

Implementing the digital multimodality of a Google Translate-assisted approach to online academic EFL reading

Shu-Chiao Tsai

Center of Liberal Arts, National Kaohsiung University of Science and Technology, Taiwan, Republic of China

This study implemented a multimodal Google Translate- (GT) assisted approach incorporating multiple literacies to online academic reading on global warming and climate change for 152 non-English major students of English as a foreign language (EFL) in Taiwan. A five-step model of the digital multimodality of a GT-assisted approach was employed. The learning activities focused on vocabulary development and reading comprehension; they were evaluated based on students' reading performance in the pretest, GT-assisted test, post-test and delayed cloze test asking students to show comprehension in their responses to a questionnaire survey. Results indicated that students had significantly better performance in their post-test scores, with a larger effect size ranging from 2.14 to 3.05. English proficiency had a significant and positive correlation with their reading scores in the pretest, GT-assisted test and post-tests, but not in the delayed test. Students' retention was 51.6% in the delayed test conducted 7 weeks after the post-test, and their reading scores were significantly higher than theirs in the pretest, with a medium effect size of 0.54. Regardless of student college, they also showed highly favorable perceptions towards the digital multimodality assisted by the GT-based tools. High-performing students perceived multimodal strategies provided by GT, especially in translation and audio aids.

Implications for practice or policy:

- The digital multimodality of a GT-assisted approach should be implemented in online academic EFL reading.
- Non-English major EFL students should make good use of multimodal GT-based tools for improving their vocabulary development and reading comprehension.
- EFL teachers should adopt technological resources and ensure their optimal utilisation to create a friendly and interactive learning environment where students' engagement and interaction can be effectively enhanced.

Keywords: multimodal, Google Translate, online reading, EFL, academic reading

Introduction

Software and tools have been implemented into language learning to create an interactive learning environment for stimulating learners' motivation, offering effective linguistic input, providing instant feedback and enhancing learners' performance (Bashori et al., 2022; Lai & Chen, 2021; Tsai, 2019). These innovative resources combine diverse inputs such as text, image, speech and data with multiple intelligent processing algorithms, which develops a paradigm of digital multimodality. As learning with digital multimodality can consolidate disconnected and heterogeneous data from various inputs into a single, easy-to-use model, learners are able to experience dynamic and interactive learning in their own way and achieve the desired learning outcomes (Bayouhd et al., 2022; X. Chen et al., 2021).

A version of Google Translate (GT) with a system of artificial intelligence (AI), Google Neural Machine Translation, was launched in 2016. Some multimodal tools embedded in GT, like text-to-speech (TTS) and automatic speech recognition (ASR) technologies, can facilitate the acquisition of English as a foreign language (EFL) vocabulary (Ningrum & Dewi, 2024), reading (Pribadi et al., 2022) and listening and speaking skills (Tsai, 2023). A recent systematic review of GT by Mirzaeian and Oskoui (2023) indicated that students' language skills, self-efficacy and confidence can be enhanced through the use of GT, and more attention should be paid to its effects on reading comprehension and translation. Accordingly, it is

essential to help EFL students effectively integrate such tools to facilitate their individual need and style of language learning so as to improve their vocabulary development and reading comprehension.

Literature

Online and academic reading

Digital texts are commonly seen on the screen of computers, notebooks or mobile devices and generally include multimodal presentations comprised of texts incorporated with pictures, audio, video, images or hypertexts. These multimodal features provide online readers with a flexible learning environment in which they can explore in a non-linear way. Based on research exploring the relation between reading speed and text understanding on screens, online reading is a more superficial and quicker approach compared to print reading and may have negative impact on readers' ability to understand texts (Singer Trakhman et al., 2019; Stiegler-Balfour et al., 2023). In addition, digital texts are more ambiguous than printed texts, due to a lack of hierarchical and static structures (Pardede, 2019). Thus, online readers need more cognitive load or ability to employ metacognitive strategy to enhance their reading comprehension. For example, online readers need digital literacy skills for searching, locating, accessing, processing and manipulating online information and resources and choosing, evaluating and interpreting digital texts (Marboot et al., 2020; Rahman, 2020).

Academic reading is an important and required task in higher education, but EFL students still encounter some problems and challenges, including limited vocabulary, content knowledge, and English proficiency; the nature of the English texts; the level of language sophistication; the complexity of disciplinary concepts; and insufficient practice with learning (Gui et al., 2021; Hirano, 2015; Rahman, 2020; Yulia et al., 2020). Research has reported that students in higher education have not been successful in coping with academic reading tasks due to their substandard level of academic comprehension and low level of readiness (K. T.-C. Chen, 2017; Hirano, 2015). In addition, teachers' focusing on vocabulary first can enhance academic reading ability (Gui et al., 2021).

Vocabulary development and reading comprehension

Vocabulary development has always been challenging for EFL students because they must process meaning, pronunciation, spelling, grammatical structures and semantic associates of the words (Ghalebi et al., 2020). Yawiloeng (2020) indicated that inadequate knowledge of second language (L2) vocabulary can hinder English learning for EFL students.

Reading comprehension is an interactive process involving complex mental operations and interactions among the reader, the texts and tasks, in which the reader uses previous knowledge and all the resources available in the text to construct the intent, ideas, thoughts and messages of the author (Grabe, 2009; Yazdanpanah, 2007). Factors such as the technology used for online reading, online readers' familiarity with the technology, readers' mastery of digital reading strategies and participants' perception of digital reading should be taken into consideration for enhancing online reading comprehension (Pardede, 2019). Software, tools and systems have been developed to improve the vocabulary development and reading comprehension of EFL students through multimodal presentations offering repetitive practice, providing multiple annotations or instant feedback and recording students' strategies in the reading process (Klimova & Zamborova, 2020; Kohnke et al., 2019; S. Wang & Lee, 2021). Multimedia glosses incorporated with textual, visual, aural or pictorial aids are useful and effective for promoting EFL students' vocabulary acquisition and reading comprehension and save students' time and effort while reading L2 texts (Alqahtani, 2024; Ouyang et al., 2020; S. Wang & Lee, 2021; Yawiloeng, 2022).

Digital multimodality of EFL teaching and learning

Multimodality refers to the use of several modes of communication within a text, including visuals, videos, graphics, animations, sounds, music, gestures and facial expressions to deliver and produce meaning. Multimodal teaching involves presenting various types of multimedia such as visuals, sound, drama and

text within classrooms. Ji and Luo (2019) indicated that the use of multimodality to appeal to multiple senses can pique students' interest, enhance their memory and focus their attention on relevant information so that they can acquire knowledge and develop comprehensive quality. The implementation of digital multimodality into language learning has increasingly attracted students' attention and discussion in the field of English language (Knight et al., 2020; Liang, 2019).

Multimodal texts and tools, including annotation or glosses, translation, fonts, colours, images, audio and video, have a significant effect on L2 vocabulary and reading because they cater to different learning styles and are familiar, authentic and contextualised to learners' lives (Al Bukhari & Dewey, 2023; Peng, 2019). However, few attempts have been made to investigate the effectiveness of GT in improving reading comprehension of academic texts from EFL students' perspectives (X. Chen et al., 2021; Peng, 2019; Varol & Erçetin, 2019), especially from those with insufficient foreign language proficiency (Maghsoudi & Mirzaeian, 2020; Mirzaeian & Oskoui, 2023).

Research questions

Ascertaining students' interests, attitudes and preferences for specific software or tools equips teachers with data and information on how to enhance vocabulary development and reading comprehension through technology (Al-Maashani & Mudhsh, 2023; Alqahtani, 2024). GT is a free, popular and useful engine, so it is interesting to investigate and evaluate its possible effectiveness, influence and impact on online academic EFL reading under time constraints, especially for non-English major EFL students. These students generally have low English proficiency and need more practice and learning support to improve their English vocabulary development and reading comprehension. Cloze tests are diagnostic and versatile tools for evaluating reading proficiency or comprehension, both at the level of vocabulary and grammatical structures and at macro-structural levels in understanding inter-sentential relationships and drawing inferences (Abreu et al., 2017; Kleijn et al, 2019). When completing cloze tests, students have to engage with the target text by applying linguistic skills related to vocabulary and content knowledge, guessing and inferring unfamiliar words and establishing meaningful comprehension in syntax and semantics, which could help students' vocabulary development and reading comprehension (Chai et al., 2020; Wilawan, 2023). Thus, in the current study, students' reading performance was evaluated based on their scores in cloze tests and their responses to a questionnaire survey. The research questions (RQs) of the study were:

- RQ1: Based on data from the pre- and post-tests, can the implementation of the GT-assisted multimodality into online academic EFL reading enhance the vocabulary development and reading comprehension of non-English major EFL students?
- RQ2: What is the relationship among students' English proficiency, reading performance and college?
- RQ3: Based on data from a delayed test conducted 7 weeks after the post-test, what is students' learning retention?
- RQ4: What is the effect of the intervention time of students' using the GT-assisted multimodality to complete the test on their vocabulary development and reading comprehension?
- RQ5: What are the perceptions of non-English major EFL students towards the implementation of GT-assisted multimodality into online academic reading and the relationship among their reading performance, perceptions, English proficiency and college?

Method

A multimodal GT-assisted approach was implemented into online academic EFL reading for 2 weeks (at the 10th and 17th weeks of the semester) in Modern Technical Issues, an elective course in the liberal arts education track at a technical university in Taiwan. The study was approved by the Human Subjects Ethics Committee at National Cheng Kung University in Taiwan.

Participants

The study was conducted through convenience sampling. The participants were students in Modern Technical Issues, an elective course in a technical university in Taiwan. The students, consisting of 152 non-English major EFL students from 7 classes, were classified as follows:

- Group ALL: entire group
- Group HM (Humanities and Management): 13 students from a humanities and social science college and 72 from a management and business college
- Group EC (Engineering and Computer): 41 students from an engineering college and 26 from a computer science college.

All the 152 students completed the assigned tests and the questionnaire. Their mean age was 21.6 years old, ranging from 19 to 22. Their English proficiency was determined by an online simulated Test of English for International Communication (TOEIC) with a total score of 990 as provided by the foreign language education centre of the university. Their TOEIC-like means was 504.1, equivalent to the level of A2 (scores between 225 and 550) based on the model of the Common European Framework of Reference for Languages (National Taiwan University, 2025).

Independent sample t test results indicated that there was no significant difference in English proficiency between Groups HM and EC ($p = .857$). Based on the TOEIC-like scores, the top 50% and the bottom 50% of students were divided into two groups: one with high English proficiency (HEP) with TOEIC-like score higher than 494; the other of low English proficiency (LEP) with TOEIC-like score not higher than 494. The background data of the student groups are listed in Table 1.

Table 1
Background of the students by group

Group	ALL		Group HM		Group EC	
	No. of students	Age (mean)	No. of students	Age (mean)	No. of students	Age (mean)
No. of students	152	21.6	85	21.4	67	21.8
Age (mean)	21.6	21.6	21.4	21.4	21.8	21.8
TOEIC-like mean	504.1	504.1	502.3	502.3	506.4	506.4

Target text

Typically, the course is taught in Chinese, but the target text of the study was given in English and focused on global warming and climate change. The text was excerpted from a report on the official website of British Broadcasting Corporation about the 27th United Nations Climate Change Conference of the Parties (Stallard, 2022), consisting of 360 words with 24 sentences. A readability analysis showed that the Flesch Reading Ease score of the target text was 63.2, corresponding to grade level 8, a reading level of plain English or average (Flesch, 1981). Students were exposed to new vocabulary through this natural and real-world text to help them focus on understanding the broader narrative of the target text and enhance their academic reading ability and vocabulary learning (Al Bukhari & Dewey, 2023; Ebadi et al., 2023). The target text and the test scripts were stored on the cloud server and accessed only within the classroom based on the curriculum that I (the teacher-as-researcher) scheduled.

Multimodal GT-based tools

At the beginning of the study, I introduced multimodal GT-based tools, including instant translation, TTS and ASR, as shown in Figure 1. The TTS tool provided two pronunciation speeds (normal and slow) to help students with pronunciation as well as reading and listening. In addition, students were able to practise, listen and modify to improve their pronunciation and speaking skills on their own and as often as they wished by using the tools.

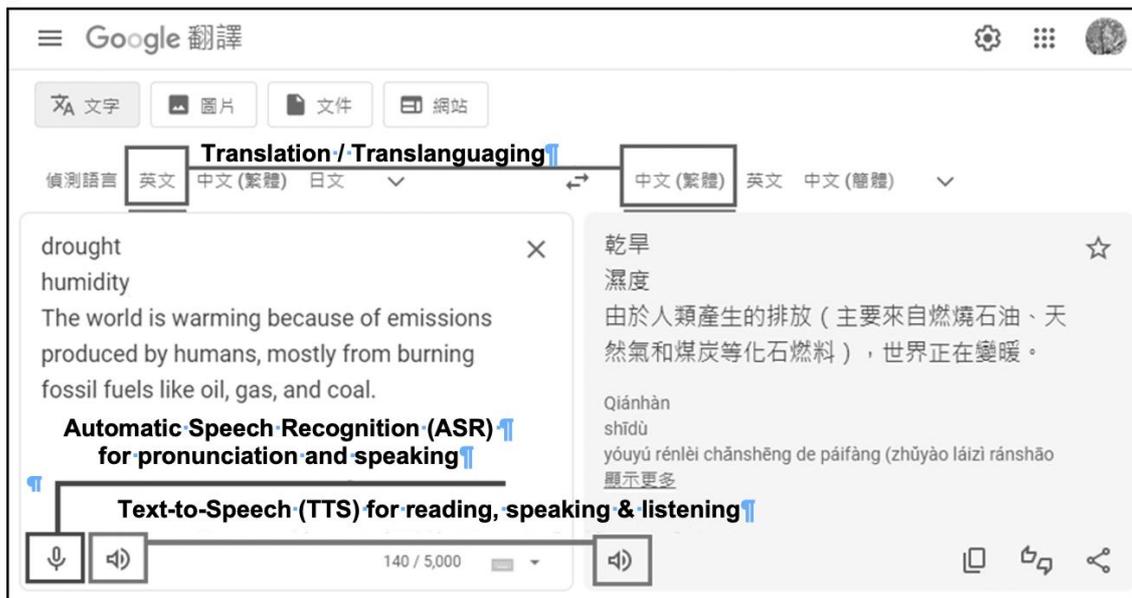


Figure 1. Screenshot of multimodal GT-based tools: instant translation, ASR and TTS

Digital multimodality of GT-assisted approach

Referring to evaluation criteria for developing multimedia computer-assisted language learning based on hypotheses about the ideal conditions for L2 acquisition by Chapelle (1998), I developed a five-step model of the multimodal GT-assisted approach to online academic EFL reading, as shown in Figure 2 and explained below:

- (1) Pretest: While conducting the pretest, students can think ahead about how to perform the task and understand and plan the language and content knowledge they need to complete the assigned task.
- (2) Input: While reading the target text, students can use multimodal GT-based tools to practise their pronunciation, reading and listening skills, as well as enhance their semantic and syntactic comprehension of the target content. Using multimodal input can provide students with various forms of modifications, including translation, repetition, adjustment of reading or audio speed, reference materials, and even change of input mode, which meets Chapelle's first and second suggestions to make key linguistic characteristics salient and offer modifications of linguistic input.
- (3) Apperception: The process of apperception takes place during the online reading process. For example, highlighting unfamiliar vocabulary and sentences and checking their meanings or pronunciation by using multimodal GT-based tools helps students notice and identify their semantic and syntactic deficiencies or errors. These features correspond to Chapelle's fourth suggestion to provide opportunities for learners to notice their errors.
- (4) Comprehension: When noticing their linguistic deficiencies or errors, students can correct and modify them by repeatedly using multimodal GT-based tools. This process can help them to focus their attention not only on solving problems of linguistic form but also on enhancing their comprehension of subject knowledge, which meets Chapelle's fifth suggestion to provide opportunities for learners to correct their linguistic output.
- (5) Output (Post-test): Through two-way information exchange and interaction supported by multimodal GT-based tools, students' vocabulary development and reading comprehension can be improved so as to enable them to complete the assigned task.

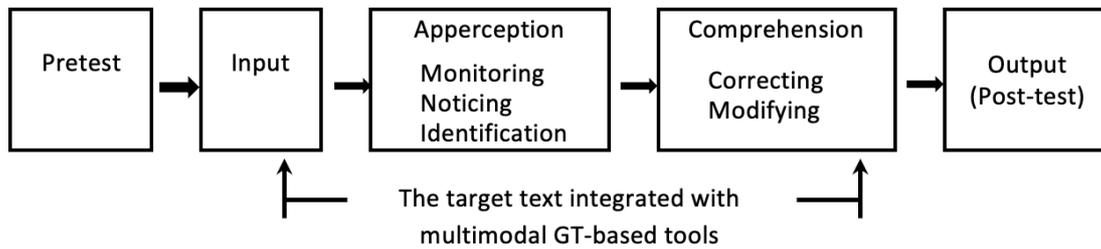


Figure 2. Five-step model of the multimodal GT-assisted approach

Procedure for implementing the multimodal GT-assisted approach

The study procedure, consisting of three phases, is shown in Figure 3 and explained below.

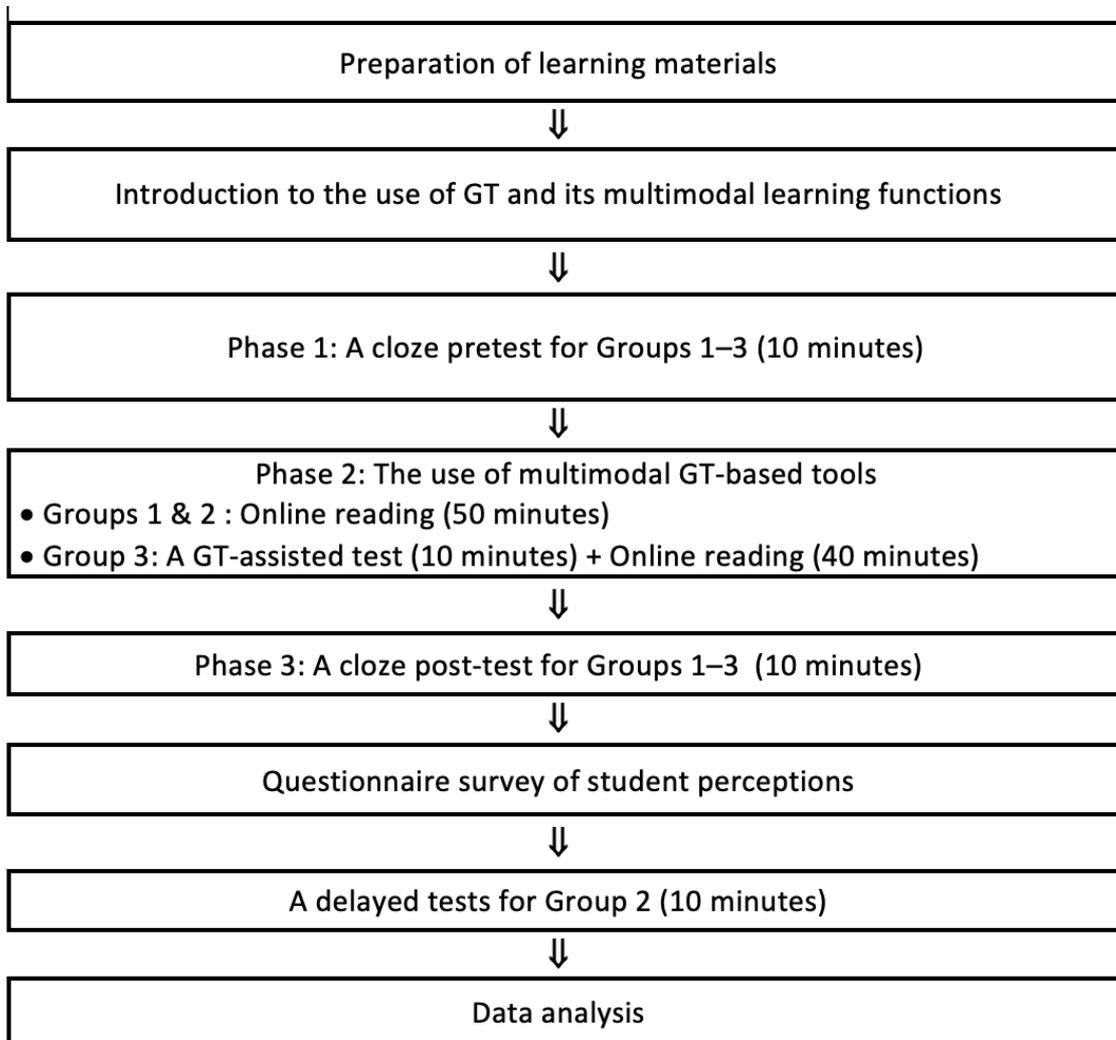


Figure 3. Procedure of the study

- (1) Phase 1: The students of each group were required to independently complete a cloze pretest on Google Forms within 10 minutes, without the use of the multimodal GT-based tools. They had to complete the pretest of 10 questions extracted from the target text by correctly selecting 10 among 13 verbs. For an objective comparison, the same questions were given in the pretest, GT-assisted test, post-test and delayed cloze test, and the students were not informed of that during the learning process. After the pretest, students were neither given the right answers to the questions nor were they able to keep the script of the pretest.
- (2) Phase 2:
 - The students of Groups 1 and 2 were required to independently conduct online reading by using the multimodal GT-based tools, with which they were able to check, read aloud, listen or translate the target text for 50 minutes on their individual computers. In addition, they were required to highlight and note the number of unfamiliar vocabulary and sentences; this aimed at enhancing students' interaction with the target text.
 - Just after the pretest, 47 students of Group 3 had to continue the test with the support of multimodal GT-based tools within 10 minutes (GT-assisted test). Then, they conducted online reading for 40 minutes as the students of Group 1 did. They also had to note the number of unfamiliar vocabulary and sentences.
- (3) Phase 3: After reading the target text online with the support of the multimodal GT-based tools, the students independently completed the post-test on Google Forms within 10 minutes. In addition, 42 students in Group 2 completed the delayed test assigned 7 weeks after the post-test to probe their learning retention.

Questionnaire survey of student perceptions

A questionnaire in Chinese was administered to the students after the post-test in order to explore their perceptions of the implementation of GT-assisted multimodality in this study. I excerpted the questionnaire from previous studies (Lin & Tsai, 2021; Tsai, 2023) and revised it; then two experienced EFL professors who specialise in the field of computer-assisted language learning reviewed it. There were 13 questions in the questionnaire, consisting of 7 items (Q1–Q6 & Q9) related to the translation and audio aid provided by multimodal GT-based tools for improving English pronunciation, listening, speaking and reading comprehension, 2 items (Q7 & Q8) regarding the Chinese translation correctness of English vocabulary and sentences provided GT, Q10 about the convenience of using multimodal GT-based tools, Q11 related to the necessity of explanation from the teacher after the post-test, Q12 and Q13 respectively regarding students' willingness to continue to use GT-based tools and their recommendation. The questionnaire used a 5-point Likert scale: *strongly agree* (5), *agree* (4), *neutral* (3), *disagree* (2) and *strongly disagree* (1). Points were assigned to question options.

Data analysis

Students' scores on the pre-, GT-assisted, post- and delayed cloze tests and their responses to the questionnaire were collected and analysed by using IBM SPSS (version 20). The relationship among reading scores, perceptions, English proficiency and colleges of students was also examined by using independent and paired sample *t* tests and Pearson correlation analysis. The effect size (Cohen's *d*) was computed from the means and standard deviations (SD) of the items with statistically significant difference to measure the magnitude of the experimental effect. Cohen's *d* value around 0.2 represents a small effect size, 0.5 a medium effect size, and 0.8 a large effect size (Cohen, 1988; McLeod, 2019).

Results

RQ1: Students' reading performance

The mean scores of all groups in the pretest, GT-assisted test, post-test and delayed cloze test are shown in Table 2, in which the means of students' unfamiliar vocabulary and sentences are also listed. The mean numbers of the unfamiliar vocabulary and sentences that students highlighted were 23.1 and 2.25,

accounting to 6.4% and 9.4% of the target text respectively. The results from a paired sample *t* test indicated that the students of Group ALL showed significantly better scores in the post-test ($M = 7.48$) than theirs in the pretest ($M = 2.75$), with an effect size of 2.28. The students of Groups 1, 2, and 3 performed significantly better post-test scores than their pretest scores, with an effect size of 2.36, 3.05, and 2.14, respectively. According to Pearson correlation analysis, there was a significant and positive correlation among the scores in the pretest, GT-assisted test, post-test and delayed cloze tests shown in Table 3. In addition, the number of unfamiliar vocabulary and sentences had a significant and positive correlation with each other ($r = .312, p = .000$), but a significant and negative correlation with students' pretest and post-test scores, not with students' scores in the GT-assisted and delayed cloze tests, as shown in Table 4. The results of an independent *t* test analysis shown in Table 5 revealed that the HEP group had significantly better reading performance than the LEP group, having significantly fewer unfamiliar vocabulary (Cohen's $d = 0.449$), significantly fewer unfamiliar sentences (Cohen's $d = 0.327$), significantly higher reading scores in the pretest (Cohen's $d = 0.603$) and post-test (Cohen's $d = 0.472$).

Table 2
Reading performance in the pretest, GT-assisted test, post-test and delayed test

Group (N = no. of students)	Mean (SD)					
	Pretest	GT-assisted test	Post-test	Delayed test	Unfamiliar vocabulary	Unfamiliar sentence
Group ALL (Classes 1–7) N = 152	2.75 (2.001)		7.48** (2.144)		23.10 (10.456)	2.25 (2.600)
Group 1 (Classes 1–5) N = 105	2.84 (2.085)		7.69** (2.016)		22.83 (11.730)	2.27 (2.788)
Group 2 (Classes 4–5) N = 42	2.69 (1.969)		7.62** (1.268)	3.93** (2.626)	25.40 (8.003)	3.33 (2.911)
Group 3 (Classes 6–7) N = 47	2.55 (1.803)	5.38** (2.454)	7.02** (2.364)		23.70 (6.878)	2.21 (2.146)

** $p < .01$.

Table 3
Pearson correlation among the pretest, GT-assisted test, post-test and delayed cloze test

Test (N = no. of students)	Pearson correlation coefficient		
	Post-test (N = 152)	GT-assisted test (N = 47)	Delayed test (N = 42)
Pretest	.362**	.570**	.444**
Post-test		.722**	.482**

** $p < .01$.

Table 4
Pearson correlation among the numbers of unfamiliar vocabulary and sentence, and mean scores in the pretest, GT-assisted test, post-test and delayed cloze test

Item (N = no. of students)	Pearson correlation coefficient				
	Unfamiliar sentence (N = 152)	Pretest (N = 152)	GT-assisted test (N = 47)	Post-test (N = 152)	Delayed test (N = 42)
Unfamiliar vocabulary	.312**	-.288**	-.184	-.206*	.012
Unfamiliar sentence		-.249**	-.272	-.209*	-.214

* $p < .05$. ** $p < .01$.

Table 5
Reading performance of student groups of English proficiency and colleges

Group (N = no. of students)		Mean (SD)			
		Unfamiliar vocabulary	Unfamiliar sentence	Pretest	Post-test
English proficiency	HEP (N = 76)	20.80** (9.953)	1.83* (2.605)	3.33** (1.989)	7.97** (2.046)
	LEP (N = 76)	25.39 (10.506)	2.67 (2.542)	2.17 (1.850)	6.99 (2.138)
College	HM (N = 85)	24.06 (9.593)	2.61 (2.503)	2.76 (2.062)	7.66 (1.973)
	EC (N = 67)	21.88 (11.416)	1.79 (2.666)	2.73 (1.935)	7.25 (2.338)

* $p < .05$. ** $p < .01$.

RQ2: Relation among students' English proficiency, reading performance and colleges

Table 6 revealed that students' English proficiency had a significant and negative correlation with their numbers of unfamiliar vocabulary and sentences, but a significant and positive correlation with their cloze scores in the pretest, GT-assisted test and post-tests. However, there was no significant correlation between students' English proficiency and their reading scores in the delayed test.

Table 6
Pearson correlation of students' English proficiency with their reading performance

English proficiency (N = no. of students)	Pearson correlation coefficient					
	Unfamiliar vocabulary (N = 152)	Unfamiliar sentence (N = 152)	Pretest (N = 152)	GT-assisted test (N = 47)	Post-test (N = 152)	Delayed test (N = 42)
English proficiency	-.272**	-.162*	.320**	.440**	.290**	.194

* $p < .05$. ** $p < .01$.

RQ3: Reading performance in the delayed tests)

A total of 42 students from Group 2 completed the delayed test seven weeks after the post-test. According to the results of Pearson correlation analysis, their scores ($M = 3.93$) in the delayed test had a significant and positive correlation with theirs in the pretest ($M = 2.69$; $r = .444$, $p = .003$) and in the post-test ($M = 7.62$; $r = .482$, $p = .001$), as shown in Table 3. A paired sample t test indicated that their scores in the delayed test were significantly lower than their post-test scores ($p = .000$; Cohen's $d = 1.895$) but significantly higher than their pretest scores ($p = .002$; Cohen's $d = 0.539$).

RQ4: Effect of the intervention time of students' using the GT-assisted multimodality to complete the test

After completing the pretest, 47 students from Group 3 continued the test with multimodal GT-based tools for 10 minutes. According to the results of Pearson correlation analysis, their scores in the GT-assisted test ($M = 5.38$) had a significant and positive correlation with theirs in the pretest ($M = 2.55$; $r = .570$, $p = .000$) and in the post-test ($M = 7.02$; $r = .722$, $p = .000$), as shown in Table 3. A paired sample t test indicated that their GT-assisted test scores were significantly higher than their pretest scores ($p = .000$; Cohen's $d = 1.329$), but significantly lower than their post-test scores ($p = .000$; Cohen's $d = 0.680$).

RQ5: Student perceptions and their relationship with reading performance, English proficiency and colleges of students

The Cronbach's α value of the students' responses to the questionnaires was 0.928. As shown in Table 7, the overall mean was 3.98, and 6 among 13 items had means higher than 4.0, including Q1 ($M = 4.19$), Q2 ($M = 4.14$), Q9 ($M = 4.01$), Q10 ($M = 4.32$), Q11 ($M = 4.03$) and Q12 ($M = 4.16$). In addition, the means of items Q3, Q4, Q5 and Q6 were close to 4, ranging from 3.93 to 3.99. Regardless of English proficiency and college, students' high means ($M = 3.93 \sim 4.00$) in these groups close to 4 indicated that they had positive perceptions towards the implementation of the multimodal GT-assisted approach to online academic EFL reading. The lowest means were on the items Q7 ($M = 3.59$) and Q8 ($M = 3.49$) regarding the correctness of the Chinese translation of English vocabulary and sentences provided by GT. The results from an independent sample t test showed that the significant difference was only found in Q1 ($p = .012$; Cohen's $d = 0.413$) between the group of English proficiency, signifying that the HEP students had significantly higher satisfaction with Chinese translation of English vocabulary than the LEP students.

Table 7

Student perceptions towards the implementation of the multimodal GT-assisted approach into online academic English reading

Item ($N =$ student number)	Mean (SD)				
	ALL	English proficiency		College	
	$N = 152$	HEP $N = 76$	LEP $N = 76$	HM $N = 85$	EC $N = 67$
Q1: The Chinese translation of English vocabulary provided by GT is helpful for reading.	4.19 .812	4.36* .761	4.03 .832	4.16 .814	4.22 .813
Q2: The two different audio speeds of English vocabulary provided by GT are helpful for English listening.	4.14 .806	4.21 .822	4.07 .789	4.09 .811	4.19 .802
Q3: The two different audio speeds of English vocabulary provided by GT is helpful for pronunciation	3.99 .906	3.96 .944	4.01 .872	3.95 .912	4.03 .904
Q4: The Chinese translation of English sentences provided by GT is helpful for English reading comprehension.	3.93 .904	3.92 .949	3.95 .862	3.91 .868	3.97 .953
Q5: The two different audio speeds of English sentences provided by GT are helpful for English speaking.	3.97 .927	4.04 .930	3.91 .926	3.98 .926	3.97 .937
Q6: The two different audio speeds of English sentences provided by GT are helpful for English pronunciation.	3.96 .934	4.01 .945	3.91 .926	3.98 .913	3.94 .967
Q7: The Chinese translation of English vocabulary provided by GT is correct.	3.59 .857	3.68 .867	3.49 .841	3.61 .860	3.55 .858
Q8: The Chinese translation of English sentence patterns provided by GT is correct	3.49 .913	3.50 .973	3.49 .856	3.51 .854	3.48 .990
Q9: GT helps improve my English reading comprehension.	4.01 .772	4.11 .741	3.92 .796	3.95 .815	4.09 .712
Q10: It is convenient to use multimodal GT-based tools for reading English texts.	4.32 .700	4.43 .645	4.23 .738	4.27 .836	4.34 .664
Q11: The explanations from the teacher after the post-test are necessary.	4.03 .809	4.05 .862	4.01 .757	4.05 .844	4.01 .769
Q12: I will continue to use GT to help me read English texts.	4.16 .924	4.21 .869	4.12 .979	4.12 1.017	4.22 .794
Q13: I recommend classmates or friends to use GT while learning English.	3.98 1.006	4.05 .992	3.91 1.022	3.98 .976	3.99 1.052
Overall mean	3.98 .867	4.04 .869	3.93 .861	3.97 .873	4.00 .862

Discussion

As shown in Table 2, students' significantly better scores in the post-test ($M = 7.48$) than in the pretest ($M = 2.75$) indicated that their English vocabulary development and reading comprehension were improved by the use of the multimodal GT-assisted approach. Students with HEP significantly performed better in the pretest and post-tests, but highlighted fewer unfamiliar vocabulary and sentences, as shown in Table 5. These results revealed that English proficiency was an important factor for students to more independently and autonomously learn the target English text and practice linguistic skills through the use of GT-based tools.

The 47 students from Group 3 did benefit from the instant use of the multimodal GT-based tools for just 10 minutes to achieve significantly higher scores ($M = 5.38$) than their pretest scores ($M = 2.55$), but they still needed 40 minutes of effort again to learn the target text through using the GT-based tools in the subsequent phase for achieving higher reading scores in the post-test ($M = 7.02$). These results showed that, in online reading, EFL students should not only make good use of technological tools but also pay more engagement or attention to learning the target text to improve performance (Alqahtani, 2024; Azmuddin et al., 2020; Z. Wang et al., 2020).

Seven weeks after the post-test, 42 students from Group 2 completed the delayed test with reading scores ($M = 3.93$) significantly lower than theirs in the post-test ($M = 7.62$), but significantly higher than their scores in the pretest ($M = 2.69$), as shown in Table 3. The retention of their reading scores still remained at 51.6% within an interval of 7 weeks. Some studies have found that vocabulary retention within an interval of 2 or 4 weeks ranged from 78% to 64% in delayed tests of ten unknown words through a multiple-choice test or a fill-in-the-blank exercise (Abdollahi & Farvardin, 2016; Hashemzadeh, 2012). In addition, the number of unfamiliar vocabulary and sentences had significant correlation with students' scores in the pretest and post-tests, but no significant correlation with students' scores in the GT-assisted test, as shown in Table 4. These results suggest that using multimodal GT-based tools in online reading helped students reduce the difficulty resulting from their unfamiliarity with vocabulary and sentence structures.

The high overall mean ($M = 3.98$) of the questionnaire indicates that students had positive perceptions towards the multimodal GT-assisted approach to academic EFL reading. The first four items that students were most satisfied with were the convenience of using multimodal GT-based tools (Q10, $M = 4.32$), and the provision of Chinese translation (Q1, $M = 4.19$) and audio aid for listening vocabulary (Q2, $M = 4.14$), and students' willingness of continuing to use GT (Q12, $M = 4.16$), as shown in Table 7. These results indicate that, in online academic EFL reading, instant GT-assisted multimodality, including translation and audio aids for pronunciation, listening and speaking, facilitated students' vocabulary development and reading comprehension.

Students' post-cloze scores had a significant and positive correlation with the mean of some individual items in the questionnaire, including Q1 (Chinese translation of English vocabulary; $r = .297$, $p = .000$), Q6 (audio aid of sentences pronunciation; $r = .185$, $p = .023$) and Q12 (continuing to use GT; $r = .187$, $p = .021$) and almost a significant and positive correlation with Q2 (audio aid of listening vocabulary; $r = .157$, $p = .054$). These results suggest that high-performing students in the post-cloze test had higher satisfaction with multimodal aids provided by GT, especially in audio aids and translation. In addition, the positive responses to the audio aids support that students' accurate and fluent pronunciation may help promote their reading fluency and skills (Khan et al., 2020; Muhaimin, 2019).

The relatively lowest means on the items Q7 ($M = 3.59$) and Q8 ($M = 3.49$) showed students' reservation about the correctness of the Chinese translation of English vocabulary and sentences provided by GT, similar to findings in previous studies in that students are often skeptical about GT translation accuracy (Mirzaeian & Oskoui, 2023; Tsai, 2022). In addition, they also expressed the need for teacher explanations after the post-test (Q11, $M = 4.03$). The results indicate that non-English major EFL students still needed

linguistic support from the teacher because they had less confidence in online academic English reading with the learner-centred multimodality assisted by GT.

The multimodal GT-based tools in this study offered multiple media forms such as visual, aural and linguistic channels to support the retrieval, acquisition, translation and feedback of word knowledge and sentence structures of the target text. In addition, these linguistic and content-based functions can also be immediately presented, highlighted, played or checked on computers for students' easy reference, which not only meets some features of the cognitive theory of multimedia learning (Mayer, 2009) but also helps strengthen students' memory retention for vocabulary acquisition and reading comprehension.

Implications and limitations

Some educational implications for this implementation of the digital multimodality of the GT-assisted approach were identified: First, this GT-assisted approach is convenient, interactive and effective in helping EFL students make good use of multimodal tools, including instant translation, TTS and ASR, to check, notice, translate and identify at their own need and pace for improving vocabulary development and reading comprehension. Second, the instant translation from English (L2) to Chinese (L1) by GT is beneficial for EFL students to enhance vocabulary development and improve their reading comprehension. The key point in using the translation strategy is that EFL students should have the ability to notice, compare and analyse the grammatical structure and semantic expression of the source English text and the translated Chinese text. Accordingly, EFL students need to keep improving their English proficiency. Third, highlighting is a useful strategy for interactive reading and provides textual, contextual and visual annotations to help students identify what should be noticed or needs to be reinforced, thus capturing their attention as visual signals for recalling and reviewing (Azmuiddin et al., 2020; Li et al., 2016). As students are required to immediately and simultaneously highlight and make related annotations on the screen of their individual computers, such a strategy can enhance their engagement, a critical factor in the success of online learning (Bedenlier et al., 2020; Goode et al., 2022). Fourth, based on the goals of the courses, EFL teachers can make good use of multimodal GT-based features in language learning to design and administer linguistic activities, assessments, homework or student self-report surveys to measure and enhance students' engagement with the content in the target language (Bedenlier et al., 2020; Hofkens & Ruzek, 2019, Chapter 21). Finally, when conducting GT-assisted courses, teachers have to play the role of facilitator to encourage students to self-study with multimodal GT-based tools, monitor their learning behaviour and guide them as they approach difficulties or problems, which will help students reduce their cognitive load – especially helpful for students with insufficient English proficiency. Teachers can ensure optimal utilisation of this GT-assisted approach within the classroom and, in the meantime, help EFL students establish a positive and appropriate attitude towards using it. More research with various types of activities or tasks should be conducted to further investigate the possible advantages and impact of such a multimodal GT-assisted approach.

Some limitations of this study are highlighted as follows: First, the sample of the participants is limited and all of them came from a university, so the results of this study might not be generalised globally. More studies should be conducted with participants from other educational backgrounds or different non-English regions or countries. Second, as the findings were obtained by one-time achievement only, more research regarding periodic experiments should be conducted to investigate and validate the long-term impact of the multimodal GT-assisted approach on EFL reading skills. Third, although I (the teacher-as-researcher) monitored students' learning behaviour, it was difficult to exactly understand what and how students were engaged with the target content. Thus, technological tools like screen recording or eye-tracking can be used to investigate students' real-time engagement, behaviour and progress in the learning process. Fourth, more varied combinations of multimodal GT-based tools with other innovative technologies or software could be developed to create a dynamic, flexible, interactive and effective learning environment in which linguistic practices, activities and tasks are provided to enhance interaction among content, students and teachers for improving students' learning effectiveness and language competence. Finally, a macro-level study related to GT-based curriculum or professional development could be conducted to provide practical teaching experience or pedagogical resources for the reference

of schools or universities when formulating or implementing policies of technology-enhanced language learning.

Conclusions

As multimodal GT-based tools are easily accessed, it is important for both students and teachers to make good use of these helpful online resources to facilitate language teaching and learning. The implementation of a five-step model of the digital multimodality of the GT-assisted approach to online academic EFL reading is a potential strategy to create an autonomous, interactive and flexible learning environment. Non-English major EFL students significantly improved their reading scores in the post-test, with a larger effect size ranging from 2.14 to 3.05, and also showed highly positive perceptions of the approach. This study also found that students' English proficiency had a significant and negative correlation with their unfamiliar vocabulary and sentences but a significant and positive correlation with their reading scores in the pretest, GT-assisted test and post-tests. Thus, it is essential for EFL students, especially non-English majors, to keep improving their English proficiency through using innovative technologies. Students' retention was 51.6% in the delayed test conducted 7 weeks after the post-test, and their reading scores were significantly higher than theirs in the pretest, with a medium effect size of 0.54. Regardless of student college, students also showed highly positive perceptions towards the multimodal GT-assisted approach. High-performing students had more significant satisfaction with the Chinese translation of English vocabulary than their counterparts of low English proficiency, and also more easily perceived multimodal strategies provided by GT, especially in translation and audio aids. The implementation of the multimodal GT-assisted approach effectively helped students engage in the cognitive processes of monitoring, noticing, highlighting, identifying, correcting and modifying to complete the assigned reading tasks. In addition, the use of multimodal GT-based tools in online reading helped students reduce the difficulty resulting from their unfamiliarity with vocabulary and sentence structures and reduce the differences in the test scores caused by students' English proficiency.

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References

- Abdollahi, M., & Farvardin, M. T. (2016). Demystifying the effect of narrow reading on EFL learners' vocabulary recall and retention. *Education Research International*, Article 5454031. <https://doi.org/10.1155/2016/5454031>
- Abreu, K., Garcia, D., Hora, K., & Souza, C. (2017). Cloze test as an instrument to measure reading proficiency: Linguistic and non-linguistic factors. *Revista de Estudos da Linguagem*, 25(3), 1767–1799. <http://www.periodicos.letras.ufmg.br/index.php/relin/article/view/11366/0>
- Al Bukhari, J., & Dewey, J. A. (2023). Multimodal glosses enhance learning of Arabic vocabulary. *Language Learning & Technology*, 27(1), 1–24. <https://hdl.handle.net/10125/73498>
- Al-Maashani, S., & Mudhsh, B. A. (2023). Educational and instructional technology in EFL/ESL classrooms: A literature review. *International Journal of Language and Literary Studies*, 5(2), 292–304. <https://doi.org/10.36892/ijlls.v5i2.1347>
- Alqahtani, A. A. (2024). Using technology to assist in EFL vocabulary acquisition and reading comprehension. *English Language Teaching*, 17(4), 70–81. <https://doi.org/10.5539/elt.v17n4p70>
- Azmuddin, R. A., Nor, N. F. M., & Hamat, A. (2020). Facilitating online reading comprehension in enhanced learning environment using digital annotation tools. *IAFOR Journal of Education: Technology in Education*, 8(2), 7–27. <https://iafor.org/journal/iafor-journal-of-education/volume-8-issue-2/article-1/>

- Bashori, M., van Hout, R., Strik, H., & Cucchiarini, C. (2022). 'Look, I can speak correctly': Learning vocabulary and pronunciation through websites equipped with automatic speech recognition technology. *Computer Assisted Language Learning*, 37(5-6), 1335–1363. <https://doi.org/10.1080/09588221.2022.2080230>
- Bayoudh, K., Knani, R., & Hamdaoui, F. (2022). A survey on deep multimodal learning for computer vision: Advances, trends, applications, and datasets. *The Visual Computer* 38, 2939–2970. <https://doi.org/10.1007/s00371-021-02166-7>
- Bedenlier, S., Bond, M., Buntins, K., Zawacki-Richter, O., & Kerres, M. (2020). Facilitating student engagement through educational technology in higher education: A systematic review in the field of arts and humanities. *Australasian Journal of Educational Technology*, 36(4), 126–150. <https://doi.org/10.14742/ajet.5477>
- Chai, Z. F., Swanto, S., & Din, W. A. (2020). Variants of cloze-test based tasks and vocabulary achievement. *Universal Journal of Educational Research*, 8(7), 2980–0989. <https://doi.org/10.13189/ujer.2020.080726>
- Chapelle, C. (1998). Multimedia CALL: Lessons to be learned from research on instructed SLA. *Language Learning & Technology*, 2(1), 21–39. <https://www.iltjournal.org/item/10125-25030/>
- Chen, K. T.-C. (2017). An exploratory study of NNEs graduate students' reading comprehension of English journal articles. *Reading in a Foreign Language*, 29(1), 20–35. <http://hdl.handle.net/10125/66726>
- Chen, X., Li, J., & Zhu, S. (2021). Translanguaging multimodal pedagogy in French pronunciation instruction: Vis-à-vis students' spontaneous translanguaging. *System*, 101, Article 102603. <https://doi.org/10.1016/j.system.2021.102603>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.
- Ebadi, S., Amini, Z. & Gheisari, N. (2023). On the relationship between mobile-based extramural activities and vocabulary development of EFL learners: A mixed-method study. *Smart Learning Environment*, 10, Article 33. <https://doi.org/10.1186/s40561-023-00252-y>
- Flesch, R. F. (1981). *How to write plain English*. Barnes & Noble.
- Ghalebi, R., Sadighi, F., & Bagheri, M. S. (2020). Vocabulary learning strategies: A comparative study of EFL learners. *Cogent Psychology*, 7, Article 1824306. <https://doi.org/10.1080/23311908.2020.1824306>
- Goode, E., Nieuwoudt, J., & Roche, T. (2022). Does online engagement matter? The impact of interactive learning modules and synchronous class attendance on student achievement in an immersive delivery model. *Australasian Journal of Educational Technology*, 38(4), 76–94. <https://doi.org/10.14742/ajet.7929>
- Grabe, W. (2009). *Reading a second language: Moving from theory to practice*. Cambridge University Press. <https://doi.org/10.1017/CBO9781139150484>
- Gui, M., Chen, X., & Verspoor, M. (2021). The dynamics of reading development in L2 English for academic purposes. *System*, 100, Article 102546. <https://doi.org/10.1016/j.system.2021.102546>
- Hashemzadeh, M. (2012). The effect of exercise types on EFL learners' vocabulary retention. *Theory and Practice in Language Studies*, 2(8), 1716–1727. <https://www.academypublication.com/issues/past/tpls/vol02/08/24.pdf>
- Hirano, E. (2015). 'I read, I don't understand': Refugees coping with academic reading. *ELT Journal*, 69(2), 178–187. <https://doi.org/10.1093/elt/ccu068>
- Hofkens, T. L., & Ruzek, E. (2019). Measuring student engagement to inform effective interventions in schools. In J. A. Fredricks, A. L. Reschly, & S. L. Christenson (Eds.), *Handbook of student engagement interventions* (pp. 309–324). Academic Press. <https://doi.org/10.1016/B978-0-12-813413-9.00021-8>
- Ji, J., & Luo, C. (2019). Scaffolding theory study based on multimodality. *Advances in Economics, Business and Management Research*, 110, 1107–1110. <https://doi.org/10.2991/aebmr.k.191225.214>
- Khan, R. M. I., Shahbaz, M., Kumar, T., & Khan, I. (2020). Investigating reading challenges faced by EFL learners at elementary level. *Register Journal*, 13(2), 277–292. <https://doi.org/10.18326/rgt.v13i2.277-292>
- Kleijn, S., Pander Maat, H., & Sanders, T. (2019). Cloze testing for comprehension assessment: The HyTeC-cloze. *Language Testing*, 36(4), 553–572. <https://doi.org/10.1177/0265532219840382>

- Klimova, B., & Zamborova, K. (2020). Use of mobile applications in developing reading comprehension in second language acquisition—A review study. *Education Sciences*, 10, Article 391. <https://doi.org/10.3390/educsci10120391>
- Knight, J., Dooly, M., & Barberà, E. (2020). Navigating a multimodal ensemble: Learners mediating verbal and non-verbal turns in online interaction tasks. *ReCALL*, 32(1), 25–46. <https://doi.org/10.1017/S0958344019000132>
- Kohnke, L., Zhang, R., & Zou, D. (2019). Using mobile vocabulary learning apps as aids to knowledge retention: Business vocabulary acquisition. *Journal of Asia TEFL*, 16(2), 683–690. <https://doi.org/10.18823/asiatefl.2019.16.2.16.683>
- Lai, K.-W. K., & Chen, H.-J. H. (2023). A comparative study on the effects of a VR and PC visual novel game on vocabulary learning. *Computer Assisted Language Learning*, 36(3), 312–345. <https://doi.org/10.1080/09588221.2021.1928226>
- Li, L.-Y., Tseng, S.-T., & Chen, G.-D. (2016). Effects of hypertext highlighting on browsing, reading, and navigational performance. *Computers in Human Behavior*, 54, 318–325. <https://doi.org/10.1016/j.chb.2015.08.012>
- Liang, M. (2019). Beyond elocution: Multimodal narrative discourse analysis of L2 storytelling. *ReCALL*, 31(1), 56–74. <https://doi.org/10.1017/S0958344018000095>
- Lin, H.-Y., & Tsai, S.-C. (2021). Student perceptions towards the usage of AR-supported STEMUP application in mobile courses development and its implementation into English learning. *Australasian Journal of Educational Technology*, 37(3), 88–103. <https://doi.org/10.14742/ajet.6125>
- Maghsoudi, M., & Mirzaeian, V. (2020). Machine versus human translation outputs: Which one results in better reading comprehension among EFL learners? *JALT CALL Journal*, 16(2), 69–84. <https://doi.org/10.29140/jaltcall.v16n2.342>
- Marboot, K., Roohani, A., & Mirzaei, A. (2020). Investigating Iranian EFL students' metacognitive online reading strategies, critical thinking, and their relationship: A mixed-methods study. *Issues in Language Teaching*, 9(1), 151–182. <https://doi.org/10.22054/ILT.2020.50833.475>
- Mayer, R. E. (2009). *Multimedia learning* (2nd ed). Cambridge University Press.
- McLeod, S. A. (2023, July 31). *What does effect size tell you?* Simply Psychology. <https://www.simplypsychology.org/effect-size.html>
- Mirzaeian, V. R., & Oskoui, K. (2023). Google Translate in foreign language learning: A systematic review. *Applied Research on English Language*, 12(2), 51–84. <https://doi.org/10.22108/are.2023.134264.1949>
- Muhaimin, A. (2019). *The use of reading aloud strategy to improve students' fluency and pronunciation accuracy in reading skills of the Eighth Grade at MTs NU Aswaja Tenggara in the academic year 2017/2018* [Master's dissertation, State Institute for Islamic Studies]. <http://perpus.iainsalatiga.ac.id/lemari/fg/free/pdf>
- National Taiwan University. (2025). *English proficiency test comparison chart*. https://admissions.ntu.edu.tw/wp-content/uploads/cefr_en.pdf
- Nirgrum, A., & Dewi, U. (2024). The use of Google Translate and U-Dictionary as machine translation for translating text: EFL college student's preference and perceptions. *Eternal: English Teaching Journal*, 15(1), 167–179. <https://doi.org/10.26877/eternal.v15i1.373>
- Ouyang, J., Huang, L., & Jiang, J. (2020). The effects of glossing on incidental vocabulary learning during second language reading: Based on an eye-tracking study. *Journal of Research in Reading*, 43(4), 496–515. <https://doi.org/10.1111/1467-9817.12326>
- Pardede, P. (2019). Print vs digital reading comprehension in EFL: A literature review. *Journal of English Teaching*, 5(2), 77–90. <https://doi.org/10.33541/jet.v5i2.1059>
- Peng, J. E. (2019). The roles of multimodal pedagogic effects and classroom environment in willingness to communicate in English. *System*, 82, 161–173. <https://doi.org/10.1016/j.system.2019.04.006>

- Pribadi, T. D., Santoso, M. E., & Rosdiana, I. (2022). The correlation between Google Translate usage and the interest in reading English articles. In M. Taufiqulloh, N. Meirisiani, M. Yuwita, A. E. Sulistywati, Y. N. Ekawati, F. Prihatini, A. Zainudin, Y. Arfiani, S. D. Mumpuni, A. Habilullah, A. Husain, D. P. S. Arum, & M. A. Budiyanto (Eds.), *Building teachers and students' literacies in English language teaching—Proceedings of the Pancasakti International Seminar on English Language Teaching* (pp. 214–224). Badan Penerbit Universitas Pancasakti Tegal.
<https://semnas.upstegal.ac.id/index.php/piselt/article/view/437/182>
- Rahman, K. (2020). Perceived use of metacognitive strategies by EFL undergraduates in academic reading. *Voices of English Language Education Society*, 4(1), 44–52.
<https://e-journal.hamzanwadi.ac.id/index.php/veles/article/view/1975>
- Singer Trakhman, L. M., Alexander, P. A., & Berkowitz, L. E. (2017). Effects of processing time on comprehension and calibration in print and digital mediums. *The Journal of Experimental Education*, 87(1), 101–115. <https://doi.org/10.1080/00220973.2017.1411877>
- Stallard, E. (2022, November 7). *What is COP27 and why is it important?* British Broadcasting Corporation. <https://www.bbc.com/news/science-environment-63316362>
- Stiegler-Balfour, J. J., Roberts, Z. S., LaChance, A. S., Sahouria, A. M., & Newborough, E. D. (2023). Is reading under print and digital conditions really equivalent? Differences in reading and recall of expository text for higher and lower ability comprehenders. *International Journal of Human-Computer Studies*, 176, Article 103036.
<https://doi.org/10.1016/j.ijhcs.2023.103036>
- Tsai, S. C. (2019). Using Google Translate in EFL drafts: A preliminary investigation. *Computer Assisted Language Learning*, 32(5-6), 510–526. <https://doi.org/10.1080/09588221.2018.1527361>
- Tsai, S. C. (2022). Chinese students' perceptions of using google Translate as a translanguaging CALL tool in EFL writing. *Computer Assisted Language Learning*, 35(5-6), 1250–1272.
<https://doi.org/10.1080/09588221.2020.1799412>
- Tsai, S. -C. (2023). Learning with mobile augmented reality- and automatic speech recognition-based materials for English listening and speaking skills: Effectiveness and perceptions of non-English major English as a foreign language students. *Journal of Educational Computing Research*, 61(2), 444–465.
<https://doi.org/10.1177/07356331221111203>
- Varol, B., & Erçetin, G. (2019). Effects of gloss type, gloss position, and working memory capacity on second language comprehension in electronic reading. *Computer Assisted Language Learning*, 34(7), 820–844.
<https://doi.org/10.1080/09588221.2019.1643738>
- Wang, S., & Lee, C. I. (2021). Multimedia gloss presentation: Learners' preference and the effects on EFL vocabulary learning and reading comprehension. *Frontiers in Psychology*, 11, Article 602520.
<https://doi.org/10.3389/fpsyg.2020.602520>
- Wang, Z., Hwang, G.-J., Yin, Z., & Ma, Y. (2020). A contribution-oriented self-directed mobile learning approach to improving EFL students' vocabulary retention and second language motivation. *Educational Technology & Society*, 23(1), 16–29.
<https://drive.google.com/open?id=1kQxgyrkotsGzQjG08S-P2SHqkjdU3W5i>
- Wilawan, S. (2023). Using lexical cohesion cloze exercises to improve EFL learners' reading comprehension. *World Journal of English Language*, 13(6), 1–10.
<https://doi.org/10.5430/wjel.v13n6p1>
- Yawiloeng, R. (2020). Second language vocabulary learning from viewing video in an EFL classroom. *English Language Teaching*, 13(7), 76–87. <https://doi.org/10.5539/elt.v13n7p76>
- Yawiloeng, R. (2022). Using instructional scaffolding and multimodal texts to enhance reading comprehension: Perceptions and attitudes of EFL students. *Journal of Language and Linguistic Studies*, 18(2), 877–894.
<https://www.jlls.org/index.php/jlls/article/view/4142>
- Yazdanpanah, K. (2007). The effect of background knowledge and reading comprehension test items on male and female performance. *The Reading Matrix*, 7(2), 64–80.
<https://www.readingmatrix.com/articles/yazdanpanah/article.pdf>

Yulia, M. F., Sulisty, G. H., & Cahyono, B. Y. (2020). Affective engagement in academic reading: What EFL student teachers reveal. *International Journal of Evaluation and Research in Education (IJERE)*, 9(3), 791–798. <https://doi.org/10.11591/ijere.v9i3.20635>

Corresponding author: Shu-Chiao Tsai, achiao@nkust.edu.tw

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