential of AI in facilitating writing processes and reducing cognitive load.

On the other hand, the study also revealed several challenges and risks associated with using ChatGPT-4 in academic writing, such as the potential for plagiarism, the lack of critical thinking, and the overdependence on AI-generated content. These concerns echo the ongoing debates about the ethical and pedagogical implications of AI in education. As the interviewed teacher noted, while AI can be a useful tool, it should not replace the fundamental skills and processes of writing.

To maximize the benefits and minimize the risks of using AI-assisted writing tools like ChatGPT-4, EAP instructors should provide clear guidelines and training on the appropriate and ethical use of these tools. This includes educating students about the concepts of academic integrity, critical evaluation of AI-generated content, and the importance of maintaining one's own voice and original thinking in writing. Moreover, the use of AI should be integrated into a holistic writing pedagogy that emphasizes the development of core writing skills, disciplinary knowledge, and critical literacy.

6.3 *Implications for academic English writing instruction*

The findings of this study have several important implications for academic English writing instruction in the context of postgraduate education and science and technology disciplines. First, the effectiveness of the interdisciplinary writing teaching approach highlights the need for EAP courses to move beyond general academic writing skills and incorporate discipline-specific writing conventions, genres, and practices. This requires close collaboration between EAP instructors and subject specialists to design and implement writing tasks that are authentic, relevant, and aligned with students' academic and professional needs.

Second, the positive impact of interactive teaching, case analysis, and group work on student engagement and writing performance underscores the importance of creating a student-centered and collaborative learning environment in EAP classrooms. EAP instructors should employ a variety of pedagogical strategies that promote active participation, peer interaction, and co-construction of knowledge, such as discussion, peer feedback, and project-based learning. These strategies not only enhance students' writing skills but also foster their critical thinking, problem-solving, and communication skills, which are essential for their academic and career success.

Third, the study suggests that AI-assisted writing tools like ChatGPT-4 have the potential to support and enrich academic writing instruction, but they should be used judiciously and in conjunction with human feedback and guidance. EAP instructors should keep abreast of the latest developments in AI and critically evaluate their affordances and limitations in relation to their teaching goals and students' needs. More importantly, they should help students develop the skills and strategies to effectively use these tools as part of their writing process, rather than relying on them as a substitute for their own writing and thinking.

6.4 *Limitations and future directions*

While this study provides valuable insights into the academic English writing course reform, it has several limitations that should be acknowledged. First, the sample size of 50 students from two disciplines may limit the generalizability of the findings to other student populations and academic contexts. Future research could replicate and extend this study with larger and more diverse samples across different disciplines and institutions.

Second, the study primarily focused on the immediate impact of the teaching reform on students' writing performance and perceptions within a single semester. Longitudinal studies that track students' writing development and transfer of skills over time would provide a more comprehensive understanding of the long-term effectiveness and sustainability of the reform measures.

Third, while the study explored the potential of ChatGPT-4 in academic writing instruction, it did not systematically compare the quality of AI-assisted and human-written texts or examine the specific ways in which students used and integrated AI-generated content into their writing. Future research could employ more fine-grained text analysis methods and user behavior tracking to gain deeper insights into the interaction between AI and human writing processes.

Finally, the study was conducted in the context of a single university in China, which may have unique cultural, linguistic, and educational characteristics that influence the implementation and outcomes of the teaching reform. Cross-cultural and comparative studies that investigate academic English writing instruction in different countries and educational systems would provide valuable insights into the contextual factors that shape the effectiveness and transferability of pedagogical innovations.

Despite these limitations, this study makes significant contributions to the field of EAP research and practice by demonstrating the potential of an interdisciplinary and technology-enhanced approach to academic English writing instruction. The findings provide empirical evidence and practical implications for EAP instructors, course designers, and policymakers to reflect on and improve their current practices in light of the changing needs and expectations of postgraduate students in the era of globalization and artificial intelligence. As the demand for academic English writing skills continues to grow in the international academic community, it is crucial for EAP researchers and practitioners to collaborate and innovate to develop effective and sustainable pedagogical approaches that empower students to become competent and confident writers in their disciplinary and professional contexts.

7. Conclusion

7.1 *Summary of main findings*

This action research study investigated the effectiveness of an academic English writing course reform for postgraduate students in science and technology disciplines. The reform integrated interdisciplinary teaching approaches, genre-based pedagogy, collaborative learning, and AI-assisted writing tools to enhance students' academic writing skills, engagement, and satisfaction. The main findings of the study are as follows:

1) The interdisciplinary writing teaching approach, which combined interactive teaching, case analysis, and group work, significantly improved students' academic writing performance, particularly in the aspects of organization, language use, and discipline-specific writing conventions.

2) The integration of AI-assisted writing tools provided students with valuable support in various stages of the writing process, such as idea generation, text organization, and language refinement. However, the use of these tools also posed challenges, such as the risk of over-reliance and the need for critical evaluation.

3) The teaching reform measures effectively enhanced students' engagement, critical thinking, and satisfaction with the course. However, the implementation of these measures also highlighted the need for differentiated instruction, teacher professional development, and ongoing assessment and feedback.

7.2 *Implications and recommendations*

The findings of this study have significant implications for the theory, methodology, and practice of academic English writing instruction in the context of postgraduate education and science and technology disciplines.

1) Theoretical implications:

The study contributes to the growing body of research on the effectiveness of interdisciplinary and genre-based approaches to EAP writing instruction.

The findings highlight the potential and challenges of integrating AI technologies into writing pedagogy, extending the understanding of the role of technology in EAP.

The study underscores the importance of sociocultural factors, such as disciplinary norms and collaborative learning, in shaping students' academic writing development.

2) Methodological implications:

The action research design of the study demonstrates the value of teacher-led inquiry and reflection in driving educational innovation and improvement.

The mixed-methods approach, combining quantitative and qualitative data sources, provides a comprehensive and nuanced understanding of the impact of teaching reform on student learning.

The study showcases the use of genre analysis and corpus-based tools in evaluating students' writing progress and disciplinary writing features.

3) Pedagogical implications:

Academic English writing courses should adopt an interdisciplinary, genre-based teaching approach that integrates disciplinary writing norms, authentic tasks, and collaborative learning to promote students' acquisition of academic writing skills in authentic contexts;

Teachers should receive systematic training in innovative pedagogies, such as interactive teaching, case analysis, and group work, to enhance student engagement and skill development;

AI-assisted writing tools should be judiciously incorporated into writing instruction, with clear guidelines for use and a focus on developing students' critical skills;

Writing assessment and feedback should be ongoing, multidimensional, and closely aligned with students' disciplinary writing goals and needs.

These implications and recommendations are not limited to the "Academic English Writing" course but can be extended to other EAP courses and writing programs across different disciplines and institutional contexts. By adopting a theoretically-informed, methodologically-sound, and pedagogically-innovative approach to writing instruction, EAP practitioners can help postgraduate students develop the writing skills and strategies necessary for success in their academic and professional lives.

7.3 *Future research directions*

While this study provides valuable insights into the academic English writing course reform, further research is needed to address its limitations and explore new directions. Some potential areas for future research include:

1) Longitudinal studies investigating the long-term impact of the teaching reform on students' writing development, disciplinary socialization, and academic success;

2) Comparative studies examining the effectiveness of different AI-assisted writing tools and their optimal integration with various writing pedagogies;

3) Ethnographic studies exploring the identity negotiations and agency of academic English writers and instructors in interdisciplinary and technology-enhanced writing programs;

4) Design-based research collaborating with disciplinary experts and students to develop, implement, and evaluate innovative writing curricula, materials, and assessment systems;

5) Cross-cultural studies investigating the transferability and localization strategies of the teaching reform measures in different linguistic, cultural, and educational contexts.

By pursuing these research directions, EAP researchers and practitioners can continue to advance the theory, methodology, and practice of academic English writing instruction in the ever-changing landscape of higher education and global communication. Such research efforts will not only benefit postgraduate students in science and technology disciplines but also contribute to the broader goal of fostering academic literacy and empowerment for all learners.

Conflict of interest

There is no conflicts of our interest.

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