

Enhancing Vocabulary Mastery through Brain-Based Learning Strategies: A Study on Junior High School Students

Irmayanti Kusuma¹, St. Asriati AM², Ratna Dewi³

¹ Universitas Muhammadiyah Makassar, Makassar, Indonesia; irmayantikusumaaa123@gmail.com

² Universitas Muhammadiyah Makassar, Makassar, Indonesia; sittiasriati@unismuh.ac.id

³ Universitas Muhammadiyah Makassar, Makassar, Indonesia; ratnadewi@unismuh.ac.id

ARTICLE INFO

Keywords:

Brain-Based Learning;
Vocabulary Accomplishment;
Quasi-experimental;
Graphic Organizer;
Word Search Puzzle Game

Article history:

Received 2024-05-20

Revised 2024-10-29

Accepted 2025-06-30

ABSTRACT

Vocabulary plays a critical role in language development, enabling individuals to communicate ideas, comprehend meaning, and foster social interaction. Brain-based learning—an instructional approach aligned with how the brain naturally processes information—engages multiple cognitive functions, such as memory and sensory input, making vocabulary acquisition more effective and durable. This study aimed to examine the effectiveness of brain-based learning in improving students' vocabulary achievement at SMP Dunia Harapan Makassar. A quantitative research method was employed using a quasi-experimental design. Two groups of eighth-grade students (ages 13–14), each consisting of 20 students, were selected based on similar English proficiency levels determined by a pre-test. The experimental group received instruction using brain-based strategies, while the control group followed traditional methods. Data were collected through vocabulary pre-tests and post-tests. The results revealed a statistically significant improvement in vocabulary scores in the experimental group. The mean post-test score of the experimental group was 90.6, compared to 82.6 in the control group. A t-test analysis confirmed that the difference was statistically significant ($p < 0.05$), indicating that brain-based learning had a positive impact on students' vocabulary achievement. The findings support the effectiveness of brain-based learning in enhancing vocabulary acquisition among junior high school students. This approach can serve as a valuable strategy for English language instruction. Brain-based learning significantly improves vocabulary achievement. Future studies should explore its long-term effects and broader application in language learning contexts.

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Corresponding Author:

St. Asriati AM

Universitas Muhammadiyah Makassar; sittiasriati@unismuh.ac.id

1. INTRODUCTION

Brain-based learning calibrates teaching according to how the human brain naturally learns, making it a powerful tool for enhancing vocabulary acquisition in educational settings (Al-Tarawneh et al., 2021; Darmawan et al., 2022; Mohd Yatim et al., 2022). It adapts to diverse learning styles, employing activities that engage multiple brain regions for better memory and understanding. Educational settings should be designed to optimize these benefits to match the brain's natural learning processes (Prenger et al., 2019). Brain-based learning thrives on personalized experiences that optimize cognitive potential and ignite a passion for learning. Implementing Brain-based learning fosters active learning and empowers students to construct their knowledge in diverse and contextual situations (Harden & Jones, 2022). One key area where Brain-based learning can be particularly effective is in the development of vocabulary, a critical factor in the enhancement of English skills. Vocabulary holds crucial significance in language education (Gegenfurtner et al., 2020; Mao et al., 2020; Tsai, 2020). Before students can speak or write in English, they must master the language's vocabulary (Rizky Setiawan & Wiedarti, 2020).

Brain-based learning refers to educational strategies grounded in neuroscience, which emphasize how the brain naturally learns best through methods such as active engagement, multi-sensory experiences, and emotional connection. These strategies can enhance vocabulary acquisition by engaging students in activities that utilize multiple brain regions, thereby improving memory retention and understanding. A strong command of vocabulary is fundamental for effective communication, learning, and critical thinking (Lai & Chang, 2021). This becomes particularly crucial for English students, as their ability to speak and comprehend the subject is intricately linked to their knowledge of vocabulary (Baten et al., 2020; Lau & Richards, 2021; Namaziandost et al., 2020). Additionally, vocabulary acquisition can be enhanced by leveraging Brain-based learning strategies, which presents new words in meaningful contexts, and personalized experiences that align with students' interests and prior knowledge. These methods equip students with essential tools for comprehending written texts and expressing their thoughts, enabling them to engage in meaningful conversations. Vocabulary instruction in a second language, defined as the words we teach (González-Fernández & Schmitt, 2020; McLean et al., 2020), is significantly enhanced when aligned with Brain-based learning principles. Good communication requires a good command of vocabulary (Amirkhanova & Bobyрева, 2020), which is effectively developed through Brain-based learning approaches that cater to the Brain's natural ways of learning and retaining information. By integrating Brain-based learning strategies into vocabulary education, educators can create a more effective and engaging learning environment. This integration not only supports the acquisition of vocabulary but also fosters a deeper understanding and long-term retention of language skills, ultimately leading to better educational outcomes in English as a Foreign Language (EFL) contexts (Jensen, 2005; Rulyansah et al., 2017).

Mastery of vocabulary is essential across all English language competencies (i.e., listening, speaking, reading, and writing) (Koubek & Wasta, 2023; Tarrayo et al., 2021). Vocabulary represents one of the most central yet intricate elements for students of the English language (Chuane et al., 2022; Li et al., 2021). Gaining proficiency in English vocabulary necessitates that students employ particular learning strategies (Duong et al., 2021; Hegarty & Thompson, 2019; Ngu et al., 2021). Moreover, the importance of vocabulary extends beyond basic language proficiency (Banegas & Consoli, 2021; Bell et al., 2020; Knolle et al., 2021; Murray et al., 2023). It plays a pivotal role in creating an environment conducive to effective teaching and learning (Hashim et al., 2022; Machali et al., 2021; Parlindungan et al., 2018). They claim that vocabulary is the main point of English language teaching. Students will only understand others or explain their ideas if they know sufficient vocabulary. Vocabulary is crucial in bolstering a students' capacity to acquire English as a second language (Klimova & Polakova, 2020; Rizky Setiawan & Wiedarti, 2020; Tlili et al., 2021). Nevertheless, teachers often encounter challenges when instructing English subjects, particularly in efficiently imparting vocabulary knowledge to their students. These challenges arise from the students' grasp of the content to be learned and the instructional methods employed. This is due to certain students not being aware of what is required to become proficient in vocabulary. For successful vocabulary instruction, an English teacher must be discerning in choosing and applying suitable strategies (Hasram

et al., 2021). A strong vocabulary foundation lays the groundwork for effective communication (Arop et al., 2020; Horwood et al., 2019; Ngu et al., 2021). Nonetheless, the initial step for Junior High School students should be to acquire a foundational inventory of words and develop their vocabulary. The more they learn and memorize a stock of words, the easier their communication is (Am et al., 2023; Asriati et al., 2022)

In the absence of words that convey a wider array of meanings, effective communication in a foreign language is unattainable (Wang et al., 2021). Teachers play a pivotal role in enhancing vocabulary achievement by recognizing and addressing the specific needs of Junior High School students. Vocabulary development is critical at this stage, as it directly influences students' overall language proficiency.

One effective approach is Brain-based learning, which incorporates strategies that engage multiple cognitive pathways. First, visual strategies are instrumental in teaching vocabulary by using materials like drawings, pictures, and graphs to facilitate understanding and retention (Birinci & Sariçoban, 2021). These visuals not only motivate learners but also provide clarity on language context, serving as specific points of reference (Tiawati et al., 2023). Research shows that visual aids, such as pictures, are especially effective at capturing students' attention and aiding lower-level learners in grasping word meanings (Hashim et al., 2022). This approach has been widely used to enhance comprehension among younger students. (Ren et al., 2021).

Second, graphic organizers help simplify complex information by visually mapping relationships between ideas (Sustersic et al., 2019). These tools allow students to better understand vocabulary and organize concepts in preparation for tests (Andrä et al., 2020). Graphic organisers, including word maps and concept maps, prevent students from becoming overwhelmed by organizing information in a structured manner (Estacio et al., 2022; Sabarun et al., 2023). By tailoring these organizers to the students' learning levels, teachers can improve both instruction and assessment (Alzahrani, 2023).

Lastly, word search puzzles provide an interactive method to reinforce vocabulary learning. As players search for words hidden within a matrix, they develop both precision and attention to detail (Beelders, 2023; Rolison & Lamarche, 2023). These puzzles are particularly useful in enhancing vocabulary recall through gamification, making learning more engaging (Nirmal et al., 2020). Educational games, such as word searches, offer customizable levels of challenge, allowing teachers to adapt them to various learning needs (Checa & Bustillo, 2020).

This research aims to enhance vocabulary achievement among Junior High School students by applying Brain-based learning strategies. Specifically, we investigate how visual aids, graphic organizers, and word search puzzles can significantly improve vocabulary retention and comprehension. The hypothesis guiding this study is that the integration of these strategies will lead to measurable improvements in students' vocabulary performance.

2. METHODS

This research employed a quasi-experimental design involving control and experimental groups (W.Creswell & N.Poth, 2018). A total sample of 40 students from SMP Dunia Harapan Makassar was selected through purposive sampling based on specific inclusion criteria, such as age (13-14 years) and similar English proficiency levels determined by a pre-test. Each group consisted of 20 students, with one group serving as the control and the other as the experimental group.

The data was collected using both a pre-test and post-test. Before the intervention, a pre-test was conducted to assess students' vocabulary achievement. The vocabulary pre-test consisted of 25 questions covering various aspects of job-related vocabulary. During the intervention phase, the experimental group participated in three sessions of Brain-based learning strategies, each lasting 2 x 40 minutes. The first session focused on visual strategies, where students engaged in activities such as picture-word associations and visual storytelling to reinforce vocabulary. In the second session, students used graphic organizers to categorize and map out job-related vocabulary, facilitating deeper understanding. The final session involved the word search puzzle, where students worked individually and in pairs to locate and

define target vocabulary. These activities were designed to align with the research objectives and actively involve students in processing language through multisensory engagement. Meanwhile, the control group received their regular instruction without the use of Brain-based learning strategies, covering the same vocabulary content. After the intervention, both groups completed a post-test to assess changes in vocabulary achievement. The experiment followed a structured process, where data was collected, processed, and analyzed using Microsoft Excel. The data processing involved organizing the raw data into spreadsheets, followed by performing descriptive statistical analysis, including calculating means to compare the experimental and control groups. The control group received regular instruction, which involved other teaching methods. In contrast, the experimental group experienced brain-based learning strategies, which emphasized activities targeting cognitive functions, including memory and problem-solving skills. Experimental research aims to identify and formulate problems while explaining the impact of treatments on outcomes (Sugiyono, 2013; Wu & Alrabah, 2020)

3. FINDINGS AND DISCUSSION

3.1 Findings

3.1.1 The Mean Score and Gain Score of Students' Vocabulary Achievement in Experimental Class

The results of this research are elaborated in the following description, which stems from the comparison of pretest and posttest results from both experimental and control groups. The analysis aims to assess the effectiveness of Brain-based learning strategies in increasing students' vocabulary achievement. These findings are structured to compare the instructional impact between classes that do not implement Brain-based learning strategies and those that do. This certainly provides insights into the respective influences of each strategy on enhancing students' vocabulary understanding.

Here is the following result of students' vocabulary achievement in the experimental class, as follows:

Table 1. The Mean Score and Gain Score of Students' Vocabulary Achievement in Experimental Class

No.	Vocabulary Achievement sub-themes	Mean		Gain Score (O ₂ -O ₁)
		Pretest (O ₁)	Posttest (O ₂)	
1.	Types of Jobs	84	94	10
2.	Proper names related to Jobs	63	87	24
3.	Adjectives attached to Job 1	77	92	15
4.	Adjectives attached to Jobs 2	80	92	12
5.	Adjectives attached to Jobs 3	64	88	24
Average		73.6	90.6	-

Table 1 presents the mean and gain scores of students' vocabulary achievement in the experimental class, measured before (pretest) and after (posttest) the implementation of Brain-Based Learning. Based on the data from 20 students, the average pretest score was 73.6. The highest pretest score, 84, was recorded in the *types of jobs* sub-theme, while the lowest score, 63, was found in the *proper names related to jobs* sub-theme. The mean scores for the *adjectives attached to jobs* sub-themes 1, 2, and 3 were 77, 80, and 64, respectively.

After applying Brain-Based Learning strategies—which included visual materials, graphic organizers, and a word search puzzle game—the students' scores improved significantly. The average posttest score rose to 90.6. The highest posttest score was 94 in the *types of jobs* sub-theme, and the lowest

was 87 in the *proper names related to jobs* sub-theme. The mean scores for *adjectives attached to jobs* 1, 2, and 3 increased to 92, 92, and 94, respectively. These results suggest that the use of Brain-Based Learning had a substantial positive impact on students' vocabulary achievement.

3.1.2 The Rate Percentage of the Frequency of the Pretest and Posttest in the Experimental Class

Here is the table that shows the rate percentage of the frequency on the pre-test and post-test in the experimental class:

Table 2. The Rate Percentage of the Frequency on the Pretest and Posttest in the Experimental Class

No.	Classification	Scale	Pre-test		Post-test	
			F	P	F	P
1.	Excellent	90-100	1	5%	10	50%
2.	Good	75-89	10	50%	10	50%
3.	Fair	60-74	6	30%	-	-
4.	Less	50-59	3	15%	-	-
5.	Poor	0-49	-	-	-	-
Total			20	100%	20	100%

Table 2 shows how Brain-based learning boosted students' vocabulary skills in the test group. Before the intervention, only 5% of students were classified as "Excellent". However, after this jumped to 50%, showing a significant improvement. The number of students in the "Good" category stayed at 50%. There were no students in the "Fair," "Less," or "Poor" categories after the intervention, suggesting a possible change in performance. Overall, Brain-based learning helped students improve their vocabulary, especially those classified as "Excellent."

The students' vocabulary achievement significantly enhanced after implementing Brain-based learning strategies. Before the intervention, only 5% of students were classified as "Excellent," but this figure rose to 50% after the intervention. Additionally, there were no students in the "Fair," "Less," or "Poor" categories after the intervention, indicating a consistent improvement. It indicated that Brain-based learning is effective in enhancing students' vocabulary achievement.

3.1.3 The Main Score and Gain Score of Students' Vocabulary Achievement in Control Class

Here is the following result of students' vocabulary achievement in control class, as follows:

Table 3. The Mean Score and Gain Score of Students' Vocabulary Achievement in Control Class

No.	Vocabulary Achievement Sub-themes	Mean		Gain Score (O ₄ -O ₃)
		Pretest (O ₃)	Posttest (O ₄)	
1.	Types of Jobs	80	94	14
2.	Proper names related to Jobs	63	80	17
3.	Adjectives attached to Job 1	75	82	7
4.	Adjectives attached to Job 2	80	87	7
5.	Adjectives attached to Job 3	56	70	14
Average		70.8	82.6	-

Table 3 displays the mean score and gain score of students' vocabulary achievement in control class before (pretest) and after (posttest) not using the Brain-based learning strategies. From this table, it can be seen that from 20 students, the average mean score in pretest is 70.8. The students' highest score in pretest is 80 in the types of jobs sub-theme. While, the students' lowest score is 56 in adjective attached to jobs 3. However, the students' mean score in proper names related to jobs is 63 and adjectives attached to jobs 1 and 2 are 75 and 80. Then, in posttest, the students' score is not significantly increased. It can be seen by the average mean score in pretest is 90.6. The students' highest score is 94

in the types of job sub-theme. While, the students' lowest score is 70 in the adjectives attached to jobs sub-theme. Although, the students' mean score in proper names related to jobs is 80 and adjectives attached to jobs 1 and 2 are 82 and 87.

3.1.4 The Rate Percentage of the Frequency on the Pretest and Posttest in the Control Class

Here is the table that shows the rate percentage of the rate percentage of the frequency on the pre-test and post-test in the control class:

Table 4. The Rate Percentage of the Frequency on the Pretest and Posttest in the Control Class

No.	Classification	Scale	Pre-test		Post-test	
			F	P	F	P
1.	Excellent	90-100	-	-	4	20%
2.	Good	75-89	10	50%	15	75%
3.	Fair	60-74	8	40%	1	5%
4.	Less	50-59	2	10%	-	-
5.	Poor	0-49	-	-	-	-
Total			20	100%	20	100%

Table 4 presents the distribution of students' performance levels before and after the test, categorized into five achievement levels. In the pretest, 10 students (50%) were classified as "Good," 8 students (40%) as "Fair," and 2 students (10%) as "Less." No students were categorized as "Excellent" or "Poor." Following the posttest, notable improvements were observed: 4 students (20%) achieved an "Excellent" rating, 15 students (75%) were rated as "Good," and only 1 student (5%) remained in the "Fair" category. No students fell into the "Poor" category after the intervention.

Overall, the posttest results indicate a positive upward trend in student performance, with more students achieving higher proficiency levels. However, despite these improvements, the increase was not statistically significant in terms of vocabulary achievement when comparing the control and experimental groups. In other words, the vocabulary gains in the control group did not show a substantial difference compared to those in the experimental group.

This improvement in vocabulary achievement among students taught using Brain-Based Learning is further illustrated in the graph below.

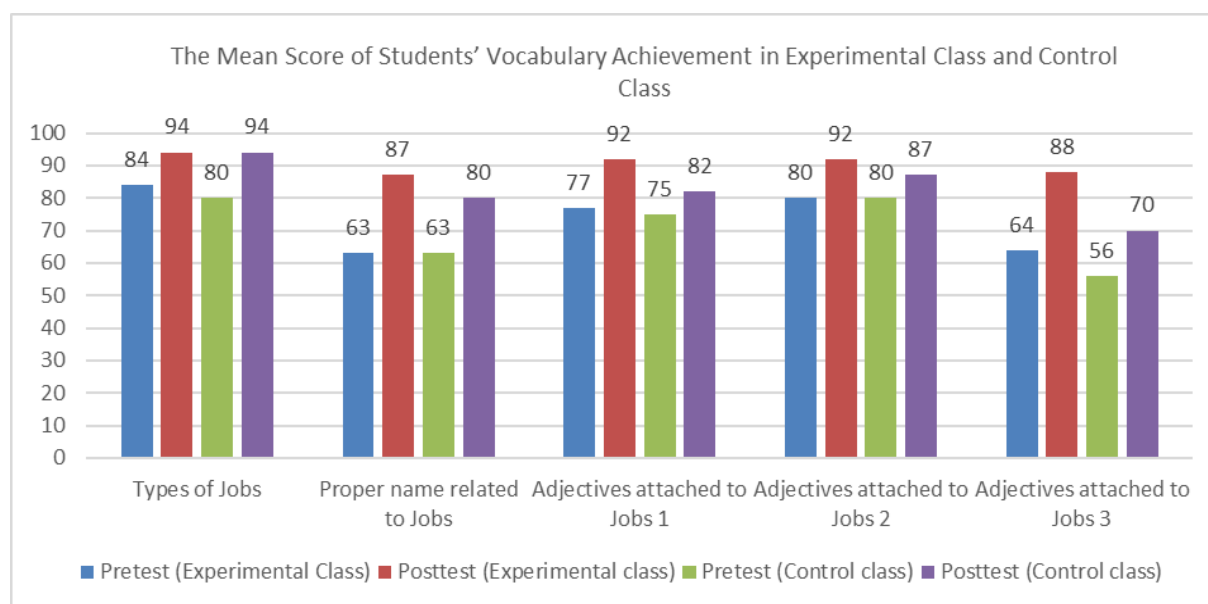


Figure 1. The Mean Score of Students' Vocabulary Achievement in Experimental Class and Control Class

Analysis of post-test scores, as shown in Figure 1, indicates a significant improvement in student vocabulary achievement after implementing Brain-based learning strategies. Initial data shows an average pre-test score in the experimental class of 73.6 among 20 students in Class VII B, with the highest score reaching 84 (types of jobs) and the lowest 63 (Proper name related to jobs). It suggests that, before the intervention, most students in Class VII B demonstrated standard comprehension or retention abilities regarding vocabulary.

There was a notable increase in scores after implementing Brain-based learning strategies. The average post-test score rose to 90.6, marking a significant improvement in vocabulary achievement. The highest post-test score reached 94 (Types of Jobs), while the lowest recorded score was 87 (Proper name related to Jobs). These changes highlight the effectiveness of brain-based learning strategies in enhancing student vocabulary achievement and indicate their potential to improve students' fundamental competencies in composition significantly. These results affirm the positive influence of Brain-based learning on enhancing students' vocabulary achievement in learning English.

3.2 Discussion

Brain-based learning has been proven effective in enhancing students' vocabulary achievement. In Brain-based learning, English language instruction focuses on improving academic achievement in the short term and enhancing the likelihood of retaining learned information and knowledge for the long term (Lagoudakis et al., 2022). Strategies of learning like this facilitate practice and vocabulary achievement improvement. Given its potential benefits, this research was designed to assess the use of Brain-based learning in enhancing students' English vocabulary using experimental and control groups, starting with a pretest to ensure comparable vocabulary achievement in both groups.

These findings align with previous research, reinforcing the efficacy of Brain-based learning strategies. According to (Darmawan et al., 2022), using Brain-based learning strategies has the potential for significant and positive impacts on students' vocabulary achievement. It involves active student participation, discussing issues in groups, sharing ideas, and staying focused during various classroom activities. Additionally, according to (Harden & Jones, 2022), there is a significant improvement in brain-based learning outcomes in enhancing vocabulary acquisition and retention. This study includes various activities such as visual storytelling, group discussions, roleplaying games, and recreation to ensure and enhance vocabulary retention.

In particular, to enhance vocabulary achievement, visual materials, graphic organizers, and word puzzle games are applied during the learning process as Brain-based learning strategies (Klimova & Polakova, 2020; Lai & Chang, 2021). This research highlights the significant role of Brain-based learning in improving students' vocabulary understanding, especially in the context of English language learning in junior high school. Data analysis results show that the experimental classes applying this approach achieved remarkable improvements in vocabulary understanding related to jobs, with post-test scores consistently indicating significant improvement. These findings indicate that Brain-based learning can enhance students' vocabulary achievement, as supported by previous research. Active strategies such as student participation, group discussions, visual materials, graphic organizers, and word puzzle games played a crucial role in improving vocabulary retention and contextual understanding of the English language. Thus, Brain-based learning provides short-term benefits in enhancing English language skills and long-term benefits by improving the retention of learned knowledge.

However, to effectively apply brain-based learning in teaching English, teachers need to have a strong understanding of the principles of neuroscience and how they relate to learning, flexibility in teaching to adapt approaches to individual learning styles, skills in designing learning that utilizes Brain-based learning principles, the ability to facilitate student interaction and collaboration, awareness of the importance of the learning environment (Ratnasari et al., 2024), and the ability to reflect on and adjust teaching practices regularly. With this combination of factors, teachers can create a learning

environment that supports increased retention of information, communication skills, and student engagement in English language learning (Karapetian, 2020).

Finally, research conducted at SMP Dunia Harapan Makassar, South Sulawesi, demonstrates the effectiveness of Brain-based learning strategies in enhancing students' vocabulary achievement. The success of these strategies is attributed to the implementation of appropriate Brain-based learning teaching strategies. Consequently, teachers (Chang et al., 2020) can foster a dynamic and captivating language learning environment that corresponds with the brain's natural way of acquiring and processing information effectively. This directly addresses students' challenges in vocabulary comprehension, fostering their motivation to learn and significantly improving their vocabulary acquisition skills (Andrä et al., 2020). These findings underscore the flexibility of Brain-based learning strategies, showcasing their applicability in enhancing students' vocabulary achievement.

4. CONCLUSION

The purpose of this research was to examine the impact of brain-based learning strategies on students' vocabulary proficiency. The findings reveal that these strategies significantly enhance vocabulary skills, with the experimental group, who received brain-based instruction, demonstrating marked improvements in vocabulary mastery compared to the control group. Specifically, the experimental group showed a higher retention rate, greater accuracy in word usage, and a broader understanding of vocabulary than their peers in the control group. These results underscore the effectiveness of brain-based learning in fostering deeper comprehension and long-term retention of vocabulary. While the study highlights the positive impact of brain-based learning on vocabulary mastery, it is essential to acknowledge its limitations and consider the broader implications for educational practice and policy. Specifically, the findings are tailored to the particular educational setting and grade level studied, indicating the need for further research to explore the effectiveness of brain-based learning strategies across diverse contexts and age groups. Nevertheless, these insights offer valuable guidance for educators and policymakers aiming to enhance student learning outcomes through neuroscience-informed practices. By fostering a more comprehensive understanding of how brain-based strategies can be integrated into curricula and teaching methods, this research has the potential to inform future educational reforms and improve long-term student success. The significance of this study lies not only in its immediate contributions but also in its potential to shape the future of education, offering a path toward more effective, research-driven teaching practices.

Acknowledgements: We extend our gratitude to the SMP Dunia Harapan Makassar teachers for their assistance in data collection and to all individuals involved, including English lecturers, for their support throughout this research endeavor, enabling its optimal completion.

Conflicts of Interest: There is no conflict of interest in this research.

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