

Improving english as a foreign language learners' vocabulary and reading comprehension through crossword-assisted teaching

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Article Info

Article History:

Received: October 18, 2024

Revised: November 14, 2024

Accepted: November 30, 2024

DOI: 10.20885/jee.v10i2.36336

Abstract

Numerous studies have demonstrated the effectiveness of crossword-assisted teaching for English as a foreign language (EFL) instruction. The present study evaluated the effectiveness of this technique in the Chinese-speaking EFL environment. Two cohorts of junior college students participated in this study. Both groups completed a vocabulary and reading skill pretest, which revealed no significant differences between the groups. For convenience, a larger cohort of 34 students was designated as the experimental group, and a smaller cohort of 32 students was designated as the control group. During the study, crossword-solving tasks and quizzes were integrated into the instruction provided to the experimental group, whereas traditional lecture-based instruction was provided to the control group. After the study, both groups underwent the same posttest. The experimental group significantly outperformed the control group in both vocabulary knowledge and reading comprehension. Additionally, the experimental group students' responses to a learning attitudes questionnaire indicated their favorable perceptions of the use of crosswords in instruction. Therefore, this study verified the effectiveness of crossword puzzles in a non-Western linguistic learning environment, reinforcing the value of crosswords for EFL teaching.

Keywords: Crossword-assisted teaching, English as a foreign language, Learning attitude, Reading comprehension, Vocabulary knowledge

INTRODUCTION

English is the most learned and widely used foreign language in Taiwan and is a major academic subject. Students' performance in this subject in an entrance examination can determine their enrolment into schools and consequently programs. In addition to its importance in education, English proficiency is a criterion for employment, with several public sector appointments and industry positions requiring the demonstration of certain levels of English proficiency by candidates ([104 Corporation, 2021](#); [Yam News, 2023](#)). Cognizant of this requirement, the Taiwanese government has officially recognized the global influence of English as a "medium of international and intercultural communication that continues to grow in importance and popularity" ([Ministry of Education, 2018](#)).

The author has an academic background in teaching English as a second language (TESOL) and 21 years of classroom teaching experience. Throughout the 21 years of teaching experience, the author has observed that several students exhibit low motivation for and a negative attitude toward learning English, an observation supported by feedback from students and colleagues. In Taiwan, students often learn English only because the subject is mandatory; they are often unable to apply the language outside of the classroom in terms of composing lexically correct and semantically meaningful sentences. Additionally, teachers and schools prioritize teaching the prescribed content according to a fixed timetable, with the primary objective of helping students pass or demonstrate proficiency in entrance or job-related licensing examinations; little time is allocated for language practice in real-world scenarios, and few opportunities to practice with native English-speaking language partners are available.

Vocabulary is the foundation of language comprehension and usage ([Learning Point Associates, 2000](#); [Schmitt & McCarthy, 1997](#); [Wilkins, 1985](#)). In the 21st century, interventions incorporating crossword puzzles into English as a foreign language (EFL) instruction have emerged. Numerous EFL/English as a second language (ESL) classroom teachers and researchers have explored whether the use of crosswords can enhance learners' vocabulary acquisition and overall language proficiency ([Alda & Wati, 2021](#); [Burston, 2005](#); [Davis et al., 2009](#); [Derer & Berkant, 2020](#); [Keshta & Al-Faleet, 2013](#); [Lestari & Yulia, 2018](#); [Merkel, 2016](#); [Mustika et al., 2022](#); [Njoroge et al., 2013](#); [Orawiwatnakul, 2011](#); [Puspita & Sabiqoh, 2017](#)). These studies have revealed the effectiveness of crossword puzzles for assisting EFL teaching and enabling vocabulary acquisition.

As a dedicated Taiwanese EFL teacher, the author has investigated valid and effective approaches that can enhance learners' vocabulary; these approaches can also supplement rote memorization techniques. Taiwanese learners of English primarily focus on memorizing as many English (L2 or second language) words and their Chinese translations as possible ([Liao, 2004](#); [Yeh & Wang, 2004](#)). In this environment, learners acquire L2 words in the absence of context and fail to grasp their meaning, rendering them unusable outside of examinations. Mayer (2002) observed that such an approach constitutes rote learning. Moreover, Ausubel (1963) described that such methods cannot produce meaningful learning outcomes.

An additional consideration in EFL learning involves comparative linguistics. Acquiring L2 (second language) vocabulary is a complex process ([Ryan, 1997](#)). Moreover, the degree of similarity between an L1 (first language) and an L2 determines the ease or difficulty in learning the L2, with greater similarity between the languages facilitating L2 learning ([Schmitt & McCarthy, 1997](#)). Substantial differences exist between Mandarin Chinese and English in terms of orthography, phonology, syntax, and semantics. The Chinese language is not based on alphabets. Chinese characters are composed of several strokes, such as "英文"

(*yingwen*, “English language”). Each of these two characters consists of multiple strokes, and each character represents a single syllable. In terms of syntax, Chinese is less amenable to subject-verb inversion than English, and the verbs cannot be conjugated, rendering the construction of verbal phrases challenging. Collocations also present challenges for learners. For example, a learner may understand the word “wait,” but phrases such as “wait on” and “wait for” may be confusing. Additionally, the meanings of individual words can be problematic for EFL learners. For instance, most learners interpret “permanent” as “everlasting” or “forever,” leading them to misunderstand “permanent employment” as a job that lasts indefinitely. Similarly, learners may not be able to distinguish between “accept” and “receive” or between “assume” and “adopt,” because these pairs can be translated using the same respective Chinese characters. The linguistic gap between Chinese and English is further compounded by cultural differences ([Merkel, 2016](#)).

This study referenced scholarly sources addressing the following four themes: 1) vocabulary in EFL context, 2) vocabulary learning in Taiwan context, 3) crossword-assisted vocabulary teaching and 4) the responsibilities of teachers.

Vocabulary in EFL context

Numerous sources have highlighted the importance of vocabulary to learning a foreign language. For example, [Wilkins \(1985\)](#) a social linguist, asserted that “while without grammar very little can be conveyed, without vocabulary *nothing* can be conveyed”. Similarly, [Richards & Renandya \(2002\)](#) described vocabulary as “a core component of language proficiency” that provides “much of the basis for how well learners speak, listen, read, and write”. Additionally, [Baker et al. \(1995\)](#) argued that “vocabulary acquisition is crucial to academic development. Not only do students need a rich body of word knowledge to succeed in basic skill areas, but they also need a specialized vocabulary to learn content area material”. [Hudson \(2007\)](#) contended that vocabulary knowledge is essential for reading comprehension, a view shared by [Ibrahim et al. \(2016\)](#). Furthermore, the NICHD defined vocabulary as “words we need to know to communicate with others”, noting that vocabulary plays crucial roles in effective listening, speaking, reading, and writing. The NICHD concluded their discussion with the maxim: “Vocabulary is important for reading to learn as well as learning to read” ([Learning Point Associates, 2000](#)).

Despite the indisputable importance of vocabulary to language learning, vocabulary has historically been undervalued in language teaching and learning. For example, Wilkins (1985) asserted that vocabulary has been overlooked by linguists; consequently, teachers prioritize grammar instruction over vocabulary. [Schmitt & McCarthy \(1997\)](#) echoed this view, noting that vocabulary studies were largely neglected until the mid-1980s. [Richards & Renandya \(2002\)](#) also indicated that in second language programs, grammar, reading, and speaking are often prioritized over vocabulary, and they also noted that vocabulary’s importance to language learning and teaching has been recognized and studied only recently.

[Liu & Nation \(1985\)](#) reported that students should understand >80% of the words in a text to infer the meanings of unknown words also emphasized that to comprehend a text, second-language learners must recognize at least 95% of the words. EFL teachers have advocated for the crucial role of vocabulary in language learning. For example, TESOL teacher [King \(2006\)](#) indicated the importance of vocabulary by referring to vocabulary as the “bricks” of effective writing. [King \(2006\)](#) also noted that vocabulary is as critical as transitions, which serve as the “mortar,” and as essay structure, which functions as the “scaffolding”. Similarly, [Nam, \(2010\)](#) described vocabulary as being “pivotal” in the ESL classroom, noting that it supports listening, speaking, reading, and writing, and the researcher also observed that a lack of vocabulary hinders learning in other academic

subjects. Moreover, [Keshta & Al-Faleet \(2013\)](#) asserted that developing vocabulary is essential to mastering a language and improving reading and listening comprehension skills, and they observed that vocabulary strongly influences students' academic success. Furthermore, [Orawiwatnakul \(2017\)](#) described vocabulary as "a key basis on which reading achievement depends" and as essential to conveying meaning and expressing ideas clearly. In a survey, [Hadi & Guo \(2020\)](#) demonstrated that strong vocabulary knowledge enhances students' ability to succeed in academic studies and use English effectively.

Vocabulary learning in Taiwan context

The crucial role of vocabulary in developing English skills and achieving success in academic and career pursuits is widely recognized ([104 Corporation, 2021](#); [Yam News, 2023](#)), and it is a public policy to enhance English-language teaching at all levels of education ([Ministry of Education, 2018](#)).

Despite being said, vocabulary learning proves a daunting task for both teachers and learners in Taiwan ([Huang, 2014](#)). There are reasons. One is the pervasive social mentality engrossed in the results of language tests, which compels learners to invest time and energy in practicing grammar and techniques in answering questions ([Chen et al., 2020](#)). This reduces diversity of reading and compromises the potential benefits of learning English. Another has to do with linguistics. Mandarin Chinese is the predominant language in Taiwan and the major medium of instruction in schools, as is in Mainland China. Mandarin Chinese is linguistically different from English in several features, and [Huang \(2014\)](#) suggested that these differences hinder vocabulary learning effectiveness in four ways: letter-sound relationships, written and spoken form, meaning, and word use.

Huang's point of view gains support of empirical evidence. One study indicated that Chinese-speaking Taiwanese learners tend to use English-Chinese dictionaries and avoid using English-English ones, and are fond of reciting the meaning piece by piece (Liao, 2004). In another study ([Yeh & Wang, 2004](#)), the authors concluded that the most frequently used strategy is rote repetition and learning words in isolation. The same authors ([Yeh & Wang, 2004](#)) also hinted that avoiding contextual learning and circumventing speaking makes poor learning outcomes.

The frustrating consequences of the attitude toward and approach to learning English are revealed in the performance on international English proficiency tests. A recent scores summary published by the Educational Testing Service (ETS) shows that Taiwanese test takers stood well below the average, with the percentile ranks 41%, 38%, 35%, and 35% achieved on Reading, Listening, Speaking, and Writing respectively, and 38% overall ([ETS, 2024](#)). On the Test of English for International Communication (TOEIC®) program, statistics reveal that in 2023 Taiwanese test takers scored an average of 566 on the TOEIC Listening and Reading test (out of 990), with 308 on the Listening section (score range 5-495) and 259 on the Reading section (score range 5-495) respectively (ETS, 2024). This level of proficiency features insufficient vocabulary knowledge, marginal written expression, and simple conversation skill ([Shin, 2024](#)).

Crossword-assisted vocabulary teaching

Recognizing the considerable influence of vocabulary on the development of English proficiency among EFL learners, numerous EFL teachers have explored methods to improve the learners' vocabulary acquisition. Several studies have suggested that crosswords are particularly effective for improving learners' vocabulary. For example, [Orawiwatnakul \(2017\)](#) described that crosswords are strong motivational aids that are highly effective for enhancing vocabulary knowledge. [Njoroge et al. \(2013\)](#) also demonstrated the effectiveness

of using crossword puzzles for teaching vocabulary to EFL learners. Similarly, in classroom action research, [Lestari & Yulia \(2018\)](#) demonstrated that crossword tasks facilitate vocabulary mastery. [Merkel \(2016\)](#) observed that crossword puzzles are powerful “vocabulary-building tools”.

The widespread use of crosswords in education has been greatly facilitated by technology. For example, [Burston \(2005\)](#) described that high accessibility to computer-generated word grids has promoted the use of vocabulary crosswords as teaching tools. Several factors have led teachers to adopt crosswords in their classrooms. First, crosswords have been employed for teaching various disciplines, such as communications, health, psychology, and reading ([Childers, 1996](#)). For example, [Childers \(1996\)](#) used crosswords to teach sociological concepts because crosswords create an enjoyable learning experience and reduce learner anxiety. [Childers \(1996\)](#) also reported that the fundamental appeal of crosswords is attributed to their ability to combine fun with learning. Notably, the first modern crossword puzzle, which was published in the early 20th century, appeared in the Sunday Fun supplement of a prominent U.S. newspaper ([Luebering, 2022](#)). During both world wars and other crises, crosswords have provided entertainment and comfort to readers ([Amlen, 2019](#); [Raphel, 2020](#)).

As the interest in crosswords has increased, educators have recognized their potential as a tool for vocabulary improvement. Thus, vocabulary crosswords generate engaging and enjoyable learning experiences for students unlike traditional rote learning methods ([Merkel, 2016](#)). Additionally, [Keshta & Al-Faleet \(2013\)](#) noted that learners prefer “interactive, exciting, and fun” study methods, and they described that the positive effects of vocabulary crosswords can be attributed to the increase in classroom activity variety and the formation of a relaxed learning environment. Keshta and Al-Faleet’s assumption is validated by the research result of [Alda & Wati \(2021\)](#), which affirmed the relationship of playing crossword games to positive learning attitudes, and of [Mustika et al. \(2022\)](#), which proved the effectiveness of crossword games to invigorate the learning atmosphere.

Second, crosswords stimulate critical thinking and imagination, thus promoting their use in education ([Childers, 1996](#)). For example, [Mollica, \(2008\)](#) associated crosswords with “imaginative” teaching and “imagistic eliciting”. Similarly, [Merkel \(2016\)](#) reported that solving vocabulary crosswords promotes active learning “through trial and error, critical thinking, and exploration of various approaches to reach an answer”. Consequently, [Merkel \(2016\)](#) advocated designing vocabulary crosswords as a “cognitive device” to support language learning. [Ayto \(1990\)](#) described solving crosswords as a process demanding “arduous reasoning”.

Third, the active engagement and cognitive effort required for solving crossword tasks promote the use of crosswords in education. To solve a crossword puzzle, learners must identify and utilize clues ([Gairns & Redman, 1999](#)). This process for solving crosswords is consistent with Burston’s observation that language learners focus on semantically rich lexical input, and supports Lewis’s assertion that learners prefer using preconstructed chunks of language ([Schmitt & McCarthy, 1997](#)). Besides, [Schmitt & McCarthy \(1997\)](#) emphasized the cognitive effort involved in solving crosswords, linking deep engagement with words to learning. Specifically, solving crossword tasks involves interpreting clues, expanding students’ vocabulary knowledge, and deepening their understanding. [Schmitt & McCarthy \(1997\)](#) further suggested that learning new words in context through extensive listening and reading enhances vocabulary. [Merkel \(2016\)](#) emphasized that word mastery is achieved through practice and not merely through the rote memorization of prescribed items.

Finally, the vocabulary crossword plays a crucial role in EFL settings for achieving meaningful learning, because learners devise and apply cognitive strategies to engage with

the vocabulary in context. [Ausubel \(1963\)](#) emphasized that learners' cognitive processes, intentions, motivation, experience, intellectual development, and practice are essential to meaningful learning. [Mayer \(2002\)](#) extended these concepts of meaningful learning by suggesting that meaningful learning involves not only acquiring knowledge but also applying this knowledge in problem-solving tasks. This observation indicates that learners must recognize problems and, through cognitive processing, integrate experience with knowledge to devise solutions. [Howland et al. \(2012\)](#) concurred that engagement in problem-solving tasks promotes meaningful learning. [Yunianta et al. \(2012\)](#) identified several other characteristics of meaningful learning, specifically active participation, critical thinking, constructing personal learning systems, goal orientation, and reading contextual clues. These findings demonstrate that, when appropriately utilized, vocabulary crosswords promote meaningful learning.

The responsibilities of teachers

Teachers are responsible for implementing crossword-assisted instruction ([Orawiwatnakul, 2017](#)). Specifically, teachers must implement an optimal teaching approach to ensure that learners achieve the requisite baseline competence; instruction should not be too challenging and discouraging or too easy and boring, which can hinder learning. The range between a learner's starting level and the upper developmental limit forms the zone of proximal development (ZPD) ([Vygotsky, 1978](#)). As instruction progresses, instructional scaffolding is provided to support learning ([Wood et al., 1976](#)). In this approach, extensive support is initially provided, which is gradually reduced until learners can progress independently (Lipscomb et al., 2004). The ZPD and instructional scaffolding are crucial in language teaching. [Nation & Newton \(1997\)](#) emphasized that teachers should introduce minimal new vocabulary to avoid overwhelming learners with unfamiliar terms. [Nation & Newton \(1997\)](#) also described that to increase students' confidence and independence, more challenging and contextually meaningful words should be introduced gradually. [Barcroft \(2004\)](#) also recommended progressing from less demanding to more demanding activities. [Hadi & Guo \(2020\)](#) noted that time and support are required by students to achieve meaningful learning. To apply the ZPD and instructional scaffolding to the use of crosswords in education, teachers must select appropriate target words, provide explanations, and offer clues. Initially, the teacher provides the most input, gradually reducing assistance as learning progresses.

The author's intention to validate the applicability of an emerging pedagogical technique in EFL settings has compelled him to do this study. To fulfill its intended purpose, this study addressed the following three research questions: (1) Does crossword-assisted teaching enhance EFL learners' vocabulary? (2) Does an increased vocabulary size enhance EFL learners' reading comprehension? (3) Does crossword-assisted teaching positively influence EFL learners' attitudes toward learning?

RESEARCH METHOD

In this study, a crossword puzzle-assisted teaching intervention was developed for use in a course titled "English: Vocabulary and Etymology." The author taught the course to students in both the experimental and control groups over 24 weeks across two consecutive semesters. A quasi-experimental design with a learning attitudes questionnaire was adopted to evaluate the intervention outcomes. The study design and intervention procedures are described in the following sections.

Study Design

The quasi-experimental model is presented in Table 1. Both the experimental and control groups received the same pretest and posttest, but only the experimental group

received the intervention and responded to the statements on the learning attitudes questionnaire.

Table 1. Quasi-experimental model

Group	Pretest	Experimental treatment	Posttest	Questionnaire survey
Experimental	Yes	Yes	Yes	Yes
Control	Yes	No	Yes	No

Participants

The study participants included the students enrolled into the English: Vocabulary and Etymology course, the researcher, three faculty members from the researcher’s academic department, and 35 additional students who participated in a pilot study. The course was taught to third-year students (equivalent to high-school seniors) in the EFL program of a 5-year junior college division in the 2021–2022 academic year. Through purposive sampling, the students were assigned to either the experimental or control group. This study involved 66 students who were divided into the two groups of different sizes. In the first session, both experimental and control groups received the same pretest, with mean scores of 25.29 and 27.84, respectively. A *t* test and Levene’s test for homogeneity of variance yielded a significance value of .374, indicating no significant differences in vocabulary knowledge or statistical distribution between the groups. For convenience, the researcher assigned a larger cohort of 34 students to the experimental group and a smaller cohort of 32 students to the control group.

The author taught both groups and participated in implementing activities for them. The three other faculty members verified the accuracy of the crossword puzzle sheets used in this study. Additionally, 35 students who had taken the author’s course, were familiar with crossword-solving techniques, and were 1 year senior to the students in the experimental and control groups, participated in a pilot study. These students completed a learning attitudes questionnaire, which was later administered to the experimental group. The pilot study results served as an index for verifying the reliability of the questionnaire.

Data Collection Tools

This study employed several tools to collect data: a textbook, a learning achievement test, crossword puzzle worksheets, and a learning attitudes questionnaire. A description of these tools is presented in the following sections.

Textbook and Learning Achievement Test

Reading Explorer, third edition published by Cengage Learning, was used as the course textbook. The series includes reading passages on a wide range of topics, such as sports, technology, the humanities, the arts, and nature. This diverse content enables students to expand the depth and breadth of their vocabulary. The textbook includes the learning achievement test. The test consists of 30 vocabulary questions and 30 reading comprehension questions. The learning achievement test was used as a pretest in this study. After the pretest was administered, the quiz scores for the correct answers were converted into standardized scores for further analysis. The same procedure was applied to standardize the results of the posttest administered at the conclusion of the course.

Crossword puzzle sheets

This section applies specifically to research-based articles. The method section describes the research design, research objectives (population and research sample: subject / respondent / participant), research procedures, data collection, measurement (measuring instruments or measurement techniques), and data analysis.

Learning Attitudes Questionnaire

The second research tool was a questionnaire (Appendix 2) designed to assess the experimental group students' perceptions regarding the course and their attitudes toward using crosswords for learning English vocabulary. The students rated each statement on a 5-point Likert scale.

To analyze the responses and extract the relevant factors, exploratory factor analysis with principal component analysis was conducted. Subsequently, the varimax method with orthogonal rotation was applied to identify the factors with eigenvalues >1 . This process reduced the number of factors to three, leading to the removal of 11 questions from the original 29 questions. Thus, the final questionnaire included 18 statements, and the three factors accounted for 64.433% of the explained variance. The Kaiser-Meyer-Olkin value was .780, with a significance of $<.001$, indicating that the factors adequately explained the variance in the responses. Cronbach's α was used to assess internal consistency; a value of 0.7 is considered acceptable (Cronbach & Shavelson, 2004). The overall correlation coefficient for the questionnaire was 0.922, indicating its high reliability.

Intervention

After administering the pretest, the author instructed the two groups using lecture-based or crossword-based instruction. The control group received lecture-based instruction, which included translation exercises, explanations of words or word forms, and a grammar review. Additionally, the researcher shared word-related stories to enhance the students' understanding. By contrast, the experimental group completed crossword-solving tasks, which occupied 20 minutes of each 50-minute class. During the remainder of the class, the experimental group engaged in activities like those engaged in by the control group, but with a more rapid and intense pace.

Throughout the instruction cycle, the experimental group completed a crossword quiz every other week, with a total of 11 quizzes, each covering 18 or 19 target words. Prior to these quizzes, a demonstration task was provided. During the intervention, the experimental group engaged in three additional in-class practice crossword tasks, each lasting 20 minutes. In the final week, a posttest was administered to both groups. Subsequently, the experimental group completed the learning attitudes questionnaire.

Data Analysis

The quiz scores of the experimental group were converted into z-scores. After the posttest, a t test was used to determine whether the difference between pretest and posttest performance for each group reached statistical significance. The questionnaire responses were also analyzed to supplement the t -test results. Pearson correlation analysis was employed to assess whether the use of crossword games positively influenced posttest outcomes.

FINDINGS AND DISCUSSION

Findings

To address the first research question of whether crossword-assisted teaching improves learners' vocabulary, both groups' vocabulary performance on the pretest and posttest was analyzed using SPSS for Windows 28.0. The experimental group exhibited mean scores of 13.21 and 17.71 in the pretest and posttest, respectively, with a paired sample t test yielding $t = -9.720$ and $p < .001$ (Table 2). This result indicated significant differences between the scores on the two tests and demonstrated that the intervention improved the students' vocabulary acquisition. By contrast, the control group exhibited mean scores of 14.22 and 14.34 in the pretest and posttest, respectively, with $t = -.370$ and $p = .714$. This finding indicated no statistically significant differences between their pretest and posttest scores.

Table 2. Paired Sample *t* test of the experimental group's performance on the pretest and posttest

Measuring	Mean	SD	<i>t</i>	Df	2-tailed <i>p</i>
Pretest	13.21				
Posttest	17.71	2.700	-9.720	33	<.001

****p* < .001.

The experimental group's quiz performance exhibited a consistent upward trend. The z-score in the first quiz averaged 24.91, whereas the z-score in the sixth quiz averaged 61.92, representing a 149% increase. In the final quiz, the average z-score was 72.85, representing a 17.65% increase over the score in the sixth quiz. From the first to final quizzes, the score of the experimental group increased by 193%. The mean z-scores in the quizzes and the posttest were 54.29 and 53.65, respectively. The Pearson correlation analysis revealed a strong correlation between the scores, with $r = .795$ and $p < .001$.

To address the second research question of whether having a larger vocabulary improves reading comprehension, the data from both groups were analyzed. The experimental group exhibited an average score of 12.09 for reading comprehension in the pretest and 14.50 in the posttest. A paired sample *t* test yielded a standard deviation of 2.488, a *t* value of -5.65 , and a *p* value of $<.001$ (Table 3). This result indicated a significant difference between the group's pretest and posttest scores for reading comprehension. By contrast, the control group exhibited average scores of 13.63 and 12.91 in the pretest and posttest, respectively, with $t = 1.640$ and $p = .111$. This finding indicated no statistically significant differences between the pretest and posttest scores.

Table 3. Paired sample *t* test of the experimental group's reading comprehension scores on the pretest and posttest

Measuring	Mean	SD	<i>t</i>	Df	2-tailed <i>p</i>
Pretest	12.09				
Posttest	14.50	2.488	-5.653	33	<.001

****p* < .001.

Regarding the intergroup differences in posttest performance, for the experimental group, the number of correct answers averaged 32.21 of 60 questions. For the control group, the number of correct answers averaged 27.25. An independent sample *t* test yielded results of $t = 2.406$ and $p = .019$ (Table 4). The analysis results suggest a causal relationship between the intervention and the students' posttest performance.

Table 4. Independent sample *t* test for posttest results

Group	N	Mean	SD	<i>t</i>	2-tailed <i>p</i>
Experimental	34	32.21	8.337		
Control	32	27.25	8.394	2.406	.019

**p* < .05.

Pearson correlation analysis was conducted to address the third research question of whether the experimental group students have a positive attitude toward using crosswords. The analysis of 34 valid questionnaires (Appendix 2) revealed a strong positive correlation between the students' attitudes and their performance for vocabulary and reading comprehension (Pearson's $r = .721$, $p < .001$).

The analysis yielded three major findings: (1) The intervention significantly enhanced the students' vocabulary acquisition, (2) the intervention significantly improved their reading comprehension, and (3) the experimental group students had favorable attitudes toward the intervention.

DISCUSSION

The results observed in this study can be explained from three perspectives. One is the engagement needed to solve crossword tasks. Studies have highlighted that crosswords can lead to the creation of a relaxed learning environment ([Franklin et al., 2003](#)). Crosswords can also render learning engaging, effective, and enjoyable ([Alda & Wati, 2021](#); [Mustika et al., 2022](#); [Weisskirch, 2006](#)) encourage active participation ([Bonwell & Eison, 1991](#)) and enrich the learning experience by promoting active learning ([Merrick, 2010](#); [Wefi et al., 2023](#)). The students' responses to the learning attitudes questionnaire are consistent with the scholarly sources.

Appendix 2 provides the scores for individual statements. The questionnaire yielded several notable findings. First, the students recognized that crossword games can promote active and contextual thinking, enhancing vocabulary learning. This perception is reflected in their responses to statements 12, 13, and 16 in the questionnaire. Second, consistent with the author's observations, the students' responses to statements 6 and 14 indicate that the students believed that solving crossword tasks was engaging and helped them to maintain focus. Third, the students recognized that solving crossword tasks required applying vocabulary knowledge, leading to increase their confidence and interest. This recognition was evident in the responses to statements 1 and 2. The positive responses to statements 12, 14, and 17 in the questionnaire indicated that the students believed that solving crossword tasks developed their ability to utilize information sources and employ contextual clues to complete tasks.

Another perspective is the linguistic benefit of using crosswords for improving vocabulary. When solving crossword tasks, the learners frequently encountered correct and meaningful word combinations, thus enriching and expanding their vocabulary knowledge as well lexical skills. This process enabled them to consider the meaning and function of English words and phrases when thinking in English rather than in Chinese, reducing language difficulties. This practice promoted the correct and fluent use of words and phrases in sentences and larger structures. Additionally, reading clues enhanced the students' vocabulary knowledge and strengthened their comprehension and memory. The students' positive responses to statements 11, 15, and 18 reflect their recognition of these benefits. The studies of [Yeh & Wang \(2004\)](#) and [Liao \(2004\)](#) add credibility to this perspective.

A third perspective is the teaching method. In addition to explaining word formations, the author provided clues to help students identify the target words. The author concurs with [Orawiwatnakul \(2011\)](#), [Wang \(2014\)](#), and [Pillai \(2017\)](#) that guiding students to analyze word structures and contextual clues is crucial to effective vocabulary teaching. Guided by Vygotsky's concept of ZPD, the author selected target words appropriate for most students' ability level, progressively increasing vocabulary difficulty as instruction advanced to maintain student engagement. Furthermore, using instructional scaffolding initially, the author gradually reduced the number of clues provided to promote meaningful learning among the students. Solving crossword puzzles involves a contextual thinking process that utilizes guided associations to reinforce memory as students identify and spell out target

words. The students' positive responses to statement 9 reflect that they favored this approach. Moreover, with experience, learners may develop additional cues for other target words, forming the scaffolding necessary for meaningful learning and systematizing the acquired knowledge ([Ausubel, 1963](#)).

The teacher's role in enhancing vocabulary learning with the aid of crosswords is consistent with scholarly recommendations. [Michalewicz & Michalewicz, \(2008\)](#) emphasized the instructor's role in facilitating learning when crosswords are integrated into classroom activities. [Slavin \(2003\)](#) described that properly executed crossword tasks are motivational and engaging, supporting vocabulary learning and the development of broader language competence. Throughout the intervention in this study, the students completed 15 crossword tasks to enhance their problem-solving skills and provide hands-on learning. The students' responses to statements 6 and 7 in the learning attitudes questionnaire reflect that they favored this approach. These responses indicate that when attempting to solve a crossword, the students first guessed the meanings of unknown words, and subsequently employed contextual clues to verify their guesses, demonstrating their drive to achieve their goal. It is worth noting that, in this study, the control group did not achieve similar outcomes to those achieved by the experimental group. This difference likely results from the lack of crossword-assisted teaching. This can be validated by the experimental group's responses to the learning attitudes questionnaire. Specifically, the responses to statement 5 highlight the importance of vocabulary to learning English, and the responses to statement 11 (reflecting students' "attitudes toward the efficacy of crossword games") indicate their recognition of the positive influence of crosswords on vocabulary and reading comprehension.

This study demonstrates the practical value of crosswords in teaching vocabulary. However, instructors must also acknowledge that the stress or anxiety experienced by learners can adversely influence the effectiveness of this technique. The relatively low ratings given by the experimental group to statements 3 and 4 indicate the influence of such stress, which may have been caused by students' preoccupation with achieving high examination scores in a required course, hindering their ability to learn at their own pace and enjoy the learning process. Additionally, a lack of learning autonomy can cause students to solely focus on meeting minimum requirements, resulting in their reluctance to engage in supplementary learning activities.

CONCLUSION

The present study concludes that incorporating crossword games into teaching facilitates vocabulary learning and enhances reading comprehension. The findings suggest that incorporating alternative vocabulary learning techniques in traditional teaching environments can aid in achieving the educational goals of an EFL class. The study results thus reinforce the findings of studies conducted in other language environments and verify the broad generalizability of crossword-assisted teaching. However, several concerns warrant further investigation. One of them is whether the positive learning outcomes and acquired vocabulary are maintained after course completion and for how long. The measurements of this study were made immediately at the conclusion of the intervention. The effects of instruction could only be temporary and is a result of rote memorization. Further efforts should be made to investigate the long-term effect of this teaching technique. Another is the potential benefits of using crossword games in combination with other

devices. There must be other alternative methods deserving consideration. Using mnemonics is a choice (Hulstijn, 1997; Pillai, 2017). It is reasonable to expect that sensible application of a combination of different devices can enrich classroom activities, attract attention, expand the avenue of learning, and ideally lead to sustainable learning habit. Nonetheless, this assumption needs verification by empirical evidence.

The outcome of this research has solid implications. At first, in the forefront of instruction, the teacher must bear the brunt of designing and implementing an empirically tested teaching technique, and during instruction, engage in the learning process. Second, the school administration should be supportive of teachers in their endeavors to improve students' learning, and the support should include teaching equipment and facilities, teaching materials, and most importantly, knowledge of innovative teaching techniques and open-mindedness about them. Third, there is a need for collaboration between departments, schools, and even geographical regions. One of the limitations of this research is noticeable, that is, the small number of students able to be recruited to partake in it, and the already small sample had yet to be grouped. For practicality, a purposive sampling, not random sampling, was adopted. Should there be a sample of suitable size, random sampling would be possible. Teachers and the school administration in tandem with inter-agency cooperation are key to success in teaching and learning. The omnipresent private learning centers (Rüdiger et al., 2023) may not be needed any more, and students don't have to be crammed with additional learning sessions if they have confidence in school.

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