Investigating Parallel English-Arabic Corpora to Enhance Vocabulary Acquisition and Reading Comprehension Among Arab ESL Learners

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Abstract

The study examines how Arab students benefit from reading texts that present both English and Arabic versions concurrently. It addresses the issue of instructing solely in one language by incorporating dual-text possibilities for acquiring vocabulary, grammar, and language application. A digital corpus of English and Arabic texts was created, segmenting each text into sentences and attaching grammatical, lexical, and morphological information to them. The researcher matched pre-existing data with newly collected qualitative information after the intervention to conduct the study. Before and after the intervention, the researcher administered reading assessments in both English and Arabic to the students. Each assessment had three reading passages accompanied by six to eight questions, and a similar group of students tried the test to evaluate comprehension and difficulty. Students were assessed on vocabulary through both scheduled examinations and impromptu quizzes about the main words identified in weekly reading materials. A Likert scale survey was employed to evaluate students' perceptions regarding the efficacy of the parallel corpus in enhancing their reading skills. The parallel corpus facilitated students' comprehension of reading materials and enhanced their vocabulary. This study enhances bilingual education for students in ESL instruction and promotes bilingual instruction through the use of technology.

Keywords: *Arabic-English, bilingual comprehension, corpus linguistics, ESL, parallel corpora, reading strategies*

1. Introduction

1.1 Research Background

Bilingual education is currently the predominant approach in international education frameworks aimed at students who engage in coursework in both their mother language and an additional language (García & Wei, 2014). The Arab world considers English the primary language for worldwide communication and higher education.

Despite substantial financial investment in English as a second language, Saudi students exhibit inadequate reading comprehension skills, essential for academic advancement and lifetime learning (Al-Seghayer, 2022).

Translation studies frequently employ parallel corpora, comprising two or more linguistic texts aligned at the phrase or sentence level (Čulo et al., 2021; Tiedemann, 2020), demonstrating increasing applicability for language teaching. Employing parallel corpora and aligned bilingual texts, students may immediately discover connections between languages, thereby enhancing their comprehension of lexical, syntactic, and semantic characteristics of both languages. In translation studies, corpus linguistics and natural language processing have facilitated the creation of parallel corpora that elucidate cross-linguistic trends, thereby augmenting the investigation of equivalence and meaning across languages (Granger, 2021; Huang, 2020).

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The study examines the impact of English-Arabic parallel corpora on improving reading comprehension in Arab university students studying English as a second language. This research effort integrates parallel versions of narrative and academic literature in English and Arabic inside an interactive digital reading platform. This platform seeks to enhance multilingual reading comprehension by focusing on vocabulary acquisition, syntactic mastery, and effective linguistic transfer between the two languages.

1.2 Research Problem

Extended English language courses in Arab institutions often fail to improve ESL learners' reading competence in both English and Arabic. Alrabai (2023) contends that current monolingual educational approaches, which omit first-language resources, exacerbate this learning difficulty. Traditional pedagogy and educational materials neglect to integrate students' native languages as a supportive tool, leading to ineffective comprehension strategies and reduced classroom participation (Cummins, 2017). Furthermore, traditional reading tools and materials demonstrate a limited application of corpus linguistics and NLP technologies, leading to the standardisation of disjointed language instruction. The present circumstances require evidence-based solutions employing contemporary linguistic techniques to address bilingual literacy challenges. The research tackles the knowledge deficiency by creating a parallel corpus, evaluated as an educational intervention for bilingual students.

1.3 Research Objectives

1. To develop a sentence-aligned English–Arabic parallel corpus comprising both narrative and academic texts that are pedagogically suitable for Arab ESL learners.
2. To investigate the impact of parallel corpora on bilingual reading comprehension, with a focus on vocabulary acquisition and syntactic awareness at the word and sentence levels.
3. To examine the cognitive processing involved in learners' interaction with parallel texts, particularly the movement between Arabic and English during bilingual reading tasks.
4. To design and evaluate an online platform that hosts the developed parallel corpus, facilitating its integration into academic instruction and independent learning environments.

1.4 Research Questions

Q1. How does the use of English–Arabic parallel corpora affect the reading comprehension of Arab ESL learners when engaging with narrative and academic texts?

Q2. What is the effect of using parallel texts on students' learning of vocabulary and syntactic structures in both English and Arabic?

Q3. How does interaction with aligned texts reveal cognitive processes and transfer between English and Arabic in bilingual reading?

Q4. How do students perceive the usefulness of a digital platform incorporating parallel corpora in enhancing their reading strategies and comprehension skills?

1.5 Significance of the Study

The study makes valuable contributions to theoretical frameworks and provides practical applications within bilingual education. The research provides empirical data about language learning through corpora in an Arabic-English bilingual environment. This research is contributing to existing theory in this field both academically and pedagogically (Mukherjee, 2022; Zughoul & Abu-Alshaar, 2023). The study establishes a flexible framework that educators can use to organize bilingual language databases in ESL learning spaces, enhancing student reading skills, promoting contrastive learning, and fostering cognitive development through cross-linguistic processing.

This research promotes educational innovation and global competitiveness by adopting a data-driven approach to bilingual literacy. The developed digital platform serves as a country-wide resource for ESL teaching, supporting all groups, from students to instructors and governing officials.

2. Literature Review

2.1 Parallel Corpora in Language Learning

Parallel corpora built using a bilingual sentence or phrase alignment have been converted into a key combined dataset for Second Language Acquisition (SLA) research, as well as translation studies. Parallel corpora emerge as a significant learning tool, as they enable students to detect equivalent cross-linguistic structures, semantic variations,

and syntactic differences (Tiedemann, 2020). Research data indicate that parallel corpora enhance EFL vocabulary development and student independence, as well as improve comprehension of multiple learning environments.

A scholarly work by Sun et al. (2023) demonstrates that students studying Chinese as a foreign language showed better progress in vocabulary learning by using parallel bilingual corpora. Students who had real-time access to concurrent translations obtained greater efficiency in learning expressions, grammatical structures, and idioms.

Parallel corpora encourage active learning strategies resembling data-driven learning (DDL), in which students explore language patterns through concordance and contextual analysis (Boulton, 2016; Frankenberg-Garcia, 2020). The combination of L1 and L2 structures in alignment interfaces and bilingual concordancers helps students improve their procedural rule development and perform lexical or grammatical inference (Mukherjee, 2022). The research conducted by Čulo et al. (2021) established that parallel corpora facilitate students in developing their contrastive linguistic awareness, combined with mastery of academic literacy and translation skills.

Sultan and Basak (2020) reveal that parallel corpora require proper pedagogical guidance to harness their benefits effectively. The extensive use of L1 among learners can lead to shallow L2 processing, which reduces their learning efficiency. The proposed solution involves using structured learning assignments, such as guided comparisons with parallel concordance and inferential quizzes (Granger & Lefer, 2021). Following the interdependence hypothesis of Cummins (1979, 2017), strong first-language reading is associated with better second-language reading when the tasks primarily focus on comprehension. L1 literacy helps bilingual reading comprehension, according to the research by Alsabbahi et al. (2023).

Most studies focusing on the Middle Eastern region present limited evidence showing that parallel corpora generate positive outcomes. According to Elabdali (2020), Saudi EFL students who used bilingual texts improved their reading comprehension abilities and developed a greater interest in complex reading materials. In addition, Al-Mogbel and Shah (2021) show that parallel Arabic-English corpora enhanced the lexical development of university students in Riyadh.

2.2 Bilingual Reading and Comprehension

Learning to read in two languages requires intricate combinations of L1 and L2 processing systems. The interdependence hypothesis, proposed by Cummins (1979, 2017), suggests that strong first-language literacy supports the development of comprehension in second-language reading. The evidence for this claim persists in different language contexts through new studies.

Research by Yau (2011), validated by Chien and Chuang in 2023, found that Taiwanese students who engaged in mental translation while reading English achieved better reading comprehension in both their native language and English. Both Saigh and Schmitt (2020) and Al Khasawneh (2021) demonstrated that Arabic speakers face difficulties in breaking down English words and processing morphological aspects of English articles due to L1 language transfer. According to Zughoul and Abu-Alshaar (2023), individuals who study in settings where two languages are used often demonstrate a deeper understanding of ambiguous grammar and possess skills for switching between language use, including while reading in a second language.

Translanguaging—allowing learners to move fluidly between languages—has been widely endorsed as a way to scaffold meaning construction, particularly in reading (García & Wei, 2014; Creese & Blackledge, 2020). Translanguaging approaches are underutilized in Saudi education systems despite research demonstrating their effectiveness. According to Alzahrani and Al-Maliki (2022), bilingual Saudi students who used Arabic symbols for markups in their English texts showed higher reading scores and demonstrated reduced instances of anxiety.

Readers navigating between Arabic and English shape their reading experience by recognizing the syntactical and textual differences between these languages. Boulton and Pérez-Paredes (2021) presented new approaches that utilize DDL principles for bilingual corpora, which display L1-L2 equivalents together. The provision of organized native language support through glosses, translations, or aligned texts effectively reduces the difficulty faced by readers during second-language reading.

2.3 Corpus Linguistics and Educational NLP

The analysis of authentic linguistic data through corpus linguistics methods has transformed how we teach and study languages. In educational contexts, corpus-informed instruction enables learners to observe real-world language use and develop rule awareness through pattern recognition (Anthony, 2019; Meunier & Gouverneur, 2020).

The research team of Boulton and Pérez-Paredes (2021) created contemporary DDL systems that connect bilingual corpora to L1 equivalent structures for language learners. Learning materials that link L1 and L2 constructs help students process information at a greater depth during encounters with unfamiliar collocations or idioms.

The development and use of corpora systems depend fundamentally on NLP tools. Technologies such as sentence alignment, part-of-speech tagging, and lemmatization have made it easier to annotate and deploy bilingual corpora for educational purposes (Tiedemann, 2020; Yousef et al., 2022). Through their research, Abdel Latif and Al-Amri (2023) demonstrated that Saudi students could successfully solve parsing problems related to English passive structures and phrasal verbs by implementing NLP-assisted corpus tools. Sketch Engine combined with Ugarit presents learners with two main features: visual displays of translation connections between languages and tools for bidirectional text search.

Users with varying learning requirements benefit from platforms that utilize Natural Language Processing technology. Kim and Lee (2021) created a reading system that automatically adjusted difficulty settings while presenting definitions that matched user ability levels. Through the analysis of language corpora using NLP tools, Saudi Arabic–English learners demonstrated a deeper understanding of passive structures and phrasal verbs, according to Abdel Latif and Al-Amri (2023).

3. Research Methodology

3.1 Research Design

This research utilised a blend of quantitative and qualitative methodologies, employing an experimental design. Participants were categorised into two groups: experimental readers, who engaged in reading comprehension exercises using parallel English–Arabic materials, and control readers, who utilised ordinary monolingual English texts. Pre-test and post-test evaluations were conducted for both English and Arabic reading comprehension to assess the impact of this intervention. Researchers performed pretest and posttest evaluations to determine participant advancement. The experimental group yielded supplementary qualitative data using think-aloud protocols and learner feedback questionnaires. The final corpus incorporated platform-based uploads, facilitating sentence searches and offering concordance capability along with word frequency analysis on the platform.

3.2 Corpus Construction

The project commenced with the establishment of a dual-language corpus that functioned as both an instructional resource and a data-gathering instrument. The investigation employed English texts and their corresponding Arabic equivalents, while also scrutinising specific Arabic texts that had been translated into English. The selection procedure evaluated works appropriate for university-level students, covering diverse genres and word counts ranging from 300 to 500 words. The corpus included narrative stories, scholarly writings, and specialised readings in science, history, and technology.

Bilingual research assistants performed sentence-level reviews and corrections of alignments generated by the Ugarit Aligner tool from each text pair. The researcher uploads this final corpus to operate through either a Sketch Engine platform or a custom-made system, providing sentence-level searching and enabling concordance and word frequency examinations for participants. In pair work, students read English and Arabic stories and discussed the meaning with the support of translanguaging. For these tasks, we selected a bilingual corpus comprising 50 texts, including stories, academic articles adapted for younger audiences, and readings focused on science, history, and health. Every sentence from the original texts was aligned in the e-books and written for students at the intermediate level of English learning. Overall, the corpus comprised approximately 125,000 English words and 134,000 Arabic words to support vocabulary learning and facilitate a comparison between these languages. The files existed in bilingual formats, including aligned JSON or TMX, which enabled them to serve as searchable reference databases for education professionals.

3.3 Participants and Sampling

Undergraduate ESL students from a Saudi public university formed a study group comprising sixty participants. The research participants consisted of 60 natives who studied English at a public institution. The assessment results demonstrated intermediate-level B1–B2 CEFR skills in English, while the institution maintained both placement test results and academic records. The study included two intact classes, each with thirty participants, selected for the research. We divided students into two distinct groups: one received the Parallel Corpus intervention

program in the experimental group, while the control group received regular ESL reading instruction. The study matched these groups to have equivalent levels of language proficiency and academic achievement, as well as comparable instructional timing. All participants provided consent for the study after research approval from the university.

3.4 Instructional Procedure

The intervention period lasted eight weeks, as it was directly integrated into the students' existing ESL reading curriculum. Students from both experimental groups completed baseline reading comprehension tests in English and Arabic during the first week of the study. Students completed an English reading test that combined three moderate-length texts with questions assessing text comprehension and understanding of contextual vocabulary. The Arabic assessment included texts in Modern Standard Arabic and maintained parallel features to the English section.

The experimental group utilized the digital platform hosting the parallel English–Arabic corpus between weeks 2 and 7. The study categorized participants' responses into their usage of translation methods, their ability to make inferences, and their comprehension failures, as well as cross-linguistic knowledge transfer. Students completed bilingual vocabulary matching exercises in their coursework, utilizing translanguaging approaches that involved translation comparison. Selected students implemented think-aloud activities in their classroom work to express their reading strategies verbally.

Students in the control group used monolingual English texts on similar topics, along with traditional reading comprehension assignments and vocabulary preview and summary materials. Students in the control group did not read any texts in Arabic or receive any translated materials. Each group of students experienced equivalent classroom durations and maintained identical assessment systems. All participants took post-tests in both English and Arabic during the last week to evaluate their improvement in comprehension.

3.5 Instruments and Measures

The research collected data through multiple assessment tools. The researcher developed and validated two main assessment tests, which utilized reading comprehension questions in both English and Arabic. Subjects received three reading passages with six to eight comprehension questions included in every test. Tests were initially administered to students with similar backgrounds to test their difficulty levels and clarity. The researchers measured vocabulary acquisition through planned tests and spontaneous quizzes that focused on words found in the weekly reading materials.

Participants in the experimental group received surveys to evaluate the effectiveness and functionalities of the parallel corpus tool. Participants answered both closed- and open-ended questions using Likert scales to rate the tools while also providing their opinions about their reading processes and the difficulties they encountered. The researcher selected six students from the experimental group to participate in think-aloud sessions, which took place during the mid-intervention and post-intervention periods. The sessions involved students reading new texts from the corpus while verbalizing their cognitive processes, which researchers recorded for transcription and then conducted thematic analysis on. Based on digital platform data collection, a researcher can monitor how long users spend reading, as well as how many times they toggle translations and utilize glosses and note functions.

3.6 Data Analysis Techniques

The research study utilized SPSS version 27 to process numerical data. The researcher performed an analysis of covariance (ANCOVA) to evaluate post-test data between experimental and control students, with pre-test scores serving as controlling variables. Within-group changes were measured using paired-sample t-tests alongside independent-sample t-tests for research group differences in vocabulary acquisition. Cohen's d-effect sizes were analyzed to assess the practical value of the examined findings.

Two methods were employed for data collection: the research team analyzed verbal protocols from participants and collected open-ended survey results, which they coded using thematic analysis methods. The study focused on four main analysis categories, covering translation strategies, inference-making, comprehension breakdowns, and cross-linguistic transfer. Two researchers independently reviewed responses to confirm inter-rater reliability (Cohen's Kappa > 0.75). Environmental Language Processing systems processed corpus-based mistakes,

as well as vocabulary statistics and system assessment metrics. The platform-based user logging system connected performance metrics to user activities, identifying persistent relationships between L1 usage and reading methods.

4. Results and Analysis

These results and analysis present the outcomes of the intervention, which utilized an English–Arabic parallel corpus to enhance bilingual reading comprehension among Arab ESL learners. The findings are organized under subheadings that correspond to the research objectives and methodological steps.

4.1 Quantitative Results

#### 4.1.1 Reading Comprehension Improvement

The research analyzed test scores for reading comprehension from pre-tests and post-tests conducted in both English and Arabic for the experimental and control groups. The research data show how the parallel English–Arabic corpus improved bilingual reading abilities in students enrolled in English as a Second Language classes.

Table 1   **Pre- and Post-Test Reading Scores (Mean and SD)**

Group	Test Type	Mean Score	Standard Deviation
Experimental	English Pre-test	11.3	2.1
Experimental	English Post-test	17.4	1.8
Control	English Pre-test	11.5	2.3
Control	English Post-test	13.1	2.0
Experimental	Arabic Pre-test	13.9	2.5
Experimental	Arabic Post-test	16.2	2.2
Control	Arabic Pre-test	13.6	2.4
Control	Arabic Post-test	14.1	2.3

The experimental group showed notable statistical increases in both their English and Arabic reading scores. The narrower standard deviation from post-tests shows that the students demonstrated stable performance growth.

Figure 1   **Reading Comprehension Gains by Group**
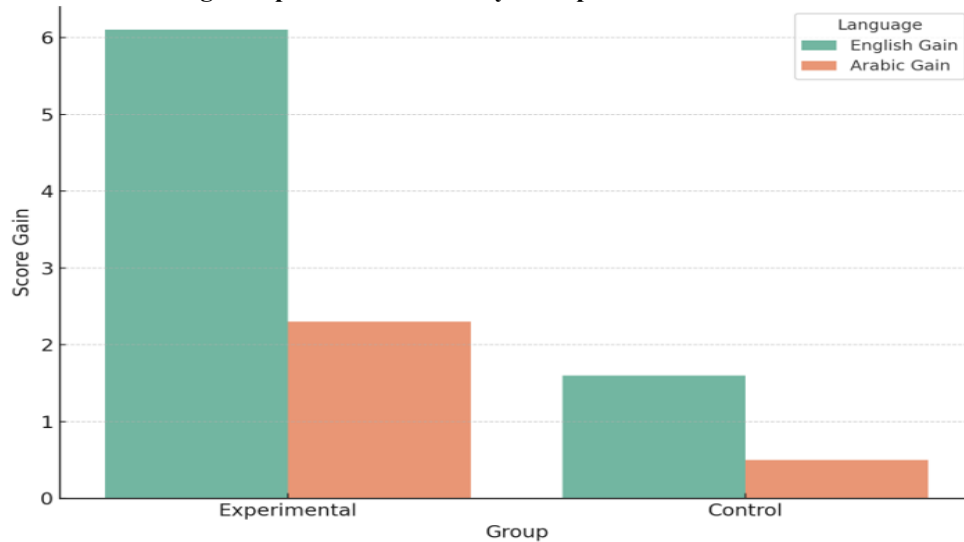
The bar graph illustrates thriving reading skills, with the experimental group showing the most noticeable improvement. Results suggest that using a corpus structure in two languages helps students understand concepts more efficiently and transfer learning between languages.

4.1.2 Vocabulary Acquisition

After the intervention, researchers evaluated the vocabulary acquisition levels of participants in both groups. Post-intervention tests showed the extent of vocabulary growth for participants because of their access to the parallel corpus database**.**

Table 2   **Post-Test Vocabulary Gains (Mean and SD)**

Group	Mean Vocabulary Gain	Standard Deviation
Experimental	4.8	1.1
Control	1.9	0.9

Table 2 indicates that bilingual translation between English and Arabic led the experimental group to maximize their vocabulary acquisition.

Figure 2   **Vocabulary Gains by Group**
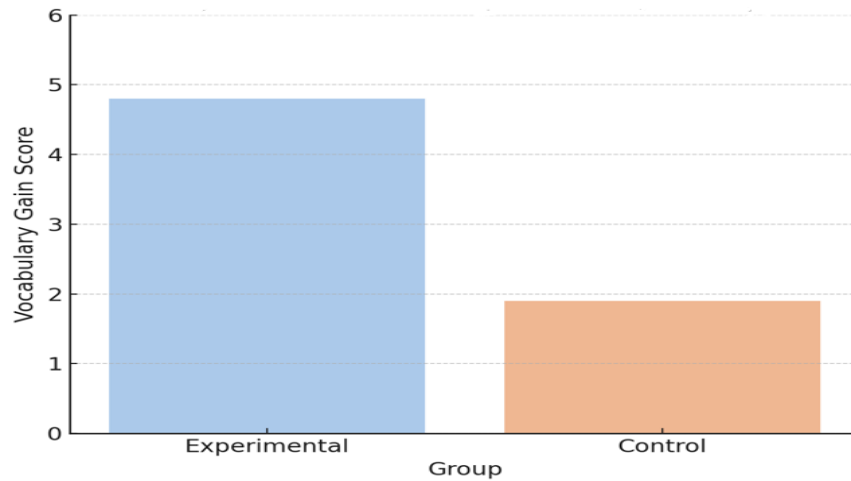
According to Figure 2, the students in the experimental group achieved vocabulary gains that exceeded those of the control group by more than 100%. The experimental group had increased semantic retrieval benefits through integrating their first language.

### 4.1.3 Corpus Tool Engagement Metrics

The evaluation measures learner interaction patterns when using the digital parallel corpus tool. The platform monitors four key metrics, including the number of texts read by users, translation toggle frequency, vocabulary gloss clicks, and average session duration.

Table 3   **Learner Interaction with Parallel Text Platform**

Metric	Experimental Group (Average per Student)
Texts Read	18.7
Translation Toggle Usage	32.5
Vocabulary Gloss Clicks	41.3
Time Spent per Session (min)	29.8

Table 3 demonstrates that the platform analytics system captured high levels of user involvement. Users demonstrating active bilingual support behavior do so by frequently switching between languages and accessing vocabulary.

Figure 3   **Tool Interaction Metrics (Mean per Student)**
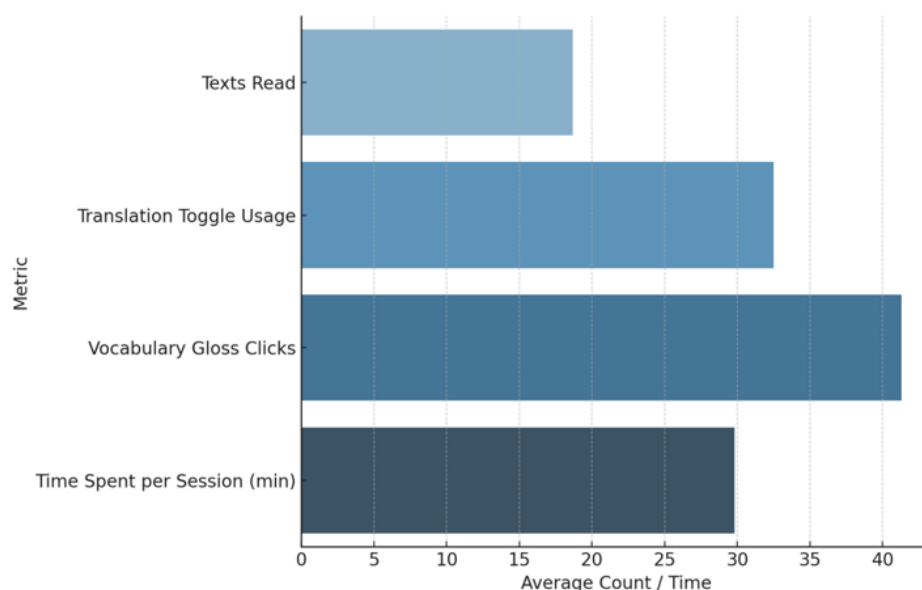
4.2 Qualitative Results

4.2.1 Think-Aloud Protocol Themes

This section analyzes findings from think-aloud protocols through a qualitative assessment. The study demonstrates how learners employ code-switching, along with contextual inference and translation pattern recognition, while working with parallel corpora to gain a greater appreciation for their cognitive processes while reading.

Table 4: **The Emergent Themes from Think-Aloud Transcripts**

Strategy Observed	Frequency	Representative Quote
Switching	High	"I read the Arabic to check the meaning, then back to English."
Inferencing using context	Moderate	"I guessed the word by looking at the sentence's meaning."
Gloss-checking	High	"The pop-up word helped me understand instantly."
Translation pattern noticing	Moderate	"They used different sentence order—interesting."

The students leveraged the provided Arabic texts to strengthen their reading process rather than using them as reading aids while demonstrating an understanding of language structures.

4.2.2 Learner Perceptions

Qualitative feedback was collected after the intervention to gauge learners' perceptions of their use of the parallel corpus. Students said in their own words that using bilingual resources boosted their reading, strengthened their vocabulary, and generally supported their learning. It was found through thematic analysis that learners considered the corpus both valuable and easy to use and appreciated its role in helping them make connections between the languages.

Table 5 **Post-Study Responses Results (% of Positive Responses)**

Statement	Agreement (%)
The Arabic version helped me understand better	87%
I prefer bilingual reading over English-only reading	78%
I became more confident reading English texts	73%
I would like to continue using this corpus platform	85%

Students demonstrated high levels of satisfaction through their responses. Students experienced decreased anxiety while simultaneously feeling a better understanding and increased participation in a bilingual learning environment.

5. Discussion

The use of English-Arabic parallel corpora in ESL education helps students develop better reading skills and better recall vocabulary. Through bilingual processing studies within MECO L2, researchers show that cross-linguistic resources enhance comprehension (Kuperman et al., 2025). The research outcomes showed that students who read material in both languages performed better in reading comprehension than students who read in only one language.

Using parallel corpora yields vocabulary success for language learners, as the project has found. Using aligned bilingual texts helps students infer words they do not yet know by comparing them in different languages, allowing them to remember them better over time. Haider et al. (2023) indicate that covering vocabulary in the learner's language as well as the new language improves both learning and use of the vocabulary. It was also found that students using the corpus practiced strategies such as switching between languages, self-monitoring, and using information from their surroundings. Bilingual learners' think-aloud recordings have previously revealed these patterns (Mukherjee, 2022; Yau, 2011). The corpus supports the formation of self-regulated habits by repeating the same strategies. As Zakaria and Aziz explained in 2023, reading parallel texts benefits students by helping them understand, develop awareness of language, and gain autonomy. In addition, better reading comprehension agrees with previous studies that claim bilingual corpora improve a learner's fluency and understanding of texts when they are cognitively engaging (Sun et al., 2023; Alsabbahi et al., 2023). As a result, this study contributes to the literature that advocates for the use of parallel corpora in ESL instruction, supporting both language and cognitive reasons.

These results also demonstrate how ESL teaching is shifting to use data and bilingual approaches. Adding NLP features to parallel corpora increases the amount of interaction learners can have as they gain instant access to translations and vocabulary, making learning incidental and less mentally demanding (Peng, 2024; Kim & Lee, 2021). The outcome shows that with bilingual support, learners became more confident in dealing with unknown texts, which aligns with Elabdali's (2020) observation that bilingual support promotes learner independence and makes reading less stressful in English learning environments. Additionally, the success of students in transferring their strategies from Arabic to English indicates that parallel corpora facilitate effective cross-linguistic transfer, as emphasized by Cummins (2017) and also demonstrated in recent bilingual reading work (Zughoul & Abu-Alshaar, 2023). Being bilingual increases a student's vocabulary, improves their ability to use language structures, and encourages them to pay greater attention to texts.

6. Conclusion

This study illustrates that the use of English–Arabic parallel corpora can improve ESL learners' reading comprehension and vocabulary learning. Students demonstrated the enhancement of cognitive abilities, notably via contextual inference, linguistic blending, and comprehension of language-related concepts while engaging with the corpus. Analysis of learners' responses and self-explanations indicated that parallel corpora facilitate both language acquisition and cognitive processes. These results affirm that bilingual corpora are essential in the instruction and acquisition of contemporary English language education. Furthermore, the application of this methodology promotes innovative teaching practices and enhances language education by utilising data-driven technological resources.

6.1 Implications

The results of this research are crucial for educational policy and practice. The use of parallel corpora assists ESL students by providing techniques to improve comprehension and foster confidence when interacting with materials in both their native language and English. This pedagogical method equips instructors with scholarly resources to integrate multilingual texts with data-driven instruments, so enhancing student learning and promoting metacognition. The results highlight the imperative for policymakers to allocate resources into bilingual and digital technologies to improve the nation's global competitiveness. The results endorse the progression of bilingual education via technology and promote the training of educators in digital techniques.

6.2 Recommendations

Research should investigate the impact of utilising multiple corpora on skills such as writing, listening, and speaking. Analysing the utilisation of parallel corpora in various L1 and L2 contexts will ascertain the effectiveness of this approach across several languages. Evaluating the results from students of varying ages, capabilities, and educational environments may illustrate the wider relevance of this method. Moreover, advanced analytics, encompassing the analysis of learners' language processing and their visual attention on the page, might furnish

researchers with deeper insights into individual bilingual learning. The development and analysis of language corpora in fields like science and medicine may enhance the evaluation of bilingual corpora's influence on the acquisition of academic English in these areas.

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