Exploring Google Translate-friendly strategies for optimizing the quality of Google Translate in academic writing contexts

Yu-Chih Sun1 · Fang-Ying Yang1 · Hsin-Ju Liu1

Received: 1 November 2021 / Accepted: 14 July 2022 © The Author(s), under exclusive licence to Springer Nature Switzerland AG 2022

Abstract

The present study explored the types of errors found in Google Translate (GT) Chinese-to-English translations and, based on those error types, proposes strategies for optimizing the performance of GT. Seven abstracts written in both Chinese and English from seven articles published in English Teaching and Learning in 2017 were selected as the materials. The researchers compared the GT translations to the English abstracts written by the original author(s) and analyzed the problems in the translations. The problematic translations consisted of grammatical errors (35%) and lexical errors (65%). Relatedly, we propose nine specific strategies to employ when writing Chinese abstracts to be translated into English using GT. According to the strategies, we suggest that users (1) avoid native language-specific expressions, (2) maintain the use of original English terminologies in composing Chinese abstracts, and (3) enhance logical relations and expressions for the discipline-specific discourse community. Further analyses revealed that 99% of the 69 identified problems in the GT translations of the seven abstracts could be avoided by using the proposed strategies. A conceptual framework for the collaboration between GT and GT users is proposed and pedagogical implications are discussed.

Keywords Machine translation · Google Translate · Academic writing · English for academic purposes

1 Institute of Teaching English to Speakers of Other Languages, National Yang Ming Chiao Tung University, 1001 University Rd., Hsin-chu 300, Taiwan
Introduction

The United Nations’ (UN) 2030 Agenda for Sustainable Development serves as a guideline “for peace and prosperity for people and the planet” (Department Economic and Social Affairs of the United Nations, History section 2022). The current 17 Sustainable Development Goals (SDGs) outlined in the agenda stressed the importance of global partnerships, which require all countries to work together to recover from the negative impact of the COVID-19 pandemic (Department Economic and Social Affairs of the United Nations 2022). At the heart of the global partnerships lies effective intercultural communication in which language is one of the major means. Learning a new language, however, is a time-consuming process and is often constrained by a number of factors (van Lieshout and Cardoso 2022). With the rapid development of technology, a variety of tools have been adopted by learners to facilitate the process of language learning. An understanding of the affordances of these tools can guide the language learners to make evidence-based decisions in selecting and using the tools. The present study focuses on one of the commonly used technological tools by language learners and users, Google Translate (GT). The purpose of the study is to explore GT’s affordances in English academic abstract writing by first analyzing the translation problems by GT, and based on which, proposing nine GT-friendly writing strategies for language learners to employ when they use GT to support their English abstract writing.

Advantages of machine translation technologies

With recent development of artificial intelligence (AI), the neural machine translation system utilized by machine translation (MT) tools such as Google Translate (GT) has greatly improved the translation accuracy and quality. This improvement has led to better translations of longer texts (Ducar and Schocket 2018). Studies have indicated that GT can be a useful learning aid for college students in English-as-a-Foreign-Language (EFL)/English-as-a-Second-Language (ESL) contexts (Nila and Susanto 2017; Tsai 2019). Recent research shows that GT is a promising tool for learning second language (L2) vocabulary and pronunciation in self-directed settings (van Lieshout and Cardoso 2022). MT has recently taken on increasing importance in scholarly fields such as L2 academic writing and publishing. Previous research shows that MT helped L2 writers improved the quality (Stapleton and Kin 2019) and quantity of their L2 writing (Chon and Shin 2020). Groves and Mundt (2015) explored GT’s effectiveness in providing writing instruction in an English for academic purposes (EAP) context. They asked students to write short essays in their first language, and then they translated the essays to English with GT. The results showed that despite the fact that they still contained ungrammatical words and sentences, GT’s translations were considered comprehensible; the results even met the minimum admission standards for most academic institutions in Malaysia. In addition to improving L2 learners’ writing outcomes, MT also offers affective supports to L2 learners in the process of L2 writing by lowering their anxiety levels and enhances motivation and confidence (Lee 2020).
Challenges of machine translation technologies

Despite MT’s positive effects, studies (e.g., Alhaisoni and Alhaysony’s 2017) found that students expressed a paradoxical view toward its use in class. Teachers often have divided opinions regarding MT’s role in language learning. Jolley and Maione (2015) reported that both students and their teachers have positive outlooks with regard to the in-class integration of MT; they also suggested that, in the future, teachers should provide guidance during the learning process in order to facilitate more appropriate use of the tool. On the other hand, some instructors still hold conservative, even antagonistic, views regarding the use of MT in class (Stapleton and Kin 2019). Chandra and Yuyun (2018) suggested that it is important for instructors to cover both the benefits and the limitations of using MT in class so that students can engage in productive and meaningful translation activity and language practice. In summary, specific guidelines of effective and appropriate MT use are called for. The present study responds to the call by offering MT-friendly writing strategies based on empirical evidence.

Evaluation and measurement of machine translation quality

Lee (2021) systematically reviewed and conducted meta-analysis on MT studies related to foreign language education published between 2000 and 2019. Based on the review of the studies that examined MT translation quality, Lee (2021) found that overall the most common error types produced by MT were syntactic and grammatical errors, and the translation quality was particularly poor with translation of longer texts. However, closer examinations of more recent studies reveal that the application of the neural machine translation system in MT has greatly improved the translation quality of longer texts.

Lee (2021) also indicates that, unlike the evaluation of MT outcomes in translation-related studies, the purpose of evaluating the MT translation quality in L2 learning and teaching mainly focuses on examining MT’s technological affordances for L2 learning and teaching rather than evaluating the translation quality per se. As a result, most studies evaluate students’ writing after students used MT as a supporting tool rather than directly evaluating the quality of machine translation output. For example, Tsai (2019) used two online computational writing assessment tools to assess L2 students’ MT-supported English writing. In this study, writing quality was evaluated in terms of the number of spelling and grammatical errors, the probability of errors, and lexical features (i.e., the number of words at different frequency bands and lexical density). In another study, Stapleton and Kin (2019) recruited English teachers to evaluate the quality of English essays, which were originally composed by students in their L1 (Chinese) and later translated by GT into English. A rubric on a four-point scale covering three dimensions (i.e., grammar, vocabulary, and comprehensibility) was developed to guide the teachers to evaluate the translated English text.

Previous studies show that GT has frequently been integrated into English writing classes and used as a support tool by language learners. Given the fact that GT
has advanced to become a more reliable tool, and will continue to advance further, its application in the field of language learning and teaching deserves our attention. The present study, therefore, sought to explore the affordances of GT in language learning and teaching and based on which to propose strategies for enhancing its affordances by addressing the following three research questions:

1. What types of errors in English translation can be identified when GT is used to translate Chinese academic abstracts?
2. What Chinese abstract writing strategies can be used to optimize the quality of GT English translations?
3. To what extent can the proposed Chinese abstract writing strategies enhance the quality of GT English translations?

**Methods**

**Materials**

Seven abstracts (containing a total of 51 Chinese sentences and 2129 Chinese characters) written in both Chinese and English from seven articles published in *English Teaching and Learning (ETL)* in 2017 were selected as the materials for data analysis. *ETL* was chosen because the journal’s corresponding English abstracts allowed the researchers to check the accuracy of terminologies translated by GT. Also, the topics of studies published in *ETL* match the researchers’ field of expertise. The researchers’ familiarity with the content knowledge of the abstracts, thus, allowed for the accurate and reliable justification of the GT translations.

**Data analysis**

To answer Research Question 1, the researchers first used GT to translate the seven Chinese abstracts into English. The English translations generated by GT were then compared to the English abstracts written by the studies’ author(s). Differences between each Google translated English abstract and the corresponding original English abstract were identified, with those differences used to identify and code errors in the translation. Grounded theory (Glaser and Strauss 1999) was employed as an analytical approach. The process of data analysis was inductive, iterative, and data driven. A research assistant, who had a master’s degree in the Teaching English as a Second Language (TESOL), coded the errors and developed an initial coding system. The final coding system was developed through several rounds of data examination and discussion with the first author, who had a Ph.D. degree in TESOL.

To answer Research Question 2, the researchers examined each error in the English translations and identified the source(s) of the errors, before then using that information to modify the corresponding portion of the Chinese abstract written by the author(s). The modification strategies were coded and analyzed inductively following the same approach described in the previous paragraph.
To answer Research Question 3, the researchers used GT to translate the modified Chinese abstracts into English. Each entry of the English output was rated by the researchers to evaluate the translation outcome. More specifically, the evaluation focused on whether the use of a given modification strategy successfully resolved the errors in the English translations. A total of 69 problems in the GT translations were evaluated. A check of interrater reliability regarding all 69 entries was conducted, and it was found that the interrater reliability was 100%.

**Results**

**Types of errors in the GT English translations**

Sixty-nine problems in the GT translations were identified (Table 1). Approximately 34.8% of those errors were categorized as grammatical errors, while 65.22% were categorized as lexical errors. The most common grammatical errors were instances of mispunctuation, null-subject sentences, and the misuse of conjunctions. The most common lexical errors were instances of academically inappropriate word choices; non-contextual, literal translations of Chinese texts; and untranslated or redundant/unnecessary words.

| Problems with GT translations | Total number of entries (%) |
|------------------------------|----------------------------|
| Grammatical errors          |                            |
| 1. Mispunctuation            | 7 (10.15)                  |
| 2. Misuse of the conjunctions *but*, *and*, or *or* and *so* (missing, repetition) | 4 (5.80) |
| 3. Singular/plural mismatch  | 1 (1.45)                   |
| 4. Excessive use of verbs in one sentence | 2 (2.90) |
| 5. Misplaced adjectives      | 1 (1.45)                   |
| 6. Null-subject sentences    | 5 (7.25)                   |
| 7. Sentences without verbs   | 1 (1.45)                   |
| 8. Sentence fragments        | 2 (2.90)                   |
| 9. Tense disagreement        | 1 (1.45)                   |
| Subtotal                     | 24 (35)                    |
| Lexical errors               |                            |
| 10. Academically inappropriate word choice | 21 (30.43) |
| 11. Uncontextual, literal translations of Chinese texts | 11 (15.94) |
| 12. Untranslated or additional words | 7 (10.15) |
| 13. Inappropriate collocation | 4 (5.80) |
| 14. Problematic word order in a phrase | 2 (2.90) |
| Subtotal                     | 45 (65)                    |

*N* = 69
Optimization strategies for Chinese abstract writing

Nine optimization strategies for Chinese abstract writing were identified based on inductive analyses of the GT translation errors. The nine strategies (Table 2) can be divided into three types of actions: (1) avoidance actions: Strategies 1–3 (2) maintenance actions: Strategy 4, and (3) enhancement actions: Strategies 5–9. Each strategy is illustrated as follows:

**Strategy 1: avoid using Chinese big words or set phrases, use modern Chinese**

Our analyses showed that GT currently cannot appropriately process Chinese big words and ancient literary Chinese. As shown in Table 3, one author used the Chinese word 服膺 (fú yīng; obey) to indicate that the students in the study identified with the core value of their textbooks. Nevertheless, Google translated the Chinese word 服膺 to clothing, an uncontextual translation which totally deviated from the Chinese word’s actual meaning. The researchers then replaced 服膺 with a more modern word, 認同 (rèn tóng; identify). The modified Chinese text, thus, generated a contextually appropriate GT English translation—“… most children agree with the value and content of textbooks.” Of the 69 translation errors, three (4.3%) could be resolved using this strategy.

**Strategy 2: avoid writing null-subject sentences**

Writing a sentence without a subject is common in Chinese. The data analyses of the present study showed that GT assigned contextually inappropriate subject(s) to null-subject sentences. The associated proposed strategy recommends that the writing of null-subject sentences in Chinese, especially long, complex sentences, be avoided. As shown in Table 4, the original Chinese text consisted of a null-subject sentence. GT assigned a contextually inappropriate subject, you, to the sentence. To avoid this problem, we added a contextually appropriate subject 研究者 (yán jiūzhě; the researchers) to the sentence. The resulting GT output was, thus, acceptable. Of the 69 translation errors, seven (9.4%) could be resolved using this strategy.

**Strategy 3: avoid using Chinese-specific punctuations**

The analyses showed that GT followed the original Chinese punctuations, which generated incorrect uses of punctuation in the English translations, especially in cases of listing. As can be seen in Table 5, we used a conjunctive coordinator, 及 (jí; and), and a Chinese-specific punctuation mark that indicates a short pause ( 、) to separate three nouns in the original Chinese sentence. GT then simply used a comma to replace the Chinese-specific punctuation ( 、) without placing a conjunctive coordinator, and, before the last listed item. The researcher modified the Chinese text by following the English punctuation rule for listing and using commas instead of the Chinese-specific one. The modified GT English translation outcome was, thus, correctly punctuated. Four of the 69 (4.3%) translation problems were resolved using this strategy.
### Table 2  Optimization strategies

| Avoid | Maintain | Enhance |
|-------|----------|---------|
| Native language-specific expressions  |
| • Strategy 1: Avoid using Chinese big words or set phrases, use modern Chinese  |
| • Strategy 2: Avoid writing null-subject sentences  |
| • Strategy 3: Avoid using Chinese-specific punctuations  |
| The use of original English terminologies  |
| • Strategy 4: Use English terminologies directly  |
| Logical relations  |
| • Strategy 5: Add the structural particle “的” (de) after compound-complex adjectives/adjectival phrases to distinguish the modifier from the modified noun  |
| • Strategy 6: Use circumposition such as “在…中” (zài… zhōng) to mark the abstract context where an event takes place  |
| • Strategy 7: Use a coordinating conjunction such as “並(且)/而(且)” (bìngqiě/érqiě) to introduce additional ideas  |
| • Strategy 8: Use an infinitive phrase such as “以/來” (yǐ/lái; in order to) to suggest that the latter clause marks the purpose for the former clause  |
| Expressions for the discipline-specific discourse community  |
| • Strategy 9: Use academically appropriate vocabulary and phrases instead of colloquial expressions  |
Strategy 4: use English terminologies directly

Strategy 4 suggests the use of English terminologies instead of Chinese terminologies when writing Chinese that is to be translated into English using GT. As shown in Table 6, Google translated 修辞言步 (xiū cíyánbù) as rhetoric step and translated 介绍本研究 (jiè shào běnyán jiù) as introducing this study. Although the translation output was still comprehensible, it deviated from the standard usage of the terms in this field of study. In this case, the English terms rhetorical move and occupying the niche can be used directly in Chinese abstract writing to avoid nonstandard GT translations of the terminologies. Approximately 30% of the English translation errors could be addressed using this skillful bilingual writing strategy.

Strategy 5: add the structural particle “的” (de) after compound-complex adjectives/adjectival phrases to distinguish the modifier from the modified noun

In Chinese, it is common to attach the attributes of a noun by directly adding complex adjectives or complex adjectival nouns before it. The analyses showed that GT was not able to distinguish the complex adjectival nouns from the nouns that they were intended to modify. Table 7 illustrates the use of Strategy 5, inserting the structural particle 的 (de) between the modifier from the modified noun, to overcome this problem. As shown in Table 7, 學習成效 (xué xíchéng xiào; learning effectiveness) was modified by adjectival nouns, 跨文化溝通能力 (kuàwén huàgōng tōngnéng lì; cross-cultural communication skills). GT translated the entire phrase into cross-cultural communication skills learning effectiveness without identifying that 學習成效 (xué xíchéng xiào; learning effectiveness) was the noun to be modified. We inserted the structural particle 的 (de) between the complex adjectival nouns and the modified noun. GT, thus, successfully identified that 學習成效 (xué xíchéng xiào; learning effectiveness) was the noun to be modified.

Table 3  Strategy 1

| Original Chinese text       | GT English translation | Modified Chinese text       | Modified GT English translation |
|-----------------------------|------------------------|-----------------------------|---------------------------------|
| ...大部分的兒童服              | ... the value and content | ...大部分的兒童服            | with the value and content       |
| 教科書所呈現的價值和內容    | of most children’s clothing textbooks | 同教科書所呈現的價值和內容    | textbooks                       |

Table 4  Strategy 2

| Original Chinese text       | GT English translation | Modified Chinese text       | Modified GT English translation |
|-----------------------------|------------------------|-----------------------------|---------------------------------|
| 透過追蹤專業術語在順景及段落主題的重複程度可了解語意重複的現象與文章連貫的關係 | You can understand the relationship between semantic repetition and article coherence by tracking the repetition of technical terms at the macro and paragraph themes | 研究者透過追蹤專業術語在順景及段落主題的重複程度可了解語意重複的現象與文章連貫的關係 | The researchers can understand the relationship between semantic repetition and article coherence by tracking the repetition of technical terms at the macro and paragraph themes |
learning effectiveness) was the modified noun and generated an appropriate translation for the phrase—learning effectiveness of cross-cultural communication skills. The analyses showed that Strategy 5 could be applied to four of the 69 (5.8%) translation errors.

**Strategy 6: use circumposition such as “在…中” (zài…zhōng) to mark the abstract context where an event takes place**

Circumposition combines the usage of a preposition (e.g., on the floor) and a post-position (e.g., 4 hours ago) to create a phrase specifying the place where an action takes place. In other words, circumposition refers to the use of two prepositions in a prepositional phrase: one at the beginning of the phrase, and one at the end. In Chinese, it is common to use circumposition to surround a complement to indicate that an event takes place in abstract locations or contexts. Our data analyses showed that using Chinese circumposition to specify abstract contexts can enhance the clarity of GT English translations. As shown in Table 8, the context identified in the sentence was an abstract context, 學術寫作 (xué shūxiě zuò; academic writing). In the original Chinese text, the author only used a preposition, 在 (zài; in), to indicate the context. The GT placed the resulting prepositional phrase, 在學術寫作 (in academic writing), at the end of the sentence, which resulted in an ambiguous sentence; the elements which form the object of the sentence were separated into two: the relationship between the presentation and coherence and in academic writing. The structure of circumposition, 在學術寫作中 (in academic writing), was added to the modified Chinese text. Although the English translations of 在學術寫作 (in academic writing) and 在學術寫作中 (in academic writing) were the same, the use of circumposition in the Chinese text generated a much clearer English sentence in which the elements which formed the object of the sentence were more consolidated.

**Strategy 7: use a coordinating conjunction such as “並(且)/而(且)” (bìngqiē/érqiē) to introduce additional ideas**

Explicitly marking relations between phrases or clauses can enhance the clarity of GT output. As shown in Table 9, the original Chinese text included three verb phrases without linking them with any coordinating conjunctions. The logical relations of the three verb phrases were not explicitly specified. GT, thus, translated the second verb phrase into two separate verb phrases, which deviated from the meaning of the original text. In the modified Chinese text, a coordinating conjunction, 並 (and), was added to introduce the third verb phrase. The addition of the coordinating conjunction resulted in an accurate translation of the three verb phrases.

| Table 5 | Strategy 3 |
|--------|------------|
| Original Chinese text | GT English translation | Modified Chinese text | Modified GT English translation |
| 課堂觀察及訪問，省思札記 | class observations and interviews, reflections | 課堂觀察，訪問，及省思札記 | class observations, interviews, and reflections |
Strategy 8: use an infinitive phrase such as “以/來”(yi/lai; in order to) to suggest that the latter clause marks the purpose of the former clause

Like Strategy 7, Strategy 8 can also be used to explicitly mark the logical relations between clauses. Table 10 illustrates an example of using an infinitive phrase, 以 (in order to), to introduce a purpose clause. In the original Chinese text, the author used a coordinating conjunction, 並 (and), to introduce a clause that was supposed to indicate a purpose. GT was unable to precisely translate this rhetorical move. An infinitive phrase, 以 (in order to) was used to replace 並 (and) in the modified Chinese text. The modified GT English translation, thus, produced a to-infinitive clause that properly introduced a purpose.

Strategy 9: use academically appropriate vocabulary and phrases instead of colloquial expressions

As shown in Table 11, in the original Chinese text, the author chose the Chinese word 訪問 (fǎng wèn) to indicate interview; however, the word 訪問 carries other general, colloquial meanings such as visit. Such a word choice resulted in an unprofessional GT translation in this context—visit. According to the proposed strategy, the word 訪問 was replaced by 訪談 (fǎng tán), a more specific one meaning interview in Chinese academic writing. The modified Chinese text, thus, generated an accurate GT English translation. The inductive analysis showed that a total of 11 (15.9%) of the GT translation errors could be avoided by using this strategy.

Evaluation of the Chinese optimization strategies

Each portion of the modified English output was evaluated. The evaluation focused on whether the use of the given modification strategy successfully avoided the problematic English translation output. Among the 69 identified problems in the GT translations, 68 were avoided using the proposed strategies. This finding indicates
that the proposed optimization strategies can be used to resolve approximately 99% of the problems in GT English translations.

Discussion and conclusion

The present study explored the types of errors found in English translations produced by GT and proposes the use of various strategies to enhance the quality of GT translations. The results showed that using the nine GT strategies introduced in the study to modify the Chinese input into GT can correct approximately 99% of the errors in the original English translations. In other words, the findings of the study revealed that by understanding the capabilities and limitations of GT and understanding their own capabilities and limitations, GT users can utilize strategies that effectively compensate for both types of limitations and optimize the performance of GT.

In Fig. 1, Zone 1 is the area in which both the user and GT can perform well. Zone 1 can be enlarged either through the user’s development of proficiency in the target language or through the advancement of the technology employed by GT. Zone 2 is the area in which GT still does not perform well but the user’s capability in the language can compensate for the limitations of GT. Zone 3 is the area in which the user can employ various strategies to enhance the quality of GT’s performance and therefore exceed his or her own limitations. This zone has been identified in previous studies; for example, GT was shown to outperform EFL users in terms of the use of precise vocabulary (Stapleton and Kin 2019; Chandra and Yuyun 2018). By using the nine strategies developed in this study, users can maximize the capability of Zone 3 and generate satisfactory translations. Finally, Zone 4 is an area that shows the limitations of GT. This zone can be reduced by growing Zones 1, 2, and 3. That is, the development of language proficiency, the skillful use of strategies to

| Table 7 Strategy 5 |
|---------------------|
| Original Chinese text | GT English translation | Modified Chinese text | Modified GT English translation |
| 研究者從國際化角度思索，利用國際化校園環境資源，邀請校內國際學生到英語課演講與本地生互動交流，並探討跨文化溝通能力學習成效與課程設計滿意度調查。 | Researchers are thinking from an international perspective, using international campus environment resources, inviting international students on campus to interact with local students in English lectures, and exploring cross-cultural communication skills learning effectiveness and curriculum design satisfaction surveys | 研究者從國際化角度思索，利用國際化校園環境資源，邀請校內國際學生到英語課演講與本地生互動交流，並探討跨文化溝通能力的學習成效與課程設計滿意度調查。 | Researchers are thinking from an international perspective, using international campus environment resources, inviting international students on campus to interact with local students in English lectures, and to explore the learning effectiveness of cross-cultural communication skills and curriculum design satisfaction surveys |
| Original Chinese text | GT English translation | Modified Chinese text | Modified GT English translation |
|-----------------------|------------------------|------------------------|---------------------------------|
| 本文探討專家和英語為外國語學習者在學術寫作詞彙鏈的呈現與連貫性的關係。 | This article explores the relationship between the presentation and coherence of experts and English as a foreign language learners in academic writing | 本文探討專家和英語為外國語學習者在學術寫作中，詞彙鏈的呈現與連貫性的關係。 | This article explores the relationship between the presentation and consistency of vocabulary chains in the academic writing of experts and English as a foreign language learners |
enhance the performance of GT, and the advancement of GT itself can lessen the
size of Zone 4.

Function-oriented language learning and teaching

As presented in Zone 3 in Fig. 1, from a function-oriented perspective, the proposed
strategies do not require fully proficient language skills. With partial, general knowl-
edge of the target language, users can better utilize GT to reach the goal of effective
communication, unlike traditional language teaching pedagogy where teachers take
time to guide students in a step-by-step manner to develop academic writing skills.
This requires a long developmental process for a learner to reach the proper level of
communicative competence in order to participate in the discourse community of
academic writing. With the help of GT, it is possible for learners who have only lim-
ited language proficiency in the target language but strong research ability, profound
discipline-specific knowledge, and knowledge of the relevant terminologies in the
target language to be empowered and given the access necessary to contribute their
research findings to the field, thereby speeding up the creation and dissemination of
knowledge.

New lingua franca

This vision of skillful user collaboration with GT to achieve effective communica-
tion may redefine the concept of a lingua franca in the future. With the swift devel-
opment of GT, the term lingua franca might no longer refer to any particular lan-
guage; instead, lingua franca could actually refer to the use of one’s first language
along with appropriate GT strategies. That is, the new definition of lingua franca
should be applicable to any language as long as it is written in a form that can effec-
tively be translated into any other language through machine translation. In other
words, the new lingua franca could be any language as long as it is written in a form
with high machine readability.

Pedagogical implications

The concept of collaborating with GT using appropriate strategies may further
transform the role of language learners into that of functional language users who
could carry out real-life communication by skillfully drawing from their knowl-
dge of their first language and the target language. This advancement may funda-
mentally change our beliefs about language teaching and learning. The col-
laboration between GT and language users is not meant to override the need for
L2 learning or eradicate current practices of English academic writing. Instead,
a shift of instructional focuses would become the priority. For example, Eng-
lish academic writing classes could potentially reduce the levels of laborious
skill practice and training currently employed to teach some linguistic functions
which GT can handle better, such as the use of tenses and definite/indefinite arti-
cles. More training could focus instead on aspects of language that GT currently
| Original Chinese text | GT English translation | Modified Chinese text | Modified GT English translation |
|-----------------------|------------------------|------------------------|----------------------------------|
| 記結果顯示課程設計打破以往書上學習單一英語系國家文化的現況，將文化學習轉化為認識、尊重跨文化的差異性，著實增進語言與文化的學習 | The results show that the curriculum design breaks the status quo of the culture of a single English-speaking country in the past, transforms cultural learning into recognition, respects cross-cultural differences, and actually enhances language and culture learning | 記結果顯示課程設計打破以往書上學習單一英語系國家文化的現況，並將文化學習轉化為認識、尊重跨文化的差異性，著實增進語言與文化的學習 | The results show that the curriculum design breaks the current situation of the culture of a single English-speaking country in the past, and translates cultural learning into recognition and respect for cross-cultural differences, and actually promotes language and culture learning |

* subject,  ** verb phrase,  ^ conjunction
| Strategy 8 | Original Chinese text | GT English translation | Modified Chinese text | Modified GT English translation |
|-----------|-----------------------|------------------------|-----------------------|---------------------------------|
| 研究者從國際化角度思索，利用國際化校園環境資源，邀請校內國際學生到英語課演講與本地生互動交流，並探討跨文化溝通能力學習成效與課程設計滿意度調查。 | Researchers think from an international perspective and use international campus environment resources to invite international students in the school to speak and interact with local students in English classes. They also discuss cross-cultural communication ability learning effectiveness and curriculum design satisfaction surveys. | 研究者從國際化角度思索，利用國際化校園環境資源，邀請校內國際學生到英語課演講與本地生互動交流，以探討跨文化溝通能力學習成效與課程設計滿意度調查。 | Researchers think from an international perspective and use international campus environment resources to invite international students in the school to give lectures in English classes and interact with local students to discuss cross-cultural communication ability learning effectiveness and curriculum design satisfaction survey. |
| Original Chinese text | GT English translation | Modified Chinese text | Modified GT English translation |
|-----------------------|------------------------|------------------------|---------------------------------|
| 資料收集包括背景訪問、課堂觀察及訪問、省思札記。 | Data collection includes background visits, classroom observations and interviews, reflections | 資料收集包括背景訪談、課堂觀察及後續訪談、省思札記 | The data collection includes background interviews, classroom observations and follow-up interviews, and reflections |
cannot handle well, such as logical connections between ideas. Also, as the present GT technology is still far from being able to generate error-free translations (Ducar and Schocket 2018), L2 learners who use GT to support their writing still need to be competent in identifying and correcting problematic translations. In other words, users still need to learn the target language to be able to effectively evaluate the GT output. However, learners may no longer need to master a language before they can produce academic text with high readability if they assume an active, not a passive, role as a GT user through the use of the nine strategies proposed in the study.

Limitations and future research

The present study has several limitations which could be used to inform the objectives of future research. First, the GT strategies proposed by the study were proposed based on the analyses of problematic GT translations. Further empirical data are needed to examine the effectiveness of the proposed strategies. Second, it is still unclear how the strategies will be used by language learners. Future studies could employ qualitative research methods such as using think-aloud protocols to gain insights into learners’ use of the strategies and to examine the effectiveness of the strategies. The findings of such research could shed new light on the integration of these strategies into future curriculum and lesson designs of EAP courses. Also, as previous studies have shown that learners with different levels of language proficiency can take advantage of GT to various extents, it is important to explore how individual differences in factors such as language proficiency and attitudes toward GT-assisted writing influence the effective use of the proposed GT strategies. Moreover, the translation data used in the present study

![Conceptual framework of cooperation between users and Google Translate](image-url)
and the proposed strategies were limited to English academic writing. Future studies could explore specific GT strategies for different writing genres. Finally, to realize the vision of using one’s own language as a lingua franca, the collaboration between GT and users will have to be explored in more language pairs in the future, as the present study was limited to English-Chinese translation alone.

**Funding** This work was supported by Ministry of Science and Technology, Taiwan [Grant No. 108-2410-H-009-018].

**Data availability** The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Declarations**

**Conflict of interest** On behalf of all authors, the corresponding author states that there is no conflict of interest.

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