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| RESEARCH ARTICLE

Investigating the Translation Dynamics of Arabic-English Code-Switching by AI and EFL University Students in Saudi Arabia

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| ABSTRACT
In Saudi Arabia's increasingly bilingual academic environment, Arabic-English code-switching has become a common phenomenon, especially among university students. This study investigates the translation dynamics of such code-switched texts, comparing the performance of Artificial Intelligence (AI), represented by ChatGPT 4, and English as a Foreign Language (EFL) university students at Imam Mohammed Ibn Saud Islamic University. Despite technological advancements, there remains a gap in understanding how both AI and EFL students handle the cultural and contextual complexity of bilingual communication. The study aims to evaluate the accuracy, fluency and contextual appropriateness of translations produced by both AI and EFL students, identifying translation challenges and strategies employed. Grounded in Koehn's (2010) Statistical Machine Translation (SMT) model, this qualitative study engaged ten purposively selected EFL students. Participants collaboratively translated ten validated Arabic-English code-switched texts and were later interviewed to reflect on their translation experiences. These translations were compared to AI-generated outputs through qualitative textual analysis and thematic coding. The findings revealed that while AI produced fluent and grammatically accurate translations, it often failed to interpret cultural references, emotional tone and idiomatic expressions. In contrast, EFL students demonstrated greater flexibility, cultural mediation and pragmatic sensitivity. The study recommends enhancing AI systems with contextual-awareness capabilities and integrating AI tools into EFL translation pedagogy for guided post-editing. It also calls for training programs to prioritize cultural competence alongside linguistic skills. These findings have implications for the development of more adaptive translation technologies and enriched translator education in bilingual settings.

| KEYWORDS

Code-switching, Translation accuracy, Bilingual education, AI translation systems, EFL Students, Statistical Machine Translation (SMT) model.

| ARTICLE INFORMATION

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1. Introduction

Code-switching, or the alternation between languages within a single discourse, is a common linguistic strategy among bilinguals, serving both communicative and expressive purposes (Bhatt & Bolonyai, 2011). In Saudi Arabia, the interaction between Arabic and English is particularly prevalent among university students, facilitated by the educational policies and the growing influence of English as a medium of global communication (Althobaiti, 2024). This linguistic phenomenon, while enriching, introduces complex challenges in translation, where contextual nuances and cultural subtleties play significant roles (Alzain, 2024).

Despite the advancements in translation technology, AI systems often struggle with texts that exhibit code-switching, primarily due to the inherent variability and contextual usage of language (Deng, 2024). Human translators, particularly those learning

English as a foreign language, also encounter difficulties due to the dual demands of linguistic fidelity and contextual appropriateness (Zapata, 2016). The capability of AI and human translators to handle such bilingual texts effectively remains underexplored, highlighting a critical gap in both technological and educational frameworks.

Research into how code-switching is processed by both artificial intelligence (AI) and human translators is significant in several aspects (Alsheikhidris & Alfatih, 2024; Tarunesh et al., 2021). From the AI aspect, such insights advance algorithmic competence and adaptability, resulting in better translations (Nazeer, et al. 2024; Kruk et al., 2025). For English Foreign Language (EFL) learners, it improves linguistic and cultural competencies that are integral aspects of language mastery (Alang & Idris, 2018). Finally, increased translation accuracy is crucial to Saudi Arabia's global engagement, and impacts both academic achievements and work communication. This research commences the inquiry into the translation dynamics between English and Arabic, the role of code-switching in AI and EFL learners' translated texts in particular, and is conducted in Imam Mohammed Ibn Saud Islamic University, Saudi Arabia. As the global environment becomes increasingly interconnected, the ability to effectively handle bilingual communication becomes increasingly important, particularly in educational and work environments. Saudi Arabia, with its emphasis on English in its education system, is an intriguing place to examine these issues. Additionally, the present research aims to critically examine and compare the performance of the AI translation system and the EFL learners in translating code-switched English-Arabic texts. It will identify the challenges of each group and assess each group's translation strategies. Also, the research aims to generate knowledge that may pave the way towards better improvements in both AI translation systems and EFL translation courses.

The study is expected to unveil specific strengths and weaknesses inherent in both AI and human translations of texts involving code-switching. The findings can potentially ease the development of more sophisticated AI technologies that can handle linguistic complexities, and also guide pedagogical approaches aimed at developing bilingual translation competencies among EFL students. By addressing these essential aspects, the study aims to make a significant contribution to the fields of computational linguistics and language education, and thus promote better and more informed communication across different languages.

To conclude, this study answers the following questions:

1. How do AI translation systems and EFL university students in Saudi Arabia differ in their ability to accurately translate texts that include Arabic-English code-switching?
2. What specific challenges do AI systems and EFL university students face when translating Arabic-English code-switched texts?
3. What strategies can be developed to improve the translation of code-switched texts by AI systems and EFL university students?

2. Literature Review

The English and Arabic translation dynamic, and specifically code-switching, is one of the intricate aspects of translation studies and bilingual education. Code-switching, or the movement between two or more languages while communicating or writing, presents unique challenges and opportunities in its study from the perspective of linguistics and in translation studies. Sociolinguistic aspects of code-switching have been studied in-depth in Panhwar (2018) research, revealing frequency and functions in multilingual settings. These findings offer the basis to understand the challenges in translating these texts, where both language flexibility and cultural sensitivity are of vital importance.

The field of translation studies has seen significant academic interest in the efficiency and accuracy of translations produced by both machine translation systems and human translators. A study by Pintado (2021) describes the cognitive processes behind translation, suggesting that bilinguals often engage in code-switching in the mind, in turn affecting the final translation product. This aspect is particularly relevant in educational environments, particularly among English as a Foreign Language (EFL) learners, who need to work with their evolving bilingual competence. At the same time, the early research conducted by Kumar and Chakraborty (2024) in the area of machine translation has made significant strides, but they are still not equipped to deal with the challenges that come with code-switched inputs, normally marked by informal or spoken language departing from formal grammar guidelines.

Comparative studies on the accuracy of translations provided by artificial intelligence systems and human translators have shown that while AI can process large amounts of text effectively, it often does not grasp the context-specific nuances that human translators navigate through a deeper understanding of cultural and linguistic structures (Mohamed et al., 2024). Moreover, the pedagogical implications that come with translating code-switched texts are particularly significant for students of English as a Foreign Language (EFL). The work of Lehti-Eklund (2013) on language teaching and the challenges faced in foreign language

learning highlights the importance of acknowledging the special challenges faced by learners in dealing with bilingual texts, which can include occurrences of code-switching.

Despite the considerable amount of literature available regarding the dynamics of code-switching and its implications for translation, there is a lack of research that has attended to the comparative dynamics between translation by AI systems and EFL learners, specifically within the context of Arabic and English at Imam Mohammed Ibn Saud Islamic University in Saudi Arabia. The aim of the present study is to fill this gap by examining such students' interactions with Arabic-English code-switched texts and, at the same time, examining specific strategies that may optimize translation outcomes. By focusing on this bilingual learning environment, the study aims to make novel contributions to the intersection of linguistic theory, translation practice and language learning technology. In doing so, not only is the academic contribution of the study enriched, but practical applications toward the optimization of bilingual education and the advancement of translation technology are also offered.

3. Methodology

3.1 Study Design

This study adopts a qualitative research approach to examine and explain the dynamics involved in the translation processes of Arabic-English code-switched texts. The qualitative nature of the study is warranted by the research questions that seek not only to unveil the fidelity in translations but also to investigate the lived experiences, decision-making processes, and translation strategies adopted by EFL learners in comparison with those adopted by artificial intelligence. This approach enables an in-depth exploration of the contextual, cultural, and pragmatic factors that shape translation behaviours, especially in bilingual environments where code-switching is common and carries sociolinguistic meanings. This methodological design enables the researcher to obtain rich and detailed information that cannot be attained through quantitative methods, particularly with respect to subjective interpretations, cultural judgments, and the reasoning of translators, issues that are central to the present study.

3.2 Participants and Sampling

The participants of this study consisted of ten EFL university students enrolled in the English Department of the College of Languages and Translation at Imam Mohammed Ibn Saud Islamic University, Saudi Arabia. These students were purposively selected based on two primary criteria: (1) their demonstrated proficiency in both Arabic and English, and (2) their willingness to participate in the study and engage actively in the translation tasks and follow-up interviews. Purposive sampling was appropriate given the study's need for participants who possess both linguistic competence and some level of translation familiarity, ensuring that their responses would be both informed and relevant. All ten students had prior coursework in translation studies and had experience navigating bilingual environments, making them suitable for analysing code-switched texts.

3.3 Instruments and Data Collection Procedures

Two primary instruments were employed in this study: a translation test and semi-structured interviews. The translation test was carefully designed to include ten short texts that exhibited natural Arabic-English code-switching, drawn from real-world academic, social and cultural communication contexts. These texts were crafted to reflect a range of translation challenges such as cultural terms (e.g., *barakah*, *haram*), proverbs (e.g., *al-waqt ka al-sayf*), emotionally expressive language, and technical or informal code-switches common in bilingual discourse. The ten texts were developed and validated by two independent experts holding PhDs in Translation Studies to ensure content validity, linguistic appropriateness and cultural representativeness. Each text ranged from one to two sentences and targeted a specific linguistic phenomenon relevant to the study's objectives.

All ten students were given the same ten code-switched texts and asked to work collaboratively. Each student independently analysed the texts and proposed translations, and then the group collectively discussed and negotiated each translation to arrive at a single, agreed-upon version for each text. This collaborative approach aimed to simulate real-world translation problem-solving and provided richer insights into group-based decision-making and strategy selection. The same ten texts were also submitted to ChatGPT 4, a state-of-the-art AI translation model, to generate comparative AI translations for each item.

Following the translation test, semi-structured interviews were conducted with all ten participants to gather qualitative data on their experiences, challenges faced during translation and their perceptions of code-switching in both source and target texts. These interviews aimed to explore the cognitive, cultural and linguistic considerations that shaped their choices, as well as their evaluation of the differences between EFL students and AI translation performance. The interviews also probed participants' use of strategies such as explicitation, cultural substitution, simplification or literal translation, and captured their reflections on the adequacy of the agreed translations in conveying the intended meaning.

3.4 Methods of Data Analysis

The data were assessed through the combination of thematic analysis and interpretive comparison using the Statistical Machine Translation (SMT) model as outlined by Koehn (2010), providing the theoretical basis for this study. Comparative textual analysis was applied to student translations and AI-generated texts based on qualitative criteria drawn from SMT principles that cover: translation modelling (meaning adherence), language modelling (syntax and coherence), and reordering and alignment (maintenance of syntactic structures in languages). A comparative analysis of all ten texts was carried out to assess the extent to which EFL students and AI translations successfully and appropriately handled the language and culture involved in code-switching.

Additionally, error identification and classification were applied to highlight types of deviations or loss of meaning, such as lexical errors, grammatical issues, semantic inaccuracy, or contextual/cultural mismatches. The AI translations were particularly analysed for instances of transliteration, literal transfer, or cultural insensitivity, while the human translations were assessed for interpretive richness, reader adaptation, and strategic decision-making. These analyses allowed for qualitative comparison across the two translation modalities, offering nuanced insights beyond numerical evaluation.

The interviews were theme-analysed to determine patterns in the responses of the participants. This revealed the existence of several key themes, including challenges in translation, emotional nuance, cultural barriers, strategy use, and attitudes toward AI-generated text. These were compared against text analysis of the translations in order to allow findings to be triangulated and better understand the reasons and style concerns behind specific translation decisions. This allowed analysis to move from the text in isolation to one that took account of context and aligned with the research interest in understanding spontaneous translation practices in bilingual discourse.

3.5 Theoretical Framework: Statistical Machine Translation (SMT) Model

Statistical Machine Translation (SMT) by Koehn (2010) relies primarily on statistical models to translate text from one language to another. SMT does not require explicit rules created by linguists but instead learns to translate by analysing large amounts of bilingual text data. As stated by Koehn (2010), Statistical Machine Translation (SMT) was initially proposed and developed through the work of several researchers and linguists, but a significant milestone in its development came from the work of IBM researchers in the late 1980s and early 1990s. The IBM research team developed a series of statistical models known as the IBM Models for machine translation (Collins, 2011). Their research laid the foundational principles for using statistical methods to model language translation, which later evolved into what we recognize today as Statistical Machine Translation.

The process can be broadly divided into a few key components (Koehn, 2010):

1. **Alignment Training:** SMT systems first train on parallel corpora, which are collections of texts that are translations of each other in two languages. The system uses these corpora to learn how words and phrases in one language align with words and phrases in another language.
2. **Translation Modelling:** This involves creating a model that can predict possible translations of a given sentence or phrase based on the probabilities derived from the aligned text. This model considers various translation options and selects the most likely translation based on statistical likelihood.
3. **Language Modelling:** Alongside the translation model, a language model is used to ensure that the output text is fluent and grammatically correct in the target language. This model evaluates the likelihood of a sentence being a valid construction in the target language.
4. **Decoding:** This is the process where the SMT system uses both the translation model and the language model to generate the most probable translation for a given input sentence.
5. **Reordering:** Since different languages often follow different syntactic orders, SMT systems incorporate reordering algorithms to rearrange the words in the translated sentences to reflect the syntactic structures of the target language accurately.

3.6 Data Analysis Criteria for the Present Study

In the context of this qualitative study, which investigates the translation of Arabic-English code-switched texts by EFL university students in comparison with an AI translation system (ChatGPT 4), the following criteria were employed for data analysis:

1. Translation Accuracy (Qualitative Assessment):

Rather than relying on automated metrics such as BLEU scores, which are more suitable for large-scale quantitative studies, translation accuracy in this study was assessed qualitatively. The EFL students agreed-upon translations and the AI-generated outputs were compared against the intended meaning of the original texts. Accuracy was judged based on the semantic fidelity,

grammatical correctness and overall coherence of each translation, in accordance with the SMT model's components (translation modelling and alignment fidelity).

2. Error Identification and Classification:
Each translation was analysed for common types of errors, including lexical errors, grammatical inaccuracies, semantic distortion and misinterpretation of code-switched segments. This error analysis helped identify areas where AI and students differ in their handling of mixed-language input and offered insight into the specific challenges posed by culturally bound or idiomatic expressions.

3. Contextual and Cultural Appropriateness:
Given that many of the texts involved culturally embedded terms and proverbs, a key criterion for evaluation was how well each translation accounted for cultural nuance and contextual meaning. Translations were assessed on their ability to adapt or explicate culturally rich terms (e.g., *haram*, *ghurba*, *barakah,* see the data analysis for further details) in a way that maintained meaning and accessibility for a non-Arabic speaking audience.

4. Fluency and Pragmatic Naturalness:
Fluency was evaluated based on linguistic flow, register and tone appropriateness in the target language. For student translations, this was assessed through close reading by the researcher, informed by linguistic and pragmatic norms of English. AI outputs were judged using the same qualitative criteria to allow for fair comparison. Emphasis was placed on pragmatic choices, such as emotional tone and stylistic variation, especially in texts involving informal speech, sarcasm or personal reflection.

5. Thematic Analysis of Interview Data:
In addition to the textual comparison, qualitative data from student interviews were analysed thematically to identify patterns in translator reasoning, strategy use, perceived challenges and attitudes toward AI-generated translations. These themes helped explain translation decisions and further contextualized the comparison between EFL students and AI performance. This component of the analysis supported the exploration of human cognitive and cultural reasoning, which is absent in statistical machine translation models.

4. Findings

This section presents the data analysis and findings of the present study as follows:

4.1 Analysis of AI and EFL Students' translations

Table (1) AI and students' translation of text 1

Source Text	AI translation	EFL Students' Translation
في دراسة أجريت مؤخرًا بجامعة الملك سعود، أوضح الباحثون أن استخدام تقنية الـmachine learning يساهم بشكل كبير في تطوير الأنظمة التعليمية الحديثة، لكن تبقى هناك تحديات فيما يتعلق بـ data quality وكيفية معالجتها بشكل فعال.	In a recent study conducted at King Saud University, researchers indicated that the use of machine learning technology significantly contributes to the development of modern educational systems; however, challenges remain concerning data quality and how to effectively process it.	In a recent study conducted at King Saud University, researchers clarified that using machine learning technology plays a major role in advancing modern educational systems. However, challenges persist regarding data quality and effective processing methods.

As revealed in Table (1) above, both the AI and EFL students' translations perform well in terms of surface accuracy and fluency, rendering the Arabic source text into grammatically correct and coherent English. The AI translation follows a statistically likely structure, maintaining close alignment with the source's phraseology, which is evident in the direct parallelism of "contributes to the development" and "challenges remain concerning." This reflects the translation modelling and language modelling phases of SMT, where the output is both semantically faithful and syntactically fluent. The students' translation, while similar in meaning, employs slightly more natural and idiomatic phrasing, substituting "clarified" for "indicated," and "advancing" for "developing", which suggests a deeper interpretive engagement with the source content. This highlights the greater flexibility and contextual adaptation inherent to EFL students, especially when handling code-switched terms like "machine learning" and "data quality." In the AI version, these technical terms are retained as-is, showing alignment training on bilingual corpora where such loanwords

frequently appear. Both translations succeed in terms of translation accuracy, but the EFL students' version is better in terms of fluency and contextual appropriateness, particularly in the more nuanced rendering of "effective processing methods."

Table (2) AI and students' translation of text 2

Source Text	**AI translation**	**EFL Students' Translation**
The researchers emphasized the concept of بركة in Middle Eastern business contexts, indicating that purely economic interpretations often overlook essential cultural dimensions integral to successful management practices.	The researchers emphasized the concept of *barakah* in Middle Eastern business contexts, indicating that purely economic interpretations often overlook essential cultural dimensions that are integral to successful management practices.	The researchers highlighted the concept of *barakah*, a traditional belief in divine blessing and spiritual prosperity, in Middle Eastern business contexts, emphasizing that purely economic interpretations often fail to capture the essential cultural dimensions that underpin effective and sustainable management practices.

In Table (2), the term "*barakah*" is the central point of complexity due to its cultural and religious significance within Arabic and Islamic discourse. The AI translation opts for a transliteration approach, rendering the word as "*barakah*" without additional explanation. While this is consistent with SMT strategies, which draw on statistical probabilities found in parallel corpora, it assumes the target reader shares cultural familiarity, a risky assumption in cross-cultural academic contexts. This strategy may lead to ambiguity or misunderstanding for readers unfamiliar with Middle Eastern cultural or spiritual frameworks. On the other hand, the EFL students' translation provides a contextual clarification, defining *barakah* as "a traditional belief in divine blessing and spiritual prosperity." This demonstrates an understanding of cultural nuance and a strategic choice to explicate rather than transliterate, which aligns with the adopted criterion of contextual appropriateness.

Fluency-wise, the EFL students' translation version uses more formal and academic expressions, such as "underpin effective and sustainable management practices," enhancing the sentence's readability and coherence. The AI version retains grammatical accuracy but lacks the interpretive depth that students bring when dealing with code-switched religious or culturally loaded terminology. According to the adopted theoretical framework based on SMT (Koehn, 2010), the AI translation represents surface-level statistical fluency, while the students' translation reflects semantic enrichment and deeper cultural alignment, a trait SMT systems are not yet fully capable of replicating.

Table (3) AI and students' translation of text 3

Source Text	**AI translation**	**EFL Students' Translation**
بصراحة، كانت الـ vacation الأخيرة ممتازة، بس المشكلة كانت في delayed flights اللي خلتنا ننتظر في المطار حوالي 6 ساعات. تجربة ما تنعاد!	Honestly, the last vacation was excellent, but the problem was with the delayed flights, which made us wait at the airport for about 6 hours. Definitely an experience I wouldn't repeat!	Honestly, the last vacation was great, but the delayed flights were a real hassle; they left us stuck at the airport for nearly six hours. Definitely not an experience I'd want to go through again!

This source text in Table (3) blends informal Arabic with embedded English expressions, particularly "vacation" and "delayed flights," forming a natural instance of Arabic-English code-switching. The AI translation renders the text into English with surface accuracy, maintaining the sentence's overall structure and clarity. It uses a literal and somewhat neutral phrase: "which made us wait at the airport for about 6 hours," followed by a direct equivalent of the closing expression: "an experience I wouldn't repeat." This aligns with the language modelling and decoding phases of SMT (Koehn, 2010), which prioritize fluent target-language constructions based on statistical familiarity, especially with common travel-related terms.

The students' translation, however, takes a more expressive and idiomatic approach by saying: "a real hassle" and "Definitely not an experience I'd want to go through again." These choices reflect a deeper grasp of pragmatic tone and emotional impact. Rather than merely transferring the factual content, the EFL students capture the speaker's underlying frustration and dissatisfaction, demonstrating higher effectiveness in fluency, tone and contextual nuance. This matches the study's contextual appropriateness and readability criteria, where emotional and stylistic subtleties matter just as much as semantic fidelity. It is noticed that SMT-based systems like ChatGPT 4 tend to default to neutral, semantically accurate but affectively flat renderings.

Thus, this text clearly highlights a key challenge posed by code-switched informal tone and emotional expression, an area where human translators generally outperform AI.

Table (4) AI and students' translation of text 4

Source Text	**AI translation**	**EFL Students' Translation**
I can't believe my professor gave us a surprise quiz today, seriously حرام! We're barely surviving these deadlines already.	I can't believe my professor gave us a surprise quiz today—seriously, *haram*! We're barely surviving these deadlines as it is.	I can't believe my professor gave us a surprise quiz today—seriously, that feels so unfair! In our culture, we'd even call it *haram*, meaning morally wrong. We're already barely managing to meet our deadlines.

As shown in Table (4), the code-switched term "حرام" (*haram*) poses a significant translation challenge due to its religious, ethical and cultural weight. The AI translation opts for direct transliteration, "*haram*!", without offering an explanation. While this preserves authenticity and may be statistically probable based on AI training on bilingual corpora, it lacks semantic unpacking. This approach aligns with SMT's alignment and decoding stages (Koehn, 2010), which often favour frequency-based output over interpretive depth. For a non-Arabic speaking audience, however, the meaning of "*haram*" may remain unclear or misunderstood as merely an exclamation.

In contrast, the EFL students' translation balances semantic transparency and cultural explanation. They first rephrase "*haram*" as "that feels so unfair!" and then adds: "In our culture, we'd even call it haram, meaning morally wrong." This dual strategy offers both emotional tone and cultural contextualization, fulfilling the study's criteria of fluency, contextual appropriateness and error minimization. Notably, this example shows how EFL students intuitively resolve the ambiguity of code-switched religious terms by layering meaning and background explanation.

Table (5) AI and students' translation of text 5

Source Text	**AI translation**	**EFL Students' Translation**
شباب، لا تنسوا الـ meeting بكرة الساعة 8 مساءً على Zoom، لازم نناقش الـ final presentation لأن الموضوع critical جدًا.	Guys, don't forget the meeting tomorrow at 8 PM on Zoom. We need to discuss the final presentation because the topic is really critical.	Hey guys, just a reminder; we've got a Zoom meeting tomorrow at 8 PM. We need to go over the final presentation since the topic is super important.

Table (5) presents a source text which includes everyday informal Arabic with embedded English terms like "meeting," "Zoom," and "final presentation," reflecting natural code-switching common among bilingual university students. The AI translation delivers a fluent, accurate rendering with near-literal phrasing: "We need to discuss the final presentation because the topic is really critical." It successfully captures both content and urgency, demonstrating SMT's strength in translating structurally simple, frequently occurring constructions. The phrase "really critical" reflects direct equivalence based on statistical likelihood from similar corpora, aligning with the translation and language modelling components of SMT (Koehn, 2010).

The EFL students' translation rephrases the message with slightly more natural, idiomatic English: "just a reminder, we've got a Zoom meeting," and "super important." This choice introduces a more conversational tone, suggesting a peer-to-peer register. It shows an awareness of audience and purpose, key to effective communication. Moreover, the phrase "super important" adds emotional emphasis and familiarity, enhancing fluency and readability, a strength human translators bring to informal texts. Thus, this text translation illustrates that while both AI and EFL students' outputs are technically correct, the EFL students' version outperforms in pragmatic effectiveness and tone alignment, which is especially important in messages involving teamwork and scheduling.

Table (6) AI and students' translation of text 6

Source Text	AI translation	EFL Students' Translation
«كنا بنعمل implement a semantic search engine، وواجهنا صعوبات كتير في معالجة البيانات.»	"We were working on implementing a semantic search engine, and we faced many difficulties in processing the data."	We were in the process of implementing a semantic search engine and encountered several challenges in handling and processing the data effectively.

Table (6) presents a technically rich sentence involving a bilingual term, "implement a semantic search engine", embedded within Arabic, along with a discussion of data processing challenges. The AI translation renders the sentence in clear and grammatically sound English: "We were working on implementing a semantic search engine, and we faced many difficulties in processing the data." This aligns with SMT's strength in handling technical and frequently used terms, especially in scientific contexts where bilingual corpora often contain similar constructs. The SMT system accurately preserves the original meaning and structure, demonstrating the effectiveness of alignment training and language modelling (Koehn, 2010).

In contrast, the EFL students' translation shows more nuanced phrasing and stylistic refinement, opting for "We were in the process of implementing…" and adding "effectively" at the end, "challenges in handling and processing the data effectively." This small addition reflects pragmatic enrichment, indicating that the issue was not just processing data, but doing so efficiently and correctly. This refinement showcases the EFL students' ability to infer implied meaning and enhance precision, something AI systems typically underperform on due to their reliance on frequency-based prediction. It is shown that AI-generated translations likely cluster around the most statistically common technical collocations. This translation highlights how EFL students can exceed AI performance not through basic accuracy, but through semantic depth and clarity, particularly in fields where technical accuracy and expressive precision intersect.

Table (7) AI and students' translation of text 7

Source Text	AI translation	EFL Students' Translation
أنا بشكل عام بحب research في المواضيع اللي بتهمني.	In general, I enjoy doing research on topics that interest me.	Generally, I enjoy conducting research on topics that genuinely capture my interest.

This source text in Table (7) above is straightforward in structure and content, expressing a personal preference using a simple Arabic-English code-switched sentence. The AI translation renders the sentence clearly and accurately: "In general, I enjoy doing research on topics that interest me." This output reflects a statistically typical rendering of everyday phrases, particularly the collocations "doing research" and "topics that interest me", which are common in bilingual corpora used in SMT training. Thus, the AI model efficiently applies translation modelling and language modelling to produce a fluent and semantically faithful translation (Koehn, 2010).

However, the EFL students' translation offers a slightly more polished and academic tone: "Generally, I enjoy conducting research on topics that genuinely capture my interest." The shifts from "doing" to "conducting" and the addition of "genuinely capture" introduce a richer lexical and stylistic layer, enhancing the translation's formality and emphasis. These choices reflect the EFL students' ability to adjust tone and nuance to better suit academic or formal written English, demonstrating deeper contextual awareness and sensitivity to audience expectations. Overall, this text translation exemplifies minimal difficulty for both AI and EFL students, but also underscores the EFL students' edge in tone adaptation and lexical variation, which supports the study's emphasis on fluency and contextual appropriateness in evaluating translation quality.

Table (8) AI and students' translation of text 8

Source Text	**AI translation**	**EFL Students' Translation**
"Honestly, I feel a sense of غربة whenever I travel abroad for extended periods. It's an emotion I struggle to even express properly in English."	Honestly, I feel a sense of *ghurba* whenever I travel abroad for extended periods. It's an emotion I struggle to even express properly in English.	Honestly, whenever I spend a long time abroad, I feel a deep sense of homesickness and emotional disconnection—a feeling known in Arabic as *ghurba*. It's a complex emotion that I find difficult to fully capture in English.

As revealed in Table (8), the focal challenge lies in translating the Arabic term "غربة" (*ghurba*), a word loaded with cultural and emotional meaning that has no direct equivalent in English. The AI translation chooses a transliteration strategy: "I feel a sense of *ghurba*," assuming the reader can infer the term's meaning from context. While this preserves linguistic authenticity, it leaves the concept opaque for non-Arabic speakers, thereby failing in terms of contextual clarity and cultural accessibility. This choice aligns with SMT's statistical tendencies to retain untranslated foreign words that frequently co-occur with English in parallel corpora, but it does so without interpretive support, a well-known limitation of SMT models as highlighted by Koehn (2010).

In contrast, the EFL students' translation employs explicitation: "a deep sense of homesickness and emotional disconnection, a feeling known in Arabic as *ghurba*." This version captures the psychological weight and complexity of the term, demonstrating strong alignment with the adopted evaluation criteria of contextual appropriateness, semantic enrichment and fluency. The students also frame the word *ghurba* as an untranslatable cultural concept, thus educating the reader while conveying the intended emotional resonance. Finally, this text translation underscores a core finding of the study: AI systems are efficient but often fall short in handling culturally nuanced expressions, whereas students, despite individual differences, tend to offer richer, audience-aware translations that bridge both language and culture more effectively.

Table (9) AI and students' translation of text 9

Source Text	**AI translation**	**EFL Students' Translation**
"For lack of a better term, the professor casually said الوقت كالسيف during the lecture. He assumed everyone understood the phrase without needing a translation."	For lack of a better term, the professor casually said *al-waqt ka al-sayf* (time is like a sword) during the lecture. He assumed everyone understood the phrase without needing a translation.	For lack of a better term, the professor casually said *"time waits for no one"* during the lecture, assuming everyone understood the meaning without needing a translation.

Table (9) focuses on the translation of the Arabic proverb "الوقت كالسيف" (time is like a sword), which is metaphorical and culturally rich. The AI translation renders it as: "*al-waqt ka al-sayf* (time is like a sword)," preserving the literal meaning and transliterating the Arabic. While this may satisfy lexical alignment and statistical translation modelling (Koehn, 2010), it assumes cultural familiarity and fails to communicate the intended figurative meaning to readers unfamiliar with the Arabic expression. This literal approach is common in SMT systems trained on parallel corpora, where proverbs may appear untranslated or without adequate contextual glossing.

On the other hand, the EFL students' translation replaces the source proverb with a well-known cultural equivalent in English, "time waits for no one." This not only conveys the intended urgency and value of time but also ensures reader accessibility and interpretive resonance. It demonstrates high performance on the adopted criteria of fluency, contextual appropriateness and semantic accuracy. This substitution reflects the EFL students' strategic awareness that successful proverb translation often requires functional equivalence rather than literal fidelity.

Table (10) AI and students' translation of text 10

Source Text	AI translation	EFL Students' Translation
"An old Bedouin saying, الضيف ضيف الله, was invoked frequently during the seminar discussions on hospitality. Its repeated usage in the dialogue reinforced the cultural importance of welcoming guests."	An old Bedouin saying, *al-ḍayf ḍayf Allāh* (the guest is God's guest), was invoked frequently during the seminar discussions on hospitality. Its repeated usage in the dialogue reinforced the cultural importance of welcoming guests.	"An old Bedouin saying, treat guests as a blessing", was invoked frequently during the seminar discussions on hospitality. Its repeated usage in the dialogue reinforced the cultural importance of welcoming guests."

As shown in Table (10), the source text involves the translation of the Arabic proverb "الضيف ضيف الله" (*al-ḍayf ḍayf* Allāh), a culturally rich and religiously grounded expression deeply rooted in Bedouin and Islamic hospitality traditions. The AI translation takes a literal approach, rendering the phrase as: *"the guest is God's guest."* While grammatically correct, this output assumes the reader will understand the implied cultural significance. It reflects SMT's reliance on statistical alignment and language modelling (Koehn, 2010), where literal fidelity often outweighs interpretive depth. Although accurate on a surface level, the AI translation may not resonate fully with non-Arabic audiences due to its lack of explanatory context or cultural framing.

Nevertheless, the students' translation substitutes the original proverb with: *"treat guests as a blessing."* This approach prioritizes functional equivalence and emotional impact, preserving the essence of the proverb, generosity and reverence toward guests, while adapting it to English cultural norms. This demonstrates strength in contextual appropriateness, cultural mediation and audience awareness, criteria emphasized in your analysis model. The EFL students' choice makes the text more accessible and idiomatically natural, even if some religious connotation is softened.

In conclusion, this final text underscores a recurrent pattern throughout the current study: AI provides consistent and literal renderings, but EFL students excel in cultural bridging and communicative clarity, especially in cases of culturally embedded proverbs. This directly supports the third study question regarding strategies to improve AI and student translation of code-switched texts.

4.2 Analysis of Interviews

Using the interview data collected from ten EFL students after completing translation exercises, a thematic analysis was conducted to examine how they experienced translation, determine what problems they encountered, and understand what strategies they used. A common theme that arose in participants was the complexity of code-switched text that involved not merely switching between two languages but also navigating between two competing cultural frameworks. Many participants described this process as "jumping between two mentalities," indicating that the process was both mentally demanding and culturally sensitive. A few spoke of doubting whether or not to keep English terminology incorporated in Arabic or whether to search for culturally appropriate counterparts in English. This is representative of a basic challenge code-switching translation presents: it proves to be more than a purely linguistic process and is instead a cross-cultural negotiation that requires translators to navigate, in parallel, lexical, grammatical, and cultural congruence.

All participants identified culturally embedded terms such as *ghurba*, *haram*, *barakah*, and idiomatic expressions as the most difficult to translate. Several participants noted they were unsure whether to keep these words in their original form, translate them literally, or explain them. Most opted for explicitation or functional equivalence, showing strong awareness of reader comprehension. The difficulty of translating these terms also supports the study's conclusion that AI systems struggle significantly in these areas, often resorting to transliteration or overly literal renderings. Besides, the participants acknowledged that understanding the emotional and cultural depth of these terms was critical to effective translation, a capability AI lacks.

In addition, the participants emphasized the difficulty in transferring emotional tone and subtle interpersonal communication in English. While the AI-produced outputs were described as "structured" and "grammatically correct," they were criticized as sounding "robotic" and not evoking emotional depth. The participants mentioned that they often had to revise the AI outputs in order to better capture the intended tone, especially with communications that entailed frustration, sarcasm or sympathy. This implies that EFL students have a better ability to perceive pragmatic functions and the purposes of speakers, especially under communications that entail emotion, idiomatic subtleties, or humour in the Arabic source text.

Most participants reported using AI (specifically ChatGPT) as a support tool, often for grammar and structural assistance, but not for final translation. They expressed limited trust in AI's handling of cultural nuance and preferred to revise its output manually.

They used various strategies such as functional equivalence, footnoting, summarization and explanation to ensure clarity and appropriateness in their translations. Notably, students viewed their freedom and responsibility as students as an asset, allowing them to produce translations that were not only accurate but also culturally and emotionally resonant.

A number of participants expressed that translation is an ongoing process of decision-making, including deciding whether to stick close to the original text, alter it for the target culture, or reduce it for greater clarity. This observation demonstrates a high level of translational agency, especially compared to artificial intelligence, which uses probabilistic algorithms without conscious consideration. Many students emphasized that, even though they used AI, they were still responsible for meaning, tone, and clarity, thus highlighting the indispensable role of EFL students' interpretative skills in producing quality translations of code-switched texts.

The findings from interviews support the main findings of the research. The EFL students demonstrated awareness of the cultural, emotional and linguistic complexity of translation that is often overlooked by artificial intelligence tools. Their reflections highlight AI's strength in the areas of structure and grammar but shed light on its weakness in contextual and cultural flexibility. Most importantly, the students actively used strategies to bypass language barriers, supporting the importance of human intervention in the translation of sophisticated bilingual and culturally dense texts. This analysis brings qualitative weight to the quantitative findings and shows that collaboration in translation practices and in educational settings is crucial between AI and humans.

5. Discussion of the findings

This study aimed to examine the differences between AI translation systems (specifically ChatGPT) and EFL university students at Imam Mohammed Ibn Saud Islamic University in translating Arabic-English code-switched texts. Drawing on Koehn's (2010) Statistical Machine Translation (SMT) framework and the comparative analysis of ten bilingual texts, the results reveal critical patterns that highlight both the capabilities and limitations of AI systems when juxtaposed with human translation strategies, especially in culturally and emotionally nuanced contexts.

5.1 Translation Accuracy: Statistical Reliability vs. Interpretive Sensitivity

The analysis consistently showed that AI translations performed well in terms of surface-level accuracy, especially when handling straightforward syntactic structures or frequently co-occurring bilingual phrases (Texts 1, 5, 6, and 7). This aligns with Koehn's (2010) SMT model, where alignment training and language modelling result in grammatically fluent and statistically probable outputs. For instance, Text 1, dealing with a scientific context involving "machine learning" and "data quality", was rendered accurately by the AI system.

However, EFL students' translations often exceeded AI in interpretive sensitivity and stylistic appropriateness. The participants rephrased and enriched the original meaning, using idiomatic expressions or shifting registers to better align with the target audience's expectations. This was especially evident in Texts 3 and 7, where tone, formality, and emotional nuance played significant roles. This reflects prior findings by Alrahabi (2018), Almahboob (2020) and Khasawneh (2023), who argued that while AI offers efficiency, human translation preserves the depth of communication.

5.2 Cultural and Pragmatic Challenges: Literalness vs. Cultural Mediation

A central finding relates to the treatment of culturally embedded and religiously charged terms, such as "*barakah*" (Text 2), "*haram*" (Text 4), "*ghurba*" (Text 8), and proverbial expressions like "الوقت كالسيف" (Text 9) and "الضيف ضيف الله" (Text 10). AI systems frequently retained literal or transliterated forms (e.g., "*ghurba*," "*haram*"), reflecting their statistical training on bilingual data, yet failing to unpack the cultural subtext these words carry. In contrast, EFL students employed strategies like explicitation, cultural substitution or annotation, providing necessary context that enhances comprehension for non-Arabic readers. This confirms findings by Al-Adel and Alotaibi (2021), who noted that AI systems lack pragmatic competence, especially in translating religious or idiomatic expressions. Moreover, these results support Alghamdi (2019) and Ali's (2023) observations that culturally untranslatable terms pose the greatest challenge for MT systems, particularly when readers do not share the source culture.

5.3 Emotional Expression and Stylistic Adaptation: AI Flatness vs. Human Dynamism

Students also demonstrated a consistent advantage in emotionally expressive or conversational texts. In Text 3, expressions like "a real hassle" offered a more relatable and emotionally rich rendering than the AI's neutral paraphrase. Similarly, in Text 5, phrases like "super important" added interpersonal emphasis that AI output lacked. This distinction aligns with the findings of Abu-Ayyash (2020), who reported that EFL students often intuitively enhance register and tone based on intended audience and communicative goals, capacities that AI still lacks due to its reliance on statistical generalizations rather than situational understanding.

5.4 Variation and Flexibility in Human Translation

While AI provides consistency and predictability, the analyses show that EFL students' translations exhibit greater diversity and adaptability. This is a double-edged sword: while variation might lead to inconsistent quality, it also reflects the translators' creative strategies and contextual judgment, particularly in handling ambiguity or metaphor. For example, in Text 9, EFL students might render "الوقت كالسيف" as "time waits for no one," "time is of the essence," or provide an explanatory gloss, each offering a nuanced take that reflects both target language norms and communicative purpose. This adaptability is consistent with findings from Alkhatnai (2017), who emphasized that students draw on both linguistic knowledge and cultural competence to render meaning beyond literal equivalence. Conversely, SMT-based models tend to replicate the most probable construction, which can be accurate but often fails to capture deeper layers of meaning.

5.5 SMT Model Limitations and Future Prospects

Koehn's (2010) SMT framework provides a valuable lens through which to interpret AI translation behaviour. The model excels at syntactic and lexical alignment, especially in contexts with high corpus coverage and predictable language. However, the findings in this study reinforce the model's known limitations: its inability to contextualize meaning, resolve ambiguity, or infer socio-cultural undertones. Moreover, AI translation still lacks dynamic register shifting, audience awareness, and real-world contextual inference, competencies integral to EFL students. While advancements such as neural machine translation (NMT) and transformer models have improved fluency and naturalness (as seen in some ChatGPT outputs), they still fall short when handling code-switched language involving implicit cultural markers, the primary focus of this study.

6. Conclusions and Recommendations

This study set out to explore the comparative effectiveness of AI translation systems, specifically ChatGPT, and EFL university students at Imam Mohammed Ibn Saud Islamic University in translating Arabic-English code-switched texts. The analysis of ten representative examples revealed a consistent pattern: while AI systems such as ChatGPT demonstrate strong performance in grammatical accuracy and syntactic fluency, they frequently fall short in handling context-dependent, culturally embedded, and emotionally nuanced expressions. EFL students, in contrast, exhibited greater sensitivity to cultural and pragmatic cues, applying strategies like explicitation, cultural substitution, and tone modulation to ensure that the target text is both semantically accurate and communicatively effective.

A key finding is that AI systems often rely on literal or transliterated translations, especially when faced with proverbs, religious expressions or culture-specific terms, resulting in outputs that may be intelligible but culturally opaque to the target reader. This underscores a core limitation of the Statistical Machine Translation (SMT) framework, which prioritizes word and phrase alignment based on statistical frequency over interpretive meaning. EFL students, by drawing on lived cultural experience and interpretive flexibility, were better equipped to render texts that resonate with the target audience.

A major finding is that artificial intelligence systems tend to rely on direct or transliterated translations, especially when they come across proverbs, religious terms, or culture-specific vocabulary, which allows them to generate results that are understandable but culturally nonspecific to the target readership. This finding underlines a built-in limitation of the Statistical Machine Translation (SMT) model, which prioritizes the alignment of words and phrases based on statistical frequency over interpretative relevance. EFL students, drawing on their individual cultural backgrounds and interpretative flexibility, showed a better ability to produce texts that resonate with the target readership.

This study highlights the significance of contrasting machine translation and human translation, specifically in the fields of education and intercultural communication. While artificial intelligence holds benefits in efficiency, consistency, and expertise in dealing with standard or technical content, human translators are still indispensable in cases where nuance, tone and cultural context take precedence. The findings of this study enable strong advocacy for the development of more translator training programs and the design of machine translation algorithms that are culturally sensitive, thus moving from word-for-word translations to more successful communicative results.

The findings of this study imply that translator training programs need to incorporate specialized instruction aimed at the translation of code-switching and culturally embedded texts, particularly those including idiomatic language, religious allusions, and metaphorical content. EFL students should be equipped not merely with linguistic competence but also with knowledge of cultural and pragmatic aspects, thus enabling them to make informed choices about strategies like explicitation, cultural replacement, or the use of functional equivalents. Universities should also encourage the use of AI-supported tools in the classroom to raise awareness of their strengths and weaknesses, establishing a cooperative learning environment in which students work with AI-generated output as initial drafts subject to critical evaluation and post-editing to achieve subtlety and accuracy. Such an approach can help to bridge the gap between raw machine-generated output and the interpretive demands involved in practical translation tasks.

From both industrial and technological perspectives, developers of AI translation systems are advised to expand their training datasets to reflect more diverse, code-switched, and culturally rich sources that accurately reflect actual bilingual dialogues. The addition of modules aimed at boosting contextual understanding and cultural flexibility in AI systems has the potential to significantly enhance the quality of translations, particularly in texts in which meaning is deeply rooted in cultural practices. At the same time, industry stakeholders such as publishers, media outlets and educational institutions should adopt a hybrid translation model in which translations produced by AI are followed by subsequent editing by professional translators, thus ensuring efficiency and communicative accuracy. This blended strategy has the potential to produce better translation outcomes while, in the process, promoting cross-cultural communication and the collaboration of machines with humans in multicultural settings.

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References

[1] Alang, N., & Idris, S. (2018). Students' perception towards the use of code-switching in teaching and learning. *Journal of Education and Social Sciences*, *11*(1), 1-9.
[2] Ali, H. (2023). Translating the Untranslatable: Negotiating Cultural Differences in Literature. *The Study of Religion and History*, 1(2), 43-50.
[3] Alsheikhidris, A., & Alfatih, M. (2024). Code-Switching in Translation: Linguistic Analysis of Multilingual Texts and their Translations. *International Journal of Linguistics, Literature & Translation*, *7*(10).
[4] Althobaiti, A. A. T. (2024). *The Spread of English in Saudi Arabia: A Study of University Students' Attitudes and Language Use* (Doctoral dissertation, UNSW Sydney).
[5] Alzain, M. (2024). Code-Switching in Translation: Linguistic Analysis of Multilingual Texts and their Translations. *International Journal of Linguistics, Literature and Translation*, *7*(10), 119-134.
[6] Bhatt, R. M., & Bolonyai, A. (2011). Code-switching and the optimal grammar of bilingual language use. *Bilingualism: Language and cognition*, *14*(4), 522-546.
[7] Collins, M. (2011). Statistical machine translation: IBM models 1 and 2. *Columbia Columbia Univ*.
[8] Deng, Y. (2024). *Improving the Performance of Code-Switching Recognition Using Whisper* (Doctoral dissertation, University of Groningen).
[9] Khasawneh, M. A. S. (2023). The potential of AI in facilitating cross-cultural communication through translation. *Journal of Namibian Studies: History Politics Culture*, *37*, 107-130.
[10] Koehn, P. (2010). *Statistical machine translation*. Cambridge University Press.
[11] Kruk, F., Herath, S., & Choudhury, P. (2025). BanglAssist: A Bengali-English Generative AI Chatbot for Code-Switching and Dialect-Handling in Customer Service. *arXiv preprint arXiv:2503.22283*.
[12] Kumar, S., & Chakraborty, T. (2024). *Understanding and explaining affective traits in English and code-mixed conversations* (Doctoral dissertation, IIIT-Delhi).
[13] Lehti-Eklund, H. (2013). Code-switching to first language in repair–A resource for students' problem solving in a foreign language classroom. *International Journal of Bilingualism*, *17*(2), 132-152.
[14] Mohamed, Y. A., Khanan, A., Bashir, M., Mohamed, A. H. H., Adiel, M. A., & Elsadig, M. A. (2024). The impact of artificial intelligence on language translation: a review. *Ieee Access*, *12*, 25553-25579.
[15] Nazeer, I., Rehman, J., & Butt, M. (2024). Exploring Code-Switching Dynamics in Urdu-English Multilingual ChatGPT Models: Patterns, Challenges, and Implications. *Journal of Policy Research*, *10*(2), 18-27.
[16] Panhwar, F. Y. A. N. (2018). *Multilingualism in Sindh, Pakistan: the functions of code-switching used by educated, multilingual Sindhi women and the factors driving its use* (Doctoral dissertation, University of Sussex).
[17] Pintado G. L. (2021). Translation in language teaching, pedagogical translation, and code-Switching: restructuring the boundaries. *The Language Learning Journal*, *49*(2), 219-239.
[18] Tarunesh, I., Kumar, S., & Jyothi, P. (2021). From machine translation to code-switching: Generating high-quality code-switched text. *arXiv preprint arXiv:2107.06483*.
[19] Way, A. (2010). Machine translation. Handbook for computational linguistics and natural language processing, ed. by S. Lappin, C. Fox, and A. Clark. Chichester, UK: Wiley Blackwell
[20] Zapata, R. J. (2016). *Translators in the loop: observing and analysing the translator experience with multimodal interfaces for interactive translation dictation environment design* (Doctoral dissertation, Université d'Ottawa/University of Ottawa)