Journal of Computer Science and Technology Studies
ISSN: 2709-104X
DOI: 10.32996/jcsts
Journal Homepage: www.al-kindipublisher.com/index.php/jcsts

JCSTS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Google Translate Then and Now: Translations From Five Languages into English and Arabic (2012–2025)

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| ABSTRACT

Google Translate (GT) is a free online service that instantly translates words, phrases, text and web pages across 249 languages including English, Arabic, German, French, Hungarian, Turkish and others. In 2006, GT was launched as a statistical machine translation system (SMT) and in 2016, it transitioned to a neural machine translation system (NMT) with differences in translation quality in the two eras. This study compares the translation of six texts from Hungarian, German and Spanish, Turkish and Japanese to English and Arabic by GT in 2012 (SMT era) and in 2025 (NMT era) in terms of intelligibility, fluency, and semantic, lexical and syntactic accuracy. For the SMT era (2012), holistic evaluations showed that Hungarian-English, German-English, Spanish-English translations were somewhat intelligible, with literal meanings, but were a bit awkward and clumsy. GT failed to capture idiomatic nuance, produced sentences with broken syntax and robotic phrasing. Turkish-English and Japanese-English translations were far more problematic, riddled with broken syntax, incoherence, and nonsensical phrases. Arabic translations by GT across the five languages were largely unintelligible. Lexical equivalents were inaccurate and sentence structure was nonsensical with jumbled, incoherent, fragmented, distorted, and clumsy word order. Arabic translations were unusable. In 2025 (NMT era), GT translation from European and non-European languages to both English and Arabic drastically changed. It became intelligible, fluent, coherent, stylistically natural, contextually accurate, and appropriately contextualized. Syntax and word order were preserved. The differences in translation quality for both English and Arabic in the two eras stem from differences in architecture, training, and linguistic modelling, In 2012, GT matched segments of source text against stored bilingual units and recombined them according to probability. It worked reasonably well for European languages that share structural similarities with English, but it struggled with languages that are typologically distant, such as Turkish, Japanese, and Arabic. In 2025, GT has been trained on much larger and more diverse datasets than SMT. This breadth of training data enables better handling of words, specialized terminology, and cross domain variation. The study concludes with recommendations for students, instructors, researchers, and developers on the effective use and improvement of GT.

| KEYWORDS

Google Translate (GT), Statistical Machine Translation (SMT), Neural Machine Translation (NMT), SMT vs NMT, Arabic translation, English translation, GT as SMT, GT as NMT, European language translations, non-European language translation

| ARTICLE INFORMATION

ACCEPTED: 04 December 2025 **PUBLISHED:** 06 December 2025 **DOI:** 10.32996/jcsts.2025.7.12.50

1. Introduction

Translation plays a vital role in transferring science, knowledge, and literature between different languages, and contributes to creating an atmosphere of understanding and rapprochement between different cultures. Europeans who are not proficient in Arabic need to communicate with Arabs who are not proficient in foreign languages to bridge perspectives and dispel negative stereotypes about Arabs and Muslims. Arab students, researchers, specialists, and others who are not proficient in foreign languages need to translate research and books and communicate with foreign specialists through translation. Europeans of

Arab origin who do not read Arabic need a search engine, system, or program that quickly translates what they want to know from Arabic into the European language they are proficient in.

The computing era began in the 1940s. With the emergence of electronic computers (ENIAC, Mark I), researchers began to explore automated translation. Warren Weaver's 1949 memorandum proposed using computers for language translation. The Georgetown–IBM experiment (1954) was the first true machine translation system which translated 60 Russian sentences into English automatically. This event marked the birth of practical MT research and led to significant funding in the U.S. and the Soviet Union. In the 1960s–1980s, the rule-based systems began. Early MT systems were rule-based, relying on dictionaries and grammar rules. They were limited in fluency but laid the groundwork for later statistical and neural systems. In 1998, Google was founded by Larry Page and Sergey Brin in Menlo Park, California, after developing their PageRank search algorithm at Stanford. In 2006, Google Translate (GT)[1] was launched. It was initially released as a statistical machine translation (SMT) system, supported a small set of languages and relied on bilingual corpora to generate translations. In 2016, the Neural Machine Translation (NMT) was introduced. On November 15, 2016, GT transitioned to neural MT, which dramatically improved fluency and contextual accuracy compared to the earlier statistical approach. In 2025, GT supports 249 languages and varieties, serving hundreds of millions of users daily.

Being a free, web-based service available to anyone with an internet connection, the large scale of languages it supports, its integration into everyday workflows (it is embedded into Google Search, Chrome, Android, Gmail, and later into countless apps), its transition from a statistical MT (2006–2016) to neural MT (2016 onward), and its leveraging of large language models, GT, SMT and NMT have been the focus of many research studies in the literature.

Prior studies compared SMT and NMT in translating a variety of Asian languages as Hindi–Tamil and English–Tamil (Kumar et al.; 2021; Ramesh et al. 2021); English–Tamil (Suryawanshi et al., 2024); Persian–Hindi (Yousofi & Bhattacharyya, 2024); English–Persian (Zand Rahimi, Madayenzadeh & Alizadeh, 2017**)**; and Japanese (Wu et al., 2025; Mondal et al., 2023). Similarly, SMT and NMT were compared in translating numerous European languages as Italian–English and Spanish–English translation (Bentivogli, Fornaciari & Pianta (2016); Dutch (Matos Veliz, De Clercq & Hoste, 2021); English–Slovak (Sabolová, Ripel & Hrebeňár, 2021); English–Greek (Stasimioti et al. , 2020); Hungarian (Al-Zebary, 2012); German (Volkart, Bouillon & Girletti, 2018; Speerstra, 2018); Spanish (El Maazouzi, El Mohajir & Al Achhab, 2017); and Turkish, (Rojas Plata & Castro Sánchez, 2024; MondaI, Zhang, Kabir, Ni & Dai, 2023). All of these studies found that NMT outperformed SMT in most aspects such as fluency, adequacy, and contextual accuracy. However, NMT is still struggling with idioms, cultural adaptation, and domain specificity. On the other hand, SMT sometimes provided more precise terminology in specialized contexts, can still be competitive in low-resource or closely related languages.

While studies on Asian and European languages established general trends, research on Arabic presents unique challenges due to its diglossia, morphology, and cultural specificity. Numerous studies compared SMT and NMT in the translation of Arabic and found that NMT consistently outperformed SMT in lexical choice and sentence flow and produced more fluent and natural Arabic sentences in WikiHow articles translated from English into Arabic, whereas SMT often generated rigid, literal renderings. NMT occasionally introduced semantic distortions, showing that fluency gains did not always align with accuracy. Both NMT and SMT systems struggled with idiomatic expressions and culturally specific references (Diab, 2021; Diab, 2022). NMT offered better readability but required careful post-editing to ensure semantic fidelity.

Further comparisons indicated that NMT errors were more subtle, often involving pragmatic misinterpretation or over-generalization, whereas SMT errors were dominated by literal mistranslations and structural rigidity (Sismat, 2020). NMT could handle dialectal variation and non-standard orthography (Arabizi) more effectively than SMT, producing more coherent translations. However, both systems struggled with informal expressions and code-switching common in Arabizi texts (Guellil, Azouaou & Abbas, 2017). NMT achieved better alignment consistency, but SMT sometimes provided more precise lexical matches in technical contexts. Hybrid approaches could leverage the strengths of both systems (Berrichi & Mazroui (2022). Effective preprocessing (tokenization, normalization, segmentation) significantly improved Arabic–English translation quality in NMT and SMT. NMT benefited more from preprocessing, producing smoother translations, but still struggles with morphologically rich Arabic structures compared to SMT (Oudah, Almahairi & Habash, 2019).

Additionally, Al-Abbas, Khalaf, Alali & Alqaryouti (2025) compared GT's translations from the SMT era with its current NMT. Results demonstrated clear improvement in accuracy and fluency and a marked reduction in lexical and syntactic errors in NMT compared to SMT. However, NMT still required human post-editing for high-stakes texts, especially in idiomatic expressions and

[1] Google Translate - Wikipedia

sentence structure. Persistent issues remained in cultural adaptation and pragmatic accuracy, with NMT sometimes producing fluent but semantically misleading translations.

Most of the studies on Asian, European and Arabic languages, in the above review, focused on comparing two languages only. Only Volkart et al. (2018) compared German with French and Italian and Speerstra (2018) compared English, French, Dutch, and German. Only one study compared GT's translation output as an SMT with that as an NMT in Arabic. There is a lack of studies that compared GT's output as an SMT and NMT in the translation of Arabic to 3 European (Hungarian, German and Spanish) and 2 non-European languages (Turkish and Japanese). Therefore, this study aims to: (i) compare the translation of a selected sample of texts some European languages into English, and into Arabic using GT when it was an SMT in 2012 with GT's translation as an NMT in 2025; (ii) evaluate accuracy in semantic, and syntactic and lexical aspects of the 2012 translations with those of 2025; (iii) shed light on the linguistic and technical reasons for the strengths and weaknesses of NMT and SMT translations; (iv) recommend improvements in MT to and from Arabic.

This study is using the same 6 texts, same systems (GT), and same scoring criteria (holistic evaluations) that were used in an article conducted in 2012 on the use of GT as an SMT in the translation of the same 5 languages to English and to Arabic.

Most existing studies in the literature compared AI systems now as GT vs DeepL vs ChatGPT, but they do not show how far we have come or what limitations persist. Few studies use identical texts from the past to test longitudinal progress. The author's 2012 study gives a rare, controlled sample. The pivot-to-direct shift (SMT → NMT) is often discussed in theory, but rarely tested with real examples across multiple languages and domains. Arabic is underrepresented in longitudinal MT studies. But this study focuses on Arabic–European and Arabic non-European pairs. It extends prior studies by comparing translations of GT as an NMT, not just in one language pair, but across 5 European and non-European languages into both English and Arabic, using 6 identical texts and scoring criteria across a thirteen-year span 2012 & 2025. This design fills a gap in the literature, since most prior studies compared only two languages, and only one study (Al Abbas et al., 2025) directly examined GT as SMT versus NMT translation outputs in Arabic. By documenting Arabic's leap from incoherence in 2012 to near parity with English in 2025, the current study is providing rare longitudinal evidence across multiple language pairs.

In addition, focusing only on GT as a translation tool is powerful, as GT is the only system with a long public record which has transitioned from an SMT to an NMT, so the 2012 and 2025 translation outputs can be directly compared across languages. Students, translators and researchers will not be distracted by multiple systems; they can focus on a clear past and present comparison. There is a historical value because GT was the dominant translation tool in 2012, and it is still widely used today. That makes the comparison in the current study both representative and impactful. Students and teachers still rely on GT, so findings of the current study have immediate classroom implications.

Moreover, this study is significant because it constitutes an addition to a series of studies by the author on the use of AI in translation and education such as: electronic translation between Arabic and European languages (Al-Jarf, 2012); Gaza–Israel war terminology (Al Jarf, 2025b); grammatical terms used metaphorically (Al Jarf, 2025h); zero expressions (Al Jarf, 2025q); Arabic *abu* brand names (Al Jarf, 2025e); denotative and metonymic abu- and umm- animal and plant folk names (Al Jarf, 2025g); folk medical terms with *om* and *abu* (Al Jarf, 2025o); medical terms (Al Jarf, 2024b); technical terms (Al Jarf, 2021; Al Jarf, 2016a); human and AI expressions of impossibility (Al Jarf, 2025m); human vs AI translation of chemical compound names (Al Jarf, 2025i); educational polysemes in AI translation of Arabic research articles (Al Jarf, 2025a); Arabic transliteration of borrowed English nouns with /g/ (Al Jarf, 2025c); pronunciation errors in Arabic YouTube videos (Al Jarf, 2025f; Al Jarf, 2025j; Al Jarf, 2025k); editors' perspectives on the publication of AI-generated research articles (Al Jarf, 2025m); Arab instructors' views on AI-generated student assignments (Al Jarf, 2024a); encrypted Arabic on Facebook and YouTube (Al Jarf, 2025d); "sleep" terms (Al Jarf, 2025p); specific linguistic questions that Artificial Intelligence cannot answer accurately (Al-Jarf, 2025l). Together, these studies illustrate recurring weaknesses in AI's handling of linguistic, cultural, and scholarly tasks, reinforcing the diagnostic framework adopted in this paper.

2. Google Translate as SMT and NMT[2]

In April 2006, Google Translate (GT) was launched as a statistical machine translation (SMT) service. It originally used European Parliament and United Nations documents and transcripts to gather linguistic data. It relied heavily on vast bilingual corpora, phrase-based alignment, and translation memories. Rather than translating languages directly, it first translated the text to English and then pivoted to the target language (TL). During a translation, it looked for patterns in millions of documents to help decide which words to choose and how to arrange them in the TL. In 2012, GT provided instant MT for any website or webpage (such as newspaper articles) and any text between 57 languages, including Arabic, English, German, French, Hungarian, Albanian,

[2] https://en.wikipedia.org/wiki/Google_Translate

Bosnian, Slovenian, Finnish, Norwegian, Swedish, Danish, and others. Users could obtain instant translations of words, phrases, sentences, long texts, and even entire web pages. As an SMT system, its translation outputs were often fragmented, literal, and syntactically distorted, particularly when translating into Arabic. The system struggled with morphology, word order, and idiomatic expressions, producing translations that were intelligible only at a surface level, and often incoherent in discourse.

In November 2016, GT transitioned to a neural machine translation (NMT) architecture, produced more fluent sentence flow, and coherent alignment across many language pairs. As a NMT system, GT can perform direct translation between languages without pivoting through English, reducing compounded errors. The shift from SMT to NMT has improved surface coherence and readability, but semantic depth and contextual reasoning remain unresolved challenges. In 2025, GT supports 249 languages and varieties, producing translations that are more fluent than those of the SMT era.

3. Methodology:

3.1 Data Collection

This study is a follow-up of a study that the author presented at a conference in 2012, with GT's translations when GT operated as an SMT system. The 2012 study used a sample of 6 texts in five languages (Hungarian, German, Spanish, Turkish, Japanese) translated into English and Arabic, and evaluated for accuracy, fluency, and cultural adaptation. The 2012 study sample included short formal announcements, academic emails, institutional names, and medium-length paragraphs in Spanish, German, Turkish, and Japanese.

In the current study, the same sample of 6 texts in the same 5 languages are re-translated in 2025, when GT is functioning as an NMT system, allowing for direct longitudinal comparison. The 2012 texts were used verbatim, including punctuation and parentheticals. The Hungarian text is 8 words, German text 1 (32 words), German Text 2 (84 words), Spanish (215 words), Turkish (65 words) and Japanese (353 characters). In 2012, the 5 languages were chosen because the author received them by email. They represent diverse linguistic families and structures, allowing for direct longitudinal comparison. The texts represent a variety of academic, cultural, institutional, and personal communication contexts and have a variety of themes: institutional names (Hungarian sample); seasonal greetings and professional correspondence (German samples), conference announcements and literary translation discourse (Spanish sample); academic emails with metaphorical language (Turkish sample); and hotel reviews and narrative descriptions (Japanese sample). This topic diversity ensures coverage of formal, informal, technical, and narrative domains, testing GT's ability to handle different registers and cultural contexts.

One German text retrieved from the author's 2012 conference folder did not include the Arabic translation from that year. For transparency, this text was retained in the corpus, with analysis limited to the English translations in 2012 but both English and Arabic translations are included in 2025. This decision reflects the study's commitment to using authentic archival material rather than reconstructed data.

3.2 *Data Analysis*

Each source text in the 5 languages (Hungarian, German, Spanish, Turkish, Japanese) was translated by GT in 2012 when GT was an SMT and again in 2025 when GT is currently an NMT. The following pairing strategies were used: Hungarian-English, German-English, Spanish-English, Turkish-English, Japanese-English and Hungarian-Arabic, German-Arabic, Spanish-Arabic, Turkish-Arabic, Japanese-Arabic.

For each text and each language, errors in the English and Arabic translations were identified and compared for the same year and across the two years. Holistic judgments were made for the 2012 (SMT) vs 2025 (NMT) translation in terms of intelligibility, fluency, accuracy and, literalism, hallucination, mis-transliteration, omission, semantic, contextual, lexical and grammatical/ syntactic correctness especially word order, translation of figurative meaning, domain shift, register mismatch, cultural terms, and domain terminology. Results of the analysis are reported qualitatively.

The 2012 SMT translations are reported only as a baseline, since SMT is no longer in use in mainstream MT systems. A detailed error analysis of SMT translations is not the focus of this study, as that era has passed. Instead, the emphasis is placed on the quality of GT's current NMT translations (2025), which demonstrate significant progress in fluency, accuracy, and usability. The longitudinal comparison highlights how far GT has evolved, while also identifying persistent challenges in idiomatic and culturally specific translation. Thus, there is no need to re-analyze every error in the old translations.

For reliability purposes, two colleagues specialized in translation and linguistics evaluated the English and Arabic translations. They went through the translations for 2012 and 2025 and made holistic judgments regarding legibility, fluency, accuracy and correctness. Classifications by all three evaluators were compared. There was a 98% agreement between the evaluators. Disagreements were resolved by discussion.

4. Results

4.1 GT translation in 2012 (SMT era)

Results of the analysis of the translation of the 6 texts by GT in 2012 and 2025 (the NMT era) from Hungarian, German, Spanish, Turkish and Japanese (ST) to English and Arabic (TT) are presents in Tables 1 to 6. The holistic translation analysis revealed that in 2012, during the (SMT) era, GT performance varied sharply depending on the source and the target languages. For translation from European languages to English (The Hungarian-English, German-English, Spanish-English), the English translations were somewhat intelligible, though a bit awkward and clumsy. The translations often preserved the literal meaning but failed to capture idiomatic nuance, producing sentences with broken syntax and robotic phrasing. Institutional names were rendered in a serviceable but unpolished way, and common expressions such as "season's greetings" were mistranslated into unnatural constructions. By contrast, translations from non-European languages (Turkish-English and Japanese-English) were far more problematic. The Turkish-English translation was riddled with broken syntax and mistranslated metaphors, while the Japanese-English hotel review collapsed into incoherence, with nonsensical phrases like "Carousing" appearing in place of meaningful content. Overall, European-to-English translations were awkward but usable, whereas non-European-to-English translations were distorted and largely unintelligible.

Regarding Arabic translations in 2012, across both European and non-European source texts (ST), the Hungarian-Arabic, German-Arabic, Spanish-Arabic, & Turkish-Arabic and Japanese-Arabic translations were incoherent, fragmented, and riddled with jumbled word order. Hungarian into Arabic produced garbled fragments, German into Arabic yielded nonsensical constructions, and Spanish into Arabic was literal but clumsy, with distorted word order. The Turkish and Japanese texts were especially unreadable, with mistranslated idioms and incoherent phrasing that rendered the texts unusable. Compared to English, Arabic translations suffered from even poorer fluency and accuracy, showing that the SMT system struggled to handle Arabic's syntax and morphology. In effect, while English translations were marginally serviceable, Arabic translations failed almost entirely, reflecting the limitations of SMT's reliance on stored translation units and statistical memory rather than contextual understanding.

4.2 GT translation in 2025 (NMT era)

Tables 1 to 6 show that in 2025 and with the advent of neural machine translation (NMT), the picture changed dramatically. Translations from both European (Hungarian, German, Spanish) and non-European (Turkish, Japanese) languages into English became fluent, natural, and contextually accurate. Institutional names were correctly rendered, professional correspondence flowed smoothly, and idiomatic expressions were handled with greater sensitivity. Even complex narrative texts, such as the Japanese hotel review, were translated coherently into English, preserving both meaning and tone. Turkish metaphors, that were distorted in 2012, were now intelligible and appropriately contextualized. The leap in quality was equally striking for Arabic. Unlike the incoherent translations of 2012, the Hungarian-Arabic, German-Arabic, Spanish-Arabic, Turkish-Arabic, Japanese-Arabic translations in 2025 were fluent, accurate, and stylistically natural. Syntax and word order were preserved, institutional names correctly rendered, and professional correspondence conveyed with clarity. The Japanese hotel review, once garbled, was now intelligible in Arabic, and Turkish metaphors were translated coherently. In short, Arabic translations moved from unreadable to nearly flawless, matching English in fluency and reliability. The translation quality from Hungarian, German, Spanish, Turkish, Japanese to English and Arabic were of comparable accuracy and fluency.

The comparison between English and Arabic translations highlights the trajectory of improvement. In 2012, English translations were slightly clearer, though awkward, while Arabic translations were completely unintelligible due to severe syntactic, and semantic distortions. By 2025, both English and Arabic translations were equally fluent, readable, coherent, and contextually accurate. The gap between the two languages closed, with Arabic achieving parity with English in terms of usability and intelligibility. This longitudinal progress demonstrates the evolution of GT from rigid SMT translations to fluent NMT translations. It also underscores Arabic's leap forward: from unintelligible in 2012 to nearly flawless in 2025. While minor issues remain, particularly in figurative language and cultural idioms, the overall quality of the translation is excellent. GT has thus evolved into a reliable tool for everyday translation tasks, offering pedagogical value for students, instructors, researchers, and general users though human oversight is still necessary for idiomatic nuance and specialized domains.

Table 1: Hungarian-English & Hungarian-Arabic Translations by Google Translate in 2012 & 2025

2012 Translation		
Hungarian ST	**Hungarian-English Translation**	**Hungarian-Arabic Transa;tion**
Zánkai Gyermek és Ifjúsági Centrum Nonprofit Közhasznú Kft	Zánka Children and Youth Centre Non Profit Company	الأطفال والشباب Zánka شركة المركز الخيرية
2025 Translation		
Zánkai Gyermek és Ifjúsági Centrum Nonprofit Közhasznú Kft	Zánka Children and Youth Center Nonprofit Public Benefit Ltd.	مركز زانكا للأطفال والشباب، مؤسسة غير ربحية ذات منفعة عامة محدودة.

Table 2: German-English and German-Arabic Translation by Google Translate in 2012 & 2025 (Text 1)

Translation In 2012		
German ST	**German-English Translation**	**German-Arabic Translation**
höchste Zeit, die jährlich anfallenden season's greetings zu übermitteln. Mit anderen Worten, wir möchten Ihnen angenehme und erholsame Feiertage und ein erfolgreiches und glückliches neues Jahr (2010, man kann's kaum fassen) wünschen.	it's time to send season's greetings incurred annually. In other words, we wish you pleasant and relaxing holiday season and a prosperous and happy new year *(2010, one can hardly grasp it)* want.	**زملاء،** إن الوقت قد حان لإرسال تحيات الموسم تكدها سنويا .وبعبارة أخرى، نتمنى الحب والاسترخاء موسم الأعياد والسنة الجديدة مزدهرة وسعيدة .(2010) يمكن للمرء فهم يردون.
Translation In 2025		
höchste Zeit, die jährlich anfallenden season's greetings zu übermitteln. Mit anderen Worten, wir möchten Ihnen angenehme und erholsame Feiertage und ein erfolgreiches und glückliches neues Jahr (2010, man kann's kaum fassen) wünschen.	It's high time to send our annual seasonal greetings. In other words, we wish you pleasant and relaxing holidays and a successful and happy new year (2010, hard to believe!).	حان الوقت لنرسل لكم تحياتنا السنوية بمناسبة الأعياد. بعبارة أخرى، نتمنى لكم عطلات ممتعة ومريحة وعاماً جديداً سعيداً وناجحاً (2010، من الصعب تصديق ذلك!).

Table 3: German-English and German-Arabic Translation by Google Translate in 2012 & 2025 (Text 2)

2012 Translation		
German ST	**German-English Translation**	**German-Arabic Translation**
Liebe Kollegen, höchste Zeit, die jährlich anfallenden season's greetings zu übermitteln. Mit anderen Worten, wir möchten Ihnen angenehmen und erholsame Feiertage und ein erfolgreiches und glückliches neues Jahr (2010, man kann's kaum fassen) wünschen. Vor allem möchten wir uns bei all denjenigen bedanken, die so kooperativ unsere deadlines nicht als leeren Wahn interpretiert haben. Diejenigen, die aus den unterschiedlichsten Gründen ihre Beitäge noch nicht abgeliefert haben, möchten wir jedoch daran erinnern, dass es so etwas wie Redaktionsschluss gibt. Mit den allerbesten (jahreszeitlich angemessenen cf. supra) Grüßen Elke & Theo	Ladies and gentlemen, it's time to send season's greetings to be generated annually. In other words, we wish you a pleasant and relaxing holidays and a prosperous and happy new year (2010's one can hardly wish to take). Above all, we want to thank all those who have not so cooperative, our deadlines interpreted as an empty illusion. Those who have not yet been delivered from a variety of reasons their Beitäge, we want to recall, however, that there is no such thing as press deadline. With the very best (Seasonally appropriate cf. supra) Regards Elke & Theo	Not Available

2025 Translation		
Liebe Kollegen, höchste Zeit, die jährlich anfallenden season's greetings zu übermitteln. Mit anderen Worten, wir möchten Ihnen angenehmen und erholsame Feiertage und ein erfolgreiches und glückliches neues Jahr (2010, man kann's kaum fassen) wünschen. Vor allem möchten wir uns bei all denjenigen bedanken, die so kooperativ unsere deadlines nicht als leeren Wahn interpretiert haben. Diejenigen, die aus den unterschiedlichsten Gründen ihre Beitäge noch nicht abgeliefert haben, möchten wir jedoch daran erinnern, dass es so etwas wie Redaktionsschluss gibt. Mit den allerbesten (jahreszeitlich angemessenen cf. supra) Grüßen Elke & Theo	Dear colleagues, it's high time to send our annual seasonal greetings. In other words, we wish you pleasant and relaxing holidays and a successful and happy new year (2010, hard to believe!). Above all, we would like to thank all those who so cooperatively didn't dismiss our deadlines as meaningless. However, to those who, for whatever reason, haven't yet submitted their contributions, we would like to remind you that there is such a thing as a deadline. With best regards (seasonally appropriate, see above), Elke & Theo	زملائنا الأعزاء، حان الوقت لنرسل لكم تحياتنا السنوية بمناسبة الأعياد. بعبارة أخرى، نتمنى لكم عطلات سعيدة ومريحة، وعامًا جديدًا مليئًا بالنجاح والسعادة (2010، يصعب تصديق ذلك!). قبل كل شيء، نود أن نشكر كل من تعاون معنا ولم يستهن بمواعيد التسليم. مع ذلك، لمن لم يقدموا مساهماتهم بعد، لأي سبب كان، نود تذكيركم بأن هناك موعدًا نهائيًا. مع أطيب التحيات (مناسبة للموسم، انظر أعلاه)، إلكي وثيو

Table 4 Spanish-English & Spanish-Arabic translations by Google Translate in 2012 & 2025

2012 Translation		
Spanish ST	**Spanish-English Translation**	**Spanish-Arabic Translation**
Traducción y traductores en América Latina En 2011 se celebrará en México la vigésima edición del Encuentro Internacional de Traductores Literarios. Veinte años, a lo largo de los cuales, traductores de México y del mundo hemos intercambiado experiencias y conocimientos, para plantear y valorar problemas de la traducción literaria. Así, hemos podido apreciar las grandes diferencias y similitudes que viven los traductores literarios. En el curso de su historia, nuestro encuentro ha experimentado dos cambios sustanciales: de un evento al que se invitaba personalmente a traductores de renombre, pasó a ser un coloquio en el que se participa también por convocatoria; del mismo modo, nuestras mesas, hasta hace algunos años dedicadas casi exclusivamente a la práctica de la traducción literaria, se han convertido en un espacio en el que intervienen también estudiantes, formadores e investigadores.	Translation and translators in Latin America In 2011 Mexico will be held in the twentieth edition of the International Literary Translators. Twenty years, during which, translators of Mexico and the world have exchanged experiences and knowledge, to propose and evaluate problems of literary translation. Thus, we have seen the major differences and similarities living literary translators. In the course of its history, our meeting has undergone two major changes: of an event that was personally invited renowned translators, it became a conference which also participates call, the same way, our tables, until recently almost exclusively devoted to the practice of literary translation, is have become a space where students are also involved, trainers and researchers. This year the meeting will be devoted to translation and research in Latin America. Our continent has many excellent Spanish translators and the	الترجمة والمترجمين في أمريكا اللاتينية وفي عام 2011 سوف يعقد المكسيك في الطبعة العشرين من المترجمين الأدبية الدولية .عشرين عاما ، خلالها ، وتبادل المترجمين من المكسيك والعالم الخبرات والمعارف ، واقتراح وتقييم مشاكل في الترجمة الأدبية .وهكذا ، شهدنا اختلافات كبيرة والتشابه المترجمين الذين يعيشون الأدبية .في سياق تاريخها ، شهدت اجتماعنا تغييرين رئيسيين : حدث أن دعيت شخصيا المترجمين الشهير ، بعد أن أصبح المؤتمر الذي يشارك أيضا الدعوة ، وبنفس الطريقة ، وجداول لدينا ، حتى وقت قريب تقريبا المكرسة حصرا لممارسة الترجمة الأدبية ، هو أصبحت الفضاء حيث تشارك أيضا الطلاب والمدربين والباحثين . وهذا العام ستخصص الجلسة الترجمة والبحوث في أمريكا اللاتينية .القارة لديها العديد من المترجمين الاسبانية الممتازة والبحوث الميدانية تكتسب مزيدا من التطوير .لذلك ، قررنا اتخاذ هذه الطبعة العشرين لتشكيل جمعية الأمريكية لدراسة الترجمة والترجمة الفورية (ALAETI) ، تهدف إلى جمع الباحثين والمدرسين من أعمال الترجمة في مختلف الجامعات في البلاد والقارة .

Este año el encuentro estará dedicado a la traducción y a la investigación en América Latina. Nuestro continente cuenta con numerosos y excelentes traductores al español y el campo de la investigación está teniendo cada vez Mayor desarrollo. Por ello, hemos decidido aprovechar esta vigésima edición para constituir la Asociación Latinoamericana de Estudios de Traducción e Interpretación (ALAETI), destinada a agrupar a los investigadores y docentes de la traducción que trabajan en distintos centros universitarios del país y del continente.	research field is gaining further development. Therefore, we decided to take this twentieth edition to form the American Association for the Study of Translation and Interpretation (ALAETI), aimed at bringing together researchers and teachers of translation work in various universities in the country and continent.	
2025 Translation		
Traducción y traductores en América Latina En 2011 se celebrará en México la vigésima edición del Encuentro Internacional de Traductores Literarios. Veinte años, a lo largo de los cuales, traductores de México y del mundo hemos intercambiado experiencias y conocimientos, para plantear y valorar problemas de la traducción literaria. Así, hemos podido apreciar las grandes diferencias y similitudes que viven los traductores literarios. En el curso de su historia, nuestro encuentro ha experimentado dos cambios sustanciales: de un evento al que se invitaba personalmente a traductores de renombre, pasó a ser un coloquio en el que se participa también por convocatoria; del mismo modo, nuestras mesas, hasta hace algunos años dedicadas casi exclusivamente a la práctica de la traducción literaria, se han convertido en un espacio en el que intervienen también estudiantes, formadores e investigadores. Este año el encuentro estará dedicado a la traducción y a la investigación en América Latina. Nuestro continente cuenta con numerosos y excelentes traductores al español y el campo de la investigación está teniendo cada vez Mayor desarrollo. Por ello, hemos decidido aprovechar esta vigésima edición para constituir la Asociación Latinoamericana de Estudios de Traducción e Interpretación (ALAETI),	Translation and Translators in Latin America In 2011, Mexico will host the twentieth edition of the International Meeting of Literary Translators. For twenty years, translators from Mexico and around the world have exchanged experiences and knowledge, raising and evaluating issues in literary translation. In doing so, we have been able to appreciate the significant differences and similarities experienced by literary translators. Throughout its history, our meeting has undergone two substantial changes: from an event to which renowned translators were personally invited, it has become a colloquium with open invitations; similarly, our panels, until a few years ago dedicated almost exclusively to the practice of literary translation, have become a forum that also includes students, educators, and researchers. This year, the meeting will be dedicated to translation and research in Latin America. Our continent boasts numerous excellent translators into Spanish, and the field of research is experiencing increasing development. Therefore, we have decided to take advantage of this twentieth edition to establish the Latin American Association of Translation and Interpreting Studies (ALAETI), intended to bring together translation researchers and teachers working in different university centers in the	الترجمة والمترجمون في أمريكا اللاتينية في عام ٢٠١١، استضافت المكسيك الدورة العشرين للاجتماع الدولي للمترجمين الأدبيين. على مدار عشرين عامًا، تبادل المترجمون من المكسيك ومختلف أنحاء العالم الخبرات والمعارف، وناقشوا قضايا الترجمة الأدبية وقيموها. ومن خلال ذلك، تمكّنا من تقدير أوجه الاختلاف والتشابه الجوهرية التي يواجهها المترجمون الأدبيون. وعلى مرّ تاريخه، شهد اجتماعنا تغييرين رئيسيين: من فعالية تُوجّه إليها دعوات شخصية للمترجمين المرموقين، أصبح ندوة مفتوحة للجميع؛ كذلك، تحوّلت جلساتنا، التي كانت حتى سنوات قليلة مضت مخصصة بشكل شبه حصري لممارسة الترجمة الأدبية، إلى منتدى يضمّ أيضًا الطلاب والمعلمين والباحثين. هذا العام، سيُخصّص الاجتماع للترجمة والبحث في أمريكا اللاتينية. تزخر قارتنا بالعديد من المترجمين المتميزين إلى الإسبانية، ويشهد مجال البحث تطورًا متزايدًا. لذلك، قررنا الاستفادة من هذه الدورة العشرين لإنشاء الرابطة اللاتينية الأمريكية لدراسات الترجمة والترجمة الفورية (ALAETI)، والتي تهدف إلى الجمع بين باحثي الترجمة والمعلمين العاملين في مراكز جامعية مختلفة في البلاد والقارة.	

destinada a agrupar a los investigadores y docentes de la traducción que trabajan en distintos centros universitarios del país y del continente.	country and the continent.	

Table 5: Turkish-English & Turkish Arabic translations by Google Translate in 2012 & 2025

2012 Translation		
Turkish ST	**Turkish-English Translation**	**Turkish-Arabic Translation**
gili Arastirmaci Arkadaslar, Bu calismanin amaclari acikca belirtilmedigi icin size yanit veremiyorum. Ancak, bu arada sunu sormadan da edemiyorum: acik uclu cevap beklediginiz bir arastirmada neden benim seceneklerim bes "metafor"la sinirli? Ben universite icin, "ticarethane", "tarla", "oyun bahcesi" ya da "yolculuk" metaforlarini da kullanabilirim. Calismalarinizin kredibilitesi icin katlimcilarin ayrintili olarak bilgilendirilmesi gerektigine inanan bir arastirmaci olarak bu konuyu gundeme getirmek istedim. Basari dileklerimle, Yasemin Alptekin	The researcher Dear Friends, For the purposes of this study specifically stated clearly to you I can not answer. However, by the way the presentation without asking I can not: open a research study, expect to respond to triple why my five options "metaphor" la frustrated? I to university, "trading", "field", "garden game" or "travel" or can I use metaphors. For the credibility of your work katlimcilarin believes should be informed in detail as a researcher wanted to bring this issue agenda. Successfully yours, Yasemin Alptekin	الباحث أيها الأصدقاء ، لأغراض هذه الدراسة وذكر على وجه التحديد بوضوح لك لا أستطيع الإجابة. ومع ذلك ، طريقة العرض دون طلب لا أستطيع : فتح دراسة بحثية ، ويتوقع أن تستجيب إلى ثلاثة أضعاف لماذا بلادي خمسة خيارات "استعارة" لا بالاحباط؟ أنا للجامعة ، "التداول" ، "الميدان" ، "لعبة حديقة" أو "السفر" أو يمكن أن استخدام الاستعارات. بالنسبة لمصداقية katlimcilarin عملك ويعتقد أن يكون على علم بالتفصيل كما أراد الباحث لتحقيق هذه الأجندة المسألة. لك بنجاح ، ياسمين Alptekin
2025 Translation		
gili Arastirmaci Arkadaslar, Bu calismanin amaclari acikca belirtilmedigi icin size yanit veremiyorum. Ancak, bu arada sunu sormadan da edemiyorum: acik uclu cevap beklediginiz bir arastirmada neden benim seceneklerim bes "metafor"la sinirli? Ben universite icin, "ticarethane", "tarla", "oyun bahcesi" ya da "yolculuk" metaforlarini da kullanabilirim. Calismalarinizin kredibilitesi icin katlimcilarin ayrintili olarak bilgilendirilmesi gerektigine inanan bir arastirmaci olarak bu konuyu gundeme getirmek istedim. Basari dileklerimle, Yasemin Alptekin	Dear Researcher Friends, I cannot respond to you because the aims of this study are not clearly stated. However, I can't help but ask: why are my options limited to five "metaphors" in a study where you expect open-ended answers? I could also use the metaphors "business," "field," "playground," or "journey" for the university. As a researcher who believes that participants need to be informed in detail for the credibility of your studies, I wanted to bring this issue to your attention. Best regards, Yasemin Alptekin	أصدقائي الباحثين الأعزاء، لا أستطيع الرد عليكم لعدم وضوح أهداف هذه الدراسة. مع ذلك، لا يسعني إلا أن أتساءل: لماذا تقتصر خياراتي على خمسة "استعارات" فقط في دراسة تتوقعون فيها إجابات مفتوحة؟ كان بإمكاني استخدام استعارات مثل "الأعمال" و"المجال" و"الملعب" و"الرحلة" للإشارة إلى الجامعة. بصفتي باحثة أؤمن بضرورة إطلاع المشاركين على كافة التفاصيل لضمان مصداقية دراساتكم، أردتُ لفت انتباهكم إلى هذه المسألة. مع خالص التحيات، ياسمين ألب تكين

Table 6 Japanese-English & Japanese-Arabic translations by Google Translate in 2012 & 2025

2012 Translation		
Japanese ST	**Japanese-English Translation**	**Japanese-Arabic Translation**
私が宿泊した部屋の近くに、部屋の外まで聞こえるほどの 大騒ぎをしている、グループのお客様がいました。 騒ぎは私の部屋の中まで聞こえてきて、23時を過ぎても収まりませんでした。 フロントの方にその旨を伝えると、フロントの方はすぐに駆けつけてくださり、 騒いでいたグループに注意をしてくれました。 その後は静かに夜を過ごせました。 こういった、常識のない方も泊まられるホテルであることは 非常に残念ですが、フロントの方の対応は、 迅速で素晴らしかったと思います。 また、部屋から奇麗な景色を見ることを 楽しみにしている方は、事前に確認を取っておいた方がいいと思います。 私の部屋からの景色は、お隣の建物に隠れてあまり見えませんでした。 ちなみに、お手洗いは、流れが悪かったです。 トイレットペーパーが、ちゃんと流れてくれませんでした・・・	I stayed close to the room, out of the room you hear about Carousing, were customers of the group. Commotion was heard coming up in my room, did not fit well past 23:00. That effect and I tell the front, who immediately rushed to you for the front, Attention to the group and gave the fuss was. 過 Gosemashita a quiet night then. These can be a hotel room rates are even more dumb I very sorry, for better support front, I think fast and great. Also, to see beautiful scenery from the room I look forward to that, I think it is better to check beforehand aside. The view from my room was seen hiding in the building next door too. Incidentally, the restroom is a bad trend. Toilet paper could give me fine flow Stayed June 2011, traveled solo	بقيت على مقربة من الغرفة ، والخروج من الغرفة سمعت عن يسرف ، كان عملاء المجموعة. لم سمع ضجة القادمة في غرفتي ، لا يصلح 23:00 الماضي جيدا. وبهذا المعنى أقول الجبهة ، الذين هرعوا على الفور للكم على الجبهة ، والانتباه إلى مجموعة وأعطى ضجة. Gosemashita 过 ليلة هادئة بعد ذلك. يمكن لهذه أن تكون أسعار الغرف الفندقية ، بل هي أكثر البكم أنا آسف جدا ، ودعم أفضل للجبهة ، أعتقد سريع وكبير. أيضا ، لرؤية المناظر الخلابة من الغرفة وإنني أتطلع إلى ذلك ، أعتقد أنه من الأفضل أن الاختيار مسبقا جانبا. كان ينظر إلى وجهة نظر من غرفتي يختبئون في المبنى المجاور للغاية. وبالمناسبة ، فإن الحمام هو الاتجاه السيئ. يمكن ورق التواليت تعطيني تدفق غرامة بقي يونيو 2011 ، سافر منفردا
2025 Translation		
私が宿泊した部屋の近くに、部屋の外まで聞こえるほどの 大騒ぎをしている、グループのお客様がいました。 騒ぎは私の部屋の中まで聞こえてきて、23時を過ぎても収まりませんでした。 フロントの方にその旨を伝えると、フロントの方はすぐに駆けつけてくださり、	Near the room where I was staying, there was a group of guests making so	بالقرب من غرفتي، كانت هناك مجموعة من النزلاء يُصدرون ضجيجًا عاليًا لدرجة أنه

騒いでいたグループに注意をしてくれました。 その後は静かに夜を過ごせました。 こういった、常識のない方も泊まられるホテルであることは 非常に残念ですが、フロントの方の対応は、 迅速で素晴らしかったと思います。 また、部屋から奇麗な景色を見ることを 楽しみにしている方は、事前に確認を取っておいた方がいいと思います。 私の部屋からの景色は、お隣の建物に隠れてあまり見えませんでした。 ちなみに、お手洗いは、流れが悪かったです。 トイレットペーパーが、ちゃんと流れてくれませんでした・・・	much noise that it could be heard outside. The noise could be heard into my room and didn't die down even after 11pm. When I told the front desk, someone came quickly and reprimanded the noisy group. I was able to spend the rest of the night in peace. It's a shame that this hotel accepts such unreasonable people, but I thought the front desk staff's response was quick and excellent. Also, if you're looking forward to enjoying a beautiful view from your room, I recommend checking in advance. The view from my room was obscured by the building next door. By the way, the bathroom didn't flush well. The toilet paper wouldn't flush properly...	كان يُسمع في الخارج. وصل الضجيج إلى غرفتي ولم يهدأ حتى بعد الساعة الحادية عشرة مساءً. عندما أبلغت مكتب الاستقبال، حضر أحدهم بسرعة ووبّخ المجموعة المُزعجة. تمكنتُ من قضاء بقية الليلة في هدوء. من المؤسف أن يقبل هذا الفندق أشخاصًا غير مُبالين، لكنني أعتقد أن استجابة موظفي الاستقبال كانت سريعة وممتازة. أيضًا، إذا كنت تتطلع إلى الاستمتاع بإطلالة جميلة من غرفتك، أنصحك بالتحقق مُسبقًا. كانت الإطلالة من غرفتي محجوبة بالمبنى المجاور. بالمناسبة، لم يكن المرحاض يعمل بشكل جيد. لم يكن ورق التواليت يُشطف بشكل صحيح...

5. Discussion

5.1 Comparison with prior studies

The current study found that GT's translation of the same 6 text from Hungarian, German, Spanish, Turkish and Japanese to English and Arabic as an NMT in 2025 outperformed GT's translation as an SMT in 2012. The current Findings are consistent with findings of prior studies across Asian and European language pairs which found that NMT surpasses SMT in translation fluency, accuracy, adequacy, and contextual alignment, while remaining fragile with idioms, cultural adaptation, and domain-specific terminology (Kumar et al., 2021; Ramesh et al., 2021; Suryawanshi et al., 2024; Yousofi & Bhattacharyya, 2024; Madayenzadeh & Alizadeh, 2017; Wu et al. (2025); Mondal et al., 2023; Bentivogli, Fornaciari & Pianta, 2016; Matos Veliz, De Clercq & Hoste, 2021; Sabolová, Ripel & Hrebeňár, 2021; Stasimioti et al. (2020); Al Zebary, 2012; Volkart, Bouillon & Girletti, 2018; Speerstra, 2018; El Maazouzi, El Mohajir & Al Achhab, 2017; Rojas Plata & Castro Sánchez, 2024; Mondal et al., 2023). NMT systems in these studies consistently produced smoother and more natural sentences, though idioms and cultural references remained problematic. SMT occasionally provided more precise terminology in specialized contexts, highlighting its residual value in low-resource or closely related languages. Similar findings were found in prior research on Arabic. NMT consistently outperformed SMT in lexical choice and sentence. NMT errors were subtler, often pragmatic misinterpretations SMT errors were dominated by literal mistranslations and structural rigidity. Both systems struggled with informal expressions and code-switching (Diab, 2021, 2022; Sismat, 2020; Guellil, Azouaou & Abbas, 2017; Berrichi & Mazroui, 2022; Oudah, Almahairi & Habash, 2019; Al Abbas et al., 2025).

Findings of the current study are partially consistent with findings of prior studies by the author between 2024 and 2025 at the discourse level and the technical terms, compounds, and metaphorical expressions level. In translating educational full-text Arabic articles to English, GT's translation sounded natural, used good style and sentence structure, but there were contextual and semantic inaccuracies. GT had difficulty translating education polysemes that have general and specialized meanings and two or more English equivalents as التحكيم والمحكمون & رسالة. GT rendered "*arbitration*" & "*arbitrators*" that are used in a legal context, rather than "*peer reviewing*" & "*reviewers*" used in an educational context. it translated most occurrences of رسالة into "*message*", rather than "*thesis*". GT failed to give conceptual equivalents and those used in a particular domain (Al-Jarf, 2025a).

In translating compound technical terms, idiomatic and metaphorical expressions as medical terminology, Arabic grammatical terms used metaphorically, GT's NMT translations also faltered in specialized domains and persistent weaknesses were revealed. 74.5% of the medical terms (Al-Jarf, 2024b; Al-Jarf, 2024c), 23.5% of the Arabic grammatical terms used metaphorically (Al-Jarf, 2025h), 50% of the zero-expressions (Al-Jarf, 2025p), 23% of the Gaza-Israel terminology (Al-Jarf, 2025b), and gave word-for-word translations (42%), transliterations (44.5%) in decoding and interpreting encrypted Arabic on Facebook and YouTube. GT did not give contextual meaning and failed to decode slang, distortions, satire, or encrypted references (e.g., *Viva 16* for F-16) (Al-Jarf, 2025d). GT often faltered in specialized domains, producing literal renderings or domain-inappropriate equivalents. These findings reinforce the conclusion that NMT's fluency gains do not extend reliably to figurative or specialized language.

Similar results were obtained as from two translation studies when GT was an SMT. GT's translation of a variety of technical terms was characterized by semantic, syntactic, contextual, lexical and transliteration inaccuracies (Al-Jarf, 2021) and Al-Jarf, 2016).

5.2 Why GT translations are better in 2025 than 2012

The superiority of GT 2025 (NMT) over 2012 (SMT) in translating both European and non-European languages into English and Arabic can be explained by differences in the architecture, training, and linguistic modelling of the two systems. In 2012, GT was an SMT which relied on statistical phrase tables and translation memories. It matched segments of source text against stored bilingual units and recombined them according to probability. SMT worked reasonably well for European languages that share structural similarities with English, but it struggled with languages that are typologically distant, such as Turkish, Japanese, and Arabic. SMT could not adequately capture, complex morphology, or flexible word order. As a result, translations were nonsensical, incoherence, with broken syntax, and mistranslated idioms. Even when the literal meaning was partially correct, the translation lacked fluency and naturalness, producing robotic phrasing that required extensive human correction. On the contrary, in 2025, NMT models learn contextual embeddings across massive multilingual corpora. This allows the system to represent meaning at the sentence and discourse level, rather than at the phrase level. NMT can handle flexible word order, and adapt to morphological complexity. For European languages, this means idioms and institutional names are rendered more naturally, while for non-European languages like Turkish and Japanese, sentence flow and pragmatic coherence are preserved in ways SMT could not achieve. The neural system's ability to learn from context also reduces literal mistranslations, producing translations that are both fluent and semantically faithful.

Another reason for the improvement is scale. By 2025, NMT systems have been trained on vastly larger and more diverse datasets than SMT. This breadth of training data enables better handling of words, specialized terminology, and cross-domain variation. NMT also benefits from sub-word segmentation techniques, which allow it to process morphologically rich languages more effectively. by contrast, SMT broke down when confronted with inflected forms or compound structures, leading to fragmented translations.

Moreover, NMT incorporates alignment mechanisms that improve consistency between source and target sentences. Attention layers in the transformer architecture allow the system to "focus" on relevant parts of the source text when generating each target word. This results in smoother sentence structures and more accurate lexical choices. SMT lacked such mechanisms, relying instead on statistical probabilities that often misaligned phrases, especially in typologically distant languages.

Finally, GT's 2025 translations surpass those of 2012 because NMT has replaced SMT's rigid phrase-based memory with context-aware neural modelling. This shift enables the system to capture meaning more holistically, handle diverse language structures, and produce fluent, natural English translations across both European and non-European languages. The improvement reflects not only architectural advances but also the expansion of training data and the refinement of preprocessing techniques, all of which combine to make NMT a far more reliable translation tool than its SMT predecessor.

6. Recommendations and Conclusion

The findings of this study have implications for multiple stakeholders. For students, GT has become a far more reliable translation tool than it was few years ago, yet caution remains essential. While the 2025 translations are fluent and coherent, idioms, metaphorical expressions and culturally specific references still pose translation challenges. Students should therefore treat GT as

a support tool rather than a final authority. They should verify meanings with their instructors, translation professionals, and subject area specialists and pay close attention to context. They can also check the meanings of English and Arabic idioms and metaphorical expressions in general as well as specialized dictionaries (Al-Jarf, 2020); Al-Jarf, 2014a); Al-Jarf, 2014b); Al-Jarf, 2011). This critical engagement not only safeguards accuracy but also enhances their linguistic competence and awareness of translation strategies.

For instructors, being a neural system, GT can be integrate into pedagogy as a practical aid and as an object of critical analysis. Classroom activities can involve comparing GT's translations with human translations, highlighting strengths in fluency and weaknesses in idiomatic accuracy. Such exercises foster digital literacy and help students develop a critical eye toward MT. Instructors should emphasize that GT is not a substitute for professional translation, but rather a resource to be interrogated, thereby cultivating both linguistic skills and critical thinking.

For AI developers, the results highlight both achievements and persistent challenges. The move away from pivot-based translation and the adoption of multilingual embeddings have dramatically improved fluency and coherence, but semantic depth and cultural nuance remain weak. AI developers should work on refining culturally sensitive translation, idiom recognition, and pragmatic interpretation. Incorporating domain-specific corpora, enhancing alignment mechanisms for figurative language, and integrating feedback from professional translators and other users could help bridge the remaining gaps. Attention should also be given to Arabic's morphological richness and diglossic variation, ensuring that GT can handle not only Modern Standard Arabic but also dialectal and informal registers.

At the institutional level, the European Union - particularly the European Translation Agency - could play a significant role in supporting and developing machine translation to and from Arabic. Such initiatives would benefit Arab communities residing in the EU, enabling them to translate texts they wish to access or share and to communicate more effectively with non-Arabic speakers. In addition, a collaborative team of linguists, specialists in Arabic computational technologies and artificial intelligence, and professional Arab translators should review machine translation outputs between European languages and Arabic. The development of a specialized glossary for machine translation, explaining lexical, semantic, morphological, and grammatical uses of words in context, would provide a valuable resource for both developers and users, ensuring greater accuracy and consistency.

For researchers, the longitudinal comparison between SMT and NMT underscores the importance of studying MT diachronically and synchronically. Future research should continue to investigate how NMT handles typologically diverse languages, morphologically rich structures, and culturally specific content. Particular attention should be given to error typologies, hybrid approaches that combine SMT's lexical precision with NMT's fluency, and the role of preprocessing in improving translations for morphologically complex languages. Researchers can also explore how multilingual embedding spaces reshape cross-lingual equivalence, offering insights into both computational linguistics and translation studies.

Bring a fertile ground for further inquiry, with its morphological richness, diglossia, and prevalence of dialectal variation, future studies could examine how NMT systems cope with informal registers in Arabic and code-switching. Research could explore whether preprocessing techniques - such as segmentation, normalization, and tokenization - continue to yield measurable improvements in NMT translation outputs, and whether these gains differ across dialects.

In addition, future studies could expand the scope of multilingual comparisons beyond the five languages examined here. Most prior research has focused on one or two language pairs, often within the same typological family. A broader design that includes additional non-European languages such as Korean, Hindi, or Swahili alongside European languages would provide a more comprehensive picture of how NMT handles such language diversity. Such work would clarify whether the improvements observed in Turkish and Japanese are replicated across other distant language families, and whether Arabic maintains parity with English in those contexts.

Finally, longitudinal studies of GT and other systems should continue. The current design—using the same texts, same systems, and same scoring criteria across a thirteen-year span—provides rare diachronic evidence of progress. Future work could replicate this model with updated corpora in 2030 or beyond, tracking how NMT evolves and whether emerging architectures (such as large language models with generative capabilities) further reduce errors in idioms, pragmatics, and cultural adaptation. Such diachronic benchmarks would be invaluable for both researchers and developers, offering a clear trajectory of machine translation's strengths and weaknesses over time.

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