

Demographic Heterogeneity in the Vocabulary Gains from Generative AI-Supported Task-Based Instruction among Chinese EFL Undergraduates

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Abstract: Traditional vocabulary instruction emphasizes the role of the teacher while neglecting the student's active role in learning. A rote-learning approach to vocabulary instruction prevents students from grasping the basic meanings of words and effective learning strategies, and fails to stimulate their interest in learning. To address these issues, this study draws on second language acquisition theory and the three-phase "pre-task, during-task, post-task" framework of task-based teaching to explore implementation pathways for using Generative Artificial Intelligence (GAI) to enhance English vocabulary instruction for undergraduate students. By leveraging GAI's capabilities in corpus generation, intelligent dialogue, and real-time assessment, this study enriches teaching materials, creates immersive contexts, and provides personalized feedback. These approaches address the pain points of traditional teaching, enhancing students' vocabulary, fluency, and logical reasoning, with the aim of providing a theoretical reference for improving the quality and efficiency of English vocabulary instruction in higher education. The results indicate that GAI-enhanced task-based English vocabulary instruction for undergraduates effectively promotes students' learning motivation, learning strategies, and vocabulary size. Regarding demographic heterogeneity, significant differences were observed between males and females in vocabulary tests (males: 73.18, females: 72.00), as well as in learning motivation and learning strategies, with males demonstrating greater improvement compared to females; Furthermore, significant differences in student motivation were observed across different parental education levels ($t = 4.3058$, $p < 0.01$). This disparity stems from the fact that parents with higher educational attainment generally recognize the long-term value of learning English and prioritize the cultivation of comprehensive competencies such as language proficiency and vocabulary acquisition, thereby subtly shaping students' intrinsic motivation.

Keywords: Second language acquisition; Vocabulary instruction; Task-based approach; Generative artificial intelligence; Demographics

1. Introduction

In today's globalized world, the importance of English as a universal international language is self-evident [1]. In the context of English as a Foreign Language (EFL), how Chinese undergraduates can effectively expand their vocabulary has become a critical issue. Vocabulary learning in EFL is the most fundamental aspect of mastering the language, and expanding undergraduates' vocabulary is a crucial step toward success in EFL instruction [2-3]. However, traditional vocabulary learning methods, which rely primarily on rote memorization and do not emphasize application, are no longer well-suited to this era of higher EFL proficiency requirements [4-5]. The introduction of task-based teaching has effectively addressed this issue, enabling undergraduates to improve their EFL proficiency through practical application.



Task-based teaching is a highly influential language teaching model grounded in second language acquisition research; “tasks” provide both input and output processes for language acquisition [6-7]. Centered on the completion of communicative tasks, instruction is organized around information gathering, problem-solving, and task evaluation. Students engage in natural, meaningful communication through negotiation and discussion. By collaborating with teachers to accomplish language-related tasks, learners acquire language naturally, thereby expanding their EFL vocabulary. The core of this approach lies in its “learner-centered” and “human-centered” philosophy [8–12]. However, current task-based teaching faces numerous challenges, such as a lack of thematic coherence, insufficient practice and application, and a disconnect from authentic communicative contexts. The development and application of generative artificial intelligence (AI) offer solutions to these issues. Generative AI can provide diverse resources and innovative interactive experiences to enhance EFL vocabulary, rapidly generating rich vocabulary materials to meet the needs of learners at various proficiency levels [13–15]. Generative AI can simulate authentic English conversation scenarios, increase the frequency of vocabulary use, and facilitate vocabulary retention [16]. Furthermore, generative AI can assist in creating interactive EFL learning games, making vocabulary learning more engaging and providing enjoyable memorization methods to enhance vocabulary acquisition [17–18].

This study holds both theoretical and practical significance. Theoretically, it aims to broaden the research perspective on the integration of GAI and English education and to refine the relevant theoretical framework. Based on second language acquisition theory and the three-phase framework of task-based teaching (“pre-task, during-task, and post-task”), the study explores implementation pathways for using GAI to enhance English vocabulary instruction for undergraduate students. In terms of practice, this study conducted a pre-post test design with 48 students from a single first-year undergraduate class at a university. Through questionnaires and tests, the study collected and analyzed data on improvements in three areas: motivation, strategies, and vocabulary size. It also examined demographic heterogeneity across three dimensions: gender, place of origin, and parents’ educational attainment.

2. Theoretical Basis and Feasibility

2.1. Theoretical Foundations

The input hypothesis in second language acquisition theory posits that comprehensible input ($i+1$) is a necessary condition for language acquisition; learners must be exposed to language input that is slightly above their current proficiency level in order to improve their skills. In contrast, the updated interaction hypothesis holds that comprehensible input is merely one important component of language acquisition. According to the output hypothesis, second language acquisition requires both comprehensible input and comprehensible output, as comprehensible output serves as an effective means of verifying whether learners have truly internalized the input.

Generative Artificial Intelligence (GAI) can dynamically adjust the difficulty of its output based on students’ current proficiency levels, generating personalized vocabulary learning materials that provide comprehensible input. At the same time, GAI offers richer and more engaging interactive methods and scenarios for English vocabulary instruction. It can also monitor students’ learning progress in real time, providing teachers with timely feedback to help them adjust their teaching strategies.

Task-based teaching is an innovative approach in the field of language education today. It not only ensures the smooth implementation of English vocabulary instruction and enhances classroom teaching efficiency but also aligns with the long-term needs of talent development, helping to cultivate high-quality, versatile, and application-oriented English vocabulary specialists. Task-based teaching divides the instructional process into three phases—“pre-task, during-task, and post-task”—and emphasizes the development of vocabulary application skills through authentic communicative tasks. The deep integration of GAI with the three-stage Task-Based Approach provides tailored support at each stage: in the pre-task stage, it completes task preparation and initial assessment of student proficiency; in the during-task stage, it creates interactive scenarios and provides real-time feedback; and in the post-task stage, it generates personalized evaluation reports and consolidation training plans.

2.2. Teaching Feasibility

As a new-generation information technology, GAI aligns closely with the intrinsic needs of English vocabulary instruction and helps promote both educational equity and teaching quality. Currently, the feasibility of GAI in empowering English vocabulary instruction in higher education is primarily reflected in three dimensions: technology, pedagogy, and student learning adaptation.

First, on the technological front, GAI has established concrete application paradigms in key aspects

of English vocabulary instruction—such as learning diagnostics, real-time feedback, quantitative assessment, and personalized reinforcement exercises—and has demonstrated significant results. For example, NetEase Youdao’s Hi Echo 3.0 can generate personalized vocabulary learning libraries using AI, while the Shanbei Words app offers customized vocabulary learning paths; the technical maturity of these tools has already met pedagogical requirements.

Second, on the pedagogical dimension, GAI can transcend temporal and spatial constraints, extending vocabulary learning from the classroom into daily life and effectively addressing the issue of insufficient class time. At the same time, GAI can handle time-consuming and repetitive teaching tasks, allowing teachers to focus their limited energy on higher-order educational activities.

Third, the dimension of learning context adaptation: As digital natives, today’s college students are curious about and highly receptive to intelligent learning; they generally have experience using GAI and prefer interactive, gamified learning methods. Furthermore, GAI can meet the needs of students at different proficiency levels by providing personalized assessment and tutoring tailored to their individual needs.

3. GAI-Enhanced Task-Based English Vocabulary Instruction

3.1. Instructional Design

Instructional design serves as a bridge between teaching theory and practice; effective instructional design helps learners achieve their learning objectives efficiently. This study adopts Dick Carey’s systematic instructional design model as its framework and employs task-based language teaching as the primary instructional design method to develop GAI-enabled task-based English vocabulary instruction for higher education. By integrating specific instructional content, the study presents an instructional design case tailored to undergraduate majors, as shown in Figure 1.

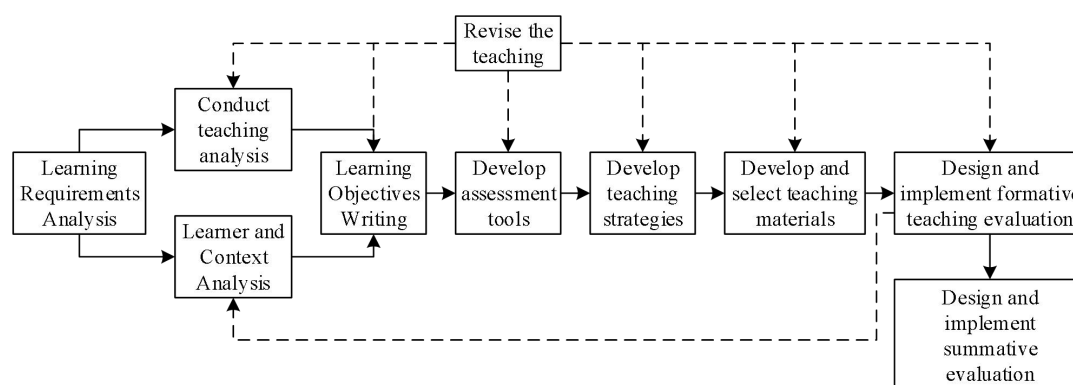


Figure 1. Dick Carey Instructional Design Model

As a systematic theoretical framework with dynamic characteristics, the Dick Carey Instructional Design Model has demonstrated exceptional inclusivity and innovation through continuous iteration and evolution. This model not only consistently integrates cutting-edge educational concepts and emerging technological advancements but also enables in-depth optimization of its own structure and functional expansion. It provides three core pillars of support for this instructional design:

First, systematic analysis lays a scientific diagnostic foundation for this study, helping us precisely identify key obstacles to students’ vocabulary development and thereby determine the optimal entry points for GAI intervention;

Second, the model emphasizes goal-orientation. When constructing a GAI-enabled teaching system, it consistently centers on the core objective of enhancing students’ English vocabulary and professional competence, ensuring that all teaching components and AI applications closely serve this central mission;

Finally, the model emphasizes dynamic adjustment and continuous optimization. During the teaching process, it is necessary to continuously collect student feedback and learning data, conduct in-depth analysis using GAI technology, promptly identify existing issues and shortcomings in teaching, and subsequently adjust teaching strategies to achieve optimal teaching outcomes.

3.2. Development of Teaching Strategies

3.2.1. Selection of Teaching Strategies

The term “teaching strategy” encompasses the sequencing and organization of content, particularly the sequence and arrangement of learning activities, as well as decisions regarding how to deliver content and activities to achieve instructional objectives. In the teaching strategy design section of this study, we have chosen to adopt the three-phase task-based teaching model proposed by Willis: the pre-task phase, the task cycle phase, and the language focus phase.

When designing task-based instruction for undergraduate English vocabulary in higher education using the three-phase task-based teaching model to incorporate GAI, we must fully leverage the strengths of GAI technology to design interactive and engaging teaching tasks that stimulate students’ interest and participation. At the same time, we must emphasize the development of professional competencies in undergraduate English vocabulary instruction by integrating vocabulary application scenarios into various teaching tasks, with the aim of ensuring the authenticity and professional relevance of the tasks.

3.2.2. The Development of Teaching Strategies

In the process of designing task-based English vocabulary instruction for undergraduate students in higher education institutions utilizing GAI technology, we referred to the five sub-components of the three-stage teaching model. By refining instructional tasks in accordance with the principles of language cognition and instructional objectives, we conducted an in-depth analysis of the enabling role of GAI technology in each phase of the teaching process and designed specific implementation strategies, as shown in Figure 2:

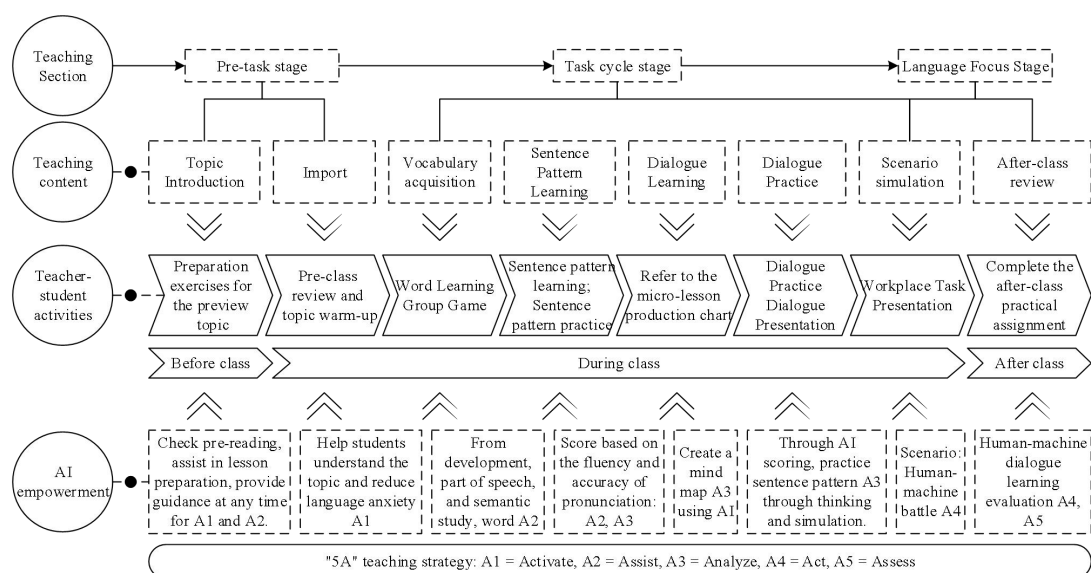


Figure 2. Design Diagram of the "5A" teaching strategy empowered by GAI

(1) In the pre-task phase, GAI activates prior knowledge and stimulates interest (A1: Activate) By exploring students’ existing knowledge base before class and sparking their interest in the relevant topic, GAI prepares them for classroom activities. To this end, designing a pre-class survey can effectively assess students’ foundational knowledge, facilitate advance preparation, reduce learning difficulty, stimulate motivation, and activate their existing subject-specific knowledge.

GAI features used: Generate pre-class surveys to dynamically analyze students’ vocabulary and familiarity with the topic; GAI generates relevant, specialized English learning resources for students to choose from, such as English introductions to different hobbies and skill descriptions for various professions; assist in answering students’ questions during the English learning process, aligning English learning topics with professional characteristics.

(2) In the task cycle phase, **Task 1:** GAI-Guided Learning Assistance (A2: Assist) The instructional content primarily covers foundational vocabulary and sentence structures. Designed teaching activities will closely revolve around these two areas, progressing gradually from basic vocabulary to complex sentence structures. The arrangement of teaching tasks will be meticulously planned based on the characteristics of the instructional content and the specific features of the major. Vocabulary is the cornerstone of language learning; the memorization process requires a

certain amount of time, and different students have varying levels of vocabulary mastery and learning styles. Therefore, group vocabulary competitions can be organized, allowing students to use the GAI voice assistant to play word pronunciations, imitate them, and record their own pronunciations. GAI will provide instant scoring, and the first group to complete the task will earn corresponding points. At the same time, memorizing individual words in isolation is not conducive to learning. Therefore, when designing tasks, GAI can be used to generate contextual scenarios that reinforce memory through sound, form, and meaning. This approach not only meets students' needs for professional English vocabulary learning and motivates them, but also energizes the classroom atmosphere.

Task 2: GAI Analysis of Dialogue and Mind Map Creation (A3: Analysis)

During vocabulary learning, students often face the challenge of determining how to respond in the next sentence. Mind maps are a meaningful learning strategy that can organize information and provide a more systematic visualization of the overall structure. Mind maps can stimulate learners' interest, helping them better recall, generate, and organize necessary information. Therefore, using GAI to analyze dialogues and create mind maps helps students clarify the structure, core content, and professional characteristics of the text, thereby enhancing learning and memory efficiency, reducing learning difficulty, and improving the practicality of language use.

Task 3: GAI Creates Scenarios and Supports Practice (A4: Act)

Limiting vocabulary practice to textbook exercises alone does not meet the requirements of the skill objectives; vocabulary practice within a professional context must be introduced. Given that undergraduate students possess a certain foundation of English vocabulary, GAI technology can be used to customize personalized vocabulary learning. Through interaction with GAI, students engage in extensive input and output, accumulating sentence patterns and vocabulary. This effectively reduces students' anxiety during practical application, thereby improving their vocabulary expression skills.

(3) During the Language Focus phase, GAI evaluates learning (A5: Assess)

In this phase, GAI provides an objective and comprehensive evaluation of students' vocabulary learning outcomes. Through speech recognition and vocabulary completion tests, GAI can analyze students' vocabulary knowledge in real time, identify issues in pronunciation, grammar, and vocabulary usage, and offer specific suggestions for improvement.

4. Empirical Research on Instructional Design

4.1. Research Design

4.1.1. Study Population

This study involved 48 students from a single first-year undergraduate class at a university. Having completed three years of English as a Foreign Language (EFL) instruction in high school, these first-year students possess a clear understanding of their own vocabulary learning motivation and academic characteristics. They have also largely developed their own English vocabulary learning strategies, enabling them to provide a realistic reflection of the current state of vocabulary learning among students. This study did not include a control class. Instead, it analyzed the practical effectiveness of the GAI-empowered task-based English vocabulary teaching model primarily by examining changes in the experimental class's vocabulary learning motivation, learning strategies, and vocabulary acquisition outcomes before and after the action research. Questionnaire surveys on vocabulary learning motivation and strategies were administered to the participants both before and after the action research, and two vocabulary tests were conducted to assess learning outcomes. The demographic statistics of the 48 research participants are shown in Table 1. Since the participants in this study are from the same class with a small age range, this study selected three dimensions—gender, place of origin, and parents' educational attainment—for demographic heterogeneity analysis.

Table 1. Basic Information of the Research Subjects (n=48)

Project	Category	Frequency	%
Gender	Male	18	37.50
	Female	30	62.50
Place of origin	City	21	43.75
	Villages and towns	27	56.25
	High school and below	8	16.67
The educational attainment of parents (taking the highest academic degree)	Junior college	15	31.25
	Undergraduate	18	37.50
	Graduate student	7	14.58

4.1.2. Research Tools

This study developed a questionnaire to assess the current state of vocabulary learning among undergraduate students. The questionnaire consists of 23 questions and uses a five-point Likert scale for scoring. It is divided into two sections: a survey on the current state of motivation for English vocabulary learning and a survey on the current state of strategies for English vocabulary learning. Both sections were developed by referencing authoritative frameworks, conducting interviews with a group of pilot testers, and drawing on the researchers' own experiences with English vocabulary learning. The questionnaire on the current status of English vocabulary learning among college students is shown in Table 2. The section on vocabulary learning motivation adopts Wen Qiufang's classification framework, distinguishing between surface-level and deep-level motivations, with questions primarily designed to assess deep-level motivations for vocabulary learning. The section on vocabulary learning strategies is based on O'Malley and Chamo's classification of learning strategies, divided into three major categories: metacognitive strategies, cognitive strategies, and social strategies, with corresponding questions designed for each.

Table 2. Questionnaire on the Current Situation of English Vocabulary Learning

Dimension		The corresponding question numbers in the questionnaire
Motivation for vocabulary learning		1-3
Vocabulary learning strategies	Metacognitive strategy	4-8
	Social strategy	9-13
	Cognitive strategy	14-23

To ensure the reliability and validity of the questionnaire, I conducted reliability and validity tests using SPSS 19.0 software. The results are shown in Table 3. Cronbach's alpha was 0.875; with a reliability coefficient above 0.7, the questionnaire demonstrates high reliability, indicating that the questionnaire is generally stable and reliable. The KMO value for the questionnaire was 0.734, with a chi-square value of 758.584, 283 degrees of freedom, and a p-value of 0.000. Since the KMO value is above 0.6, the validity of the questionnaire is reasonable.

Table 3. Results of the reliability and validity Test of the Questionnaire

Reliability statistics		
Cronbach's Alpha	0.875	Number of items 23
The test by KMO and Bartlett		
The KMO metric of sampling adequacy		0.734
Bartlett's sphericity test	Approximate chi-square	758.584
	Degree of freedom (df)	283
	Sig.	0.000

This study investigates whether GAI-enhanced task-based English vocabulary instruction can improve the vocabulary size of undergraduate students. The proficiency levels and question types of the vocabulary test are shown in Table 4. When designing the vocabulary test, teachers with extensive teaching experience were invited to participate in its development and to discuss the test format. After multiple rounds of discussion and revision, the test was ultimately structured around four proficiency levels: recall, comprehension, application, and communication. The vocabulary test was developed in alignment with the instructional content of the action research. Students were tested both before and after the implementation of the action research. The two tests were of comparable difficulty, with consistent question distributions and scoring, and both had a total score of 100 points.

Table 4. Details of the Vocabulary Test Paper

Examination level	Question type	Score
Remember	1. Select words by sound	5
	2. Write words based on phonetic symbols	5
Understand	3. Matching of words with English definitions	10
	4. Word selection in single-sentence context	10
	5. Polysemous understanding of one word	10
Application	6. Fill in the correct form of the vocabulary according to the context of the single sentence.	10
	7. Fill in the blanks with words and use the correct form	10
Communication	8. Cloze questions in the text	10
	9. English-Chinese translation of single sentences	10
	10. Situational micro-writing	20

4.1.3. Data analysis tools

The data analysis tool used in this study was SPSS 19.0. This software was employed to analyze the raw data from the questionnaires and vocabulary tests collected before and after the action research. Paired *t*-tests were conducted to investigate the impact of GAI-empowered task-based English vocabulary instruction on students' vocabulary learning motivation, strategies, and learning outcomes, as well as any demographic differences.

4.2. Pre- and post-test results

4.2.1. The Impact on Students' Motivation to Learn Vocabulary

The statistical results of the pre- and post-test samples for students' vocabulary learning motivation are shown in Table 5. The pre-test score was 2.39 ± 0.859 , and the post-test score was 3.15 ± 0.725 . The paired-sample *t*-test for pre- and post-test vocabulary learning motivation, as shown in Table 6, indicates that the Sig. (two-tailed) for the paired data is 0.000, with $P < 0.05$ and a *t*-value of -8.37. This indicates a significant difference between the pre- and post-tests, with a mean difference of -0.76 (pre-test minus post-test). Cohen's *d* (the mean difference divided by the absolute value of the standard deviation) was approximately 1.36. According to Cohen's criteria, $d = 0.2$ indicates a small effect, 0.5 a moderate effect, and 0.8 a large effect. Since $1.36 > 0.8$, the effect size is large, indicating a significant improvement. The above results indicate that GAI-enabled task-based English vocabulary instruction has a highly significant practical effect on enhancing the deep-seated motivation for vocabulary learning among undergraduate students.

Table 5. Pre - and post-test Sample Statistics of Students' Vocabulary Learning Motivation

Paired sample statistics					
Pairing		N	Mean	SD	The SE of the Mean
Pairing	Pre-test of learning motivation	48	2.39	0.859	0.134
	Post-test of learning motivation	48	3.15	0.725	0.092

Table 6. Paired Sample T-Test for Pre - and Post-Test of Vocabulary Learning Motivation

Pairing	Pre-test - Post-test	Mean	SD	The SE of the Mean	95% confidence interval of the difference		<i>t</i>	df	Sig. (Bilateral)
					Lower limit	Upper limit			
					-0.76	0.558			

4.2.2. The Impact on Students' Vocabulary Learning Strategies

The statistical results for the pre- and post-test samples of vocabulary learning strategies are shown in Table 7, and the results of the paired *t* test for the pre- and post-test data on vocabulary learning strategies are shown in Table 8. In all three groups of paired data, the Sig. (two-tailed) value was 0.000 ($p < 0.05$), indicating significant differences. The post-test mean scores for the three dimensions—metacognitive strategies, cognitive strategies, and social strategies—were all higher than the pre-test scores. The *t*-value for metacognitive strategies (with a larger absolute value indicating a stronger effect) was -10.834, the *t*-value for cognitive strategies was -9.007, and the *t*-value for social

strategies was -4.384. This indicates that students' mean scores across all three dimensions were significantly higher after instruction than before. The Cohen's d values for metacognitive strategies, cognitive strategies, and social strategies were approximately 1.75, 1.45, and 0.49, respectively. The order of effect sizes was metacognitive strategies ($d \approx 1.75$) > social strategies ($d \approx 1.45$) > cognitive strategies ($d \approx 0.49$). Based on the above analysis, it is evident that metacognitive strategies showed the most significant improvement, cognitive strategies also saw a substantial increase, while the improvement in social strategies was relatively limited.

Table 7. Pre - and Post-test Sample Statistics of Vocabulary Learning Strategies

		Paired sample statistics			
		N	Mean	SD	The SE of the Mean
Pairing 1	Pre-test of metacognitive strategies	48	2.28	0.893	0.134
	Post-test of metacognitive strategies	48	3.31	0.588	0.081
Pairing 2	Pre-test of social strategies	48	1.85	0.904	0.131
	Post-test of social strategies	48	2.26	0.830	0.107
Pairing 3	Pre-test of cognitive strategy	48	2.83	0.622	0.085
	Post-test of cognitive strategy	48	3.16	0.404	0.062

Table 8. Pre - and Post-test Paired Sample T-Test for Vocabulary Learning Strategies

		Mean	SD	The SE of the Mean	95% confidence interval of the difference		t	df	Sig. (Bilateral)
					Lower limit	Upper limit			
Pairing 1	Metacognitive strategy (Pre-test - Post-test)	-1.03	0.589	0.078	-1.108	-0.788	-10.834	47	0.000
Pairing 2	Social strategies (Pre-test - Post-test)	-0.41	0.283	0.035	-0.481	-0.271	-9.007	47	0.000
Pairing 3	Cognitive strategy (Pre-test - Post-test)	-0.33	0.674	0.094	-0.573	-0.211	-4.384	47	0.000

4.2.3. Impact on Students' Vocabulary Development

The statistical results for the pre- and post-test samples of the total score on the vocabulary improvement test are shown in Table 9, and the paired-sample t test results for the total score are shown in Table 10. The results show that the Sig. (two-tailed) for the paired pre- and post-test data on vocabulary learning scores is .000, with $P < 0.05$ and a t -value of -11.552. This indicates a significant difference between the pre- and post-tests, with the post-test score increasing by approximately -11.66 points compared to the pre-test. The effect size (Cohen's d) is approximately 2.03. According to Cohen's criteria, $d = 2.03 > 0.8$, indicating a very large effect size and a substantial improvement. These results demonstrate that GAI-enabled task-based English vocabulary instruction significantly improved students' overall vocabulary scores.

Table 9. Statistics of Samples Before and After the Total Score of the Learning Effect Test

		Paired sample statistics			
		N	Mean	SD	The SE of the Mean
Pairing	Pre-test of total score	48	60.78	14.085	1.756
	Post-test of total score	48	72.44	10.834	1.374

Table 10. T-test of paired samples before and after the total score of the learning effect test

		Mean	SD	The SE of the Mean	95% confidence interval of the difference		t	df	Sig. (Bilateral)
					Lower limit	Upper limit			
Pairing	Pre-test - Post-test	-11.66	5.734	0.789	-12.731	-8.025	-11.552	47	0.000

4.3. Analysis of Demographic Heterogeneity

4.3.1. Gender Differences

Table 11 shows a comparison of the differences in various metrics between male and female students under GAI-enhanced task-based English vocabulary instruction. Significant differences were observed across all indicators, with male students demonstrating greater improvement in all metrics compared to female students in the GAI-enabled task-based English vocabulary instruction setting. This disparity stems from differences in gender traits: male students tend to be more outgoing and, compared to female students, are more proactive in the classroom. Consequently, in the GAI-enabled instructional environment, male students—leveraging more tool-oriented, high-frequency, and GAI-interactive approaches, coupled with lower language anxiety—are better positioned to achieve significant improvement than female students.

Table 11. Comparison of Differences in English Vocabulary Learning between Different Genders

Indicator		Gender	Mean	Standard deviation	t value
Learning motivation		Male	3.35	0.731	-4.424**
		Female	3.03	0.682	
Metacognitive strategies		Male	3.58	0.633	-5.382**
		Female	3.15	0.704	
Learning strategy	Cognitive strategy	Male	2.32	0.532	-3.184*
		Female	2.22	0.489	
	Social Strategy	Male	3.43	0.580	-5.105**
		Female	3.24	0.615	
Learning effect (Total score)		Male	73.18	5.884	-5.087**
		Female	72.00	5.545	

Note: ** represents $p < 0.005$, * represents $p < 0.01$, the same below.

4.3.2. Place of origin

Table 12 shows a comparison of the differences in various indicators among students from different regions under GAI-enabled task-based English vocabulary instruction. Post-hoc comparisons (using the LSD method) reveal that there are no significant differences in any of the indicators between urban and rural students in the GAI-enabled task-based English vocabulary instruction setting.

Table 12. Differences in Indicators among Students from Different Origins

Indicator		Place of origin	Mean	Standard deviation	t value
Learning motivation		City	3.18	0.704	-1.084
		Villages and towns	3.12	0.688	
Learning strategy	Metacognitive strategies	City	3.34	0.621	-0.634
		Villages and towns	3.32	0.673	
	Cognitive strategy	City	2.25	0.405	0.855
		Villages and towns	2.28	0.433	
Social Strategy		City	3.16	0.620	0.283
		Villages and towns	3.17	0.633	
Learning effect (Total score)		City	72.24	6.084	1.835
		Villages and towns	72.83	5.945	

4.3.3. Parents' educational attainment

Table 13 shows the comparison of various indicators among students with parents of different educational backgrounds under GAI-enabled task-based English vocabulary instruction. It can be seen that, with the exception of learning motivation ($t = 4.308^*$, $p < 0.01$), there were no significant differences across the other dimensions. This difference stems from the fact that parents with higher educational attainment generally recognize the long-term value of learning English and place importance on cultivating comprehensive competencies such as language skills and vocabulary acquisition. These values are actively conveyed to their children in daily life, subtly shaping the students' intrinsic motivation to learn.

Table 13. Differences in Indicators for Different Levels of English Knowledge

Indicator	The educational level of parents	Mean	Standard deviation	t value
Learning motivation	High school and below	2.84	0.683	4.308*
	Junior college	2.95	0.585	
	Undergraduate	3.09	0.734	
	Graduate student	3.25	0.685	
Metacognitive strategies	High school and below	3.28	0.622	1.084
	Junior college	3.32	0.634	
	Undergraduate	3.35	0.560	
Learning strategy	Graduate student	3.34	0.668	1.242
	High school and below	2.21	0.418	
	Junior college	2.25	0.398	
	Undergraduate	2.28	0.385	
Cognitive strategy	Graduate student	2.26	0.405	1.084
	High school and below	3.17	0.634	
	Junior college	3.20	0.685	
Social Strategy	Undergraduate	3.19	0.661	1.084
	Graduate student	3.15	0.692	
	High school and below	73.05	6.047	
	Junior college	72.52	6.580	
Learning effect (Total score)	Undergraduate	72.48	6.725	1.895
	Graduate student	73.09	6.133	
	High school and below	73.05	6.047	

5. Conclusion

Drawing on second language acquisition theory and task-based teaching methods, this study addresses the core challenges in university English vocabulary instruction and has developed a three-phase implementation framework—“pre-task, during-task, and post-task”—for GAI to enhance university English vocabulary teaching. By leveraging GAI to achieve precise diagnostic assessment of student learning, diverse scenario creation, and personalized feedback and evaluation, this approach effectively addresses the three major pain points in traditional vocabulary instruction—lack of context, insufficient guidance, and student anxiety regarding expression. It provides a scientific and practical solution for university English vocabulary instruction, further enriching research outcomes on the deep integration of GAI and English education. Furthermore, the “5A” teaching strategy creatively proposed in this study not only enriches the theoretical framework of English vocabulary instruction for undergraduate students but also provides frontline teachers with concrete and actionable teaching guidance, thereby promoting the development of English instruction toward a more intelligent and efficient direction.

This study still has significant limitations: First, no control experiments were conducted; the effectiveness of the GAI-enabled task-based English vocabulary teaching model was analyzed solely based on changes in vocabulary learning motivation, learning strategies, and vocabulary acquisition among students in the experimental class before and after the action research. Second, the study did not fully account for differences in vocabulary needs among students from different majors, leaving room for improvement in the model’s specificity and adaptability. Future research will focus on two key areas: first, establishing a control group to quantitatively evaluate the effectiveness of the approach through various methods and to optimize and refine it; second, refining teaching content and task design to align with the specific characteristics of different majors, thereby achieving precise alignment between the approach and disciplinary needs. For example, this could involve adding cross-border e-commerce communication scenarios for Business English majors and designing tasks related to doctor-patient communication and academic exchange for medical majors.

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