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| RESEARCH ARTICLE

AI Translation of Full-Text Arabic Research Articles: The Case of Educational Polysemes

Prof. Reima Al-Jarf
King Saud University, Riyadh, Saudi Arabia
Corresponding Author: Reima Al-Jarf, **E-mail:** reima.al.jarf@gmail.com

| ABSTRACT

Due to the latest technological advancements, AI tools, assistants and chatbots have been used to perform tasks in a variety of domains, including translation. Some researchers and graduate students use ChatGPT, Google Translate, QuillBot, Smartling, and DeepL to translate research articles from Arabic to English for their theses or assignments as AI saves them time and effort. Although AI translation of full texts sounds natural uses good style and sentence structure, there are still contextual and semantic inaccuracies. There is insufficient research on the quality of AI translation of full-text articles from Arabic to English. Therefore, this study explores the problems that AI has in translating polysemes in research articles from Arabic to English. Mistranslated Arabic polysemes in full-text education articles were identified. Data analysis showed that AI has difficulty translating polysemes that have general and specialized meanings and two or more English equivalents (i.e., one to many), such as صدق which has the general equivalent "honesty" and the technical equivalent "validity" used in research; والمحكمون التحكيم are used in legal, sports and research contexts, but AI gave the equivalent used in legal contexts not the one used in an educational contexts. It gave "arbitration" & "arbitrators" rather than "peer reviewing" & "reviewers". AI translated المنهج المحوري to "axial" instead of "spiral" curriculum. رسالة has 4 meanings in Arabic with 4 English equivalents (thesis, message, mission & letter) depending on the context. Most occurrences of رسالة were translated into "message", rather than "thesis". تصورات was translated into "visions" not "models", خطة > "plan" not "proposal", لجنة المناقشة > "discussion committee" not "defense committee". Further mistranslations were given to junior and senior high school grades, العبء التدريسي, المادة العلمية, الدليل الإرشادي and others. It was noted that AI tends to give literal, not conceptual, equivalents to Arabic terms and those used in a particular domain. The study recommends that researchers use AI translation with caution, post-editing the translation, and using the technical terms commonly used in education. Results, causes of AI mistranslations and recommendations for improvement are given.

| KEYWORDS

Google Translate, artificial intelligence, AI translation, polysemous terms, full-text articles, translation errors

| ARTICLE INFORMATION

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I. Introduction

Polysemes are words or phrases that have two or more meanings as in English *base wing plant, left, system, hand,* and Arabic رسالة رواية كتب مجلس بحث يمثل جناح تأهل عين. Other linguistic terms for words that have different meanings are homographs, homophones, and homonyms. Homographs are words that are spelled the same but have different meanings *(single, mean, mind, bear, close, read) &* In Arabic *(عود a type of musical instrument (lute)/ stick or return;* نظر *to look or see/opinion or perspective);* ساعد *(help/arm;* سد *(dam/obstruct/close;* حاسب *(computer/pay for/be careful/hold someone accountable).* Homophones are words that are pronounced the same but have different meanings (*flower/flour; site/cite/ sight; male/mail; maid/made; red/read; Right/write)* & in Arabic (أبا/أبى; على/علا; دعا/دعى ; راح/راحة; لم/لمة). Homonyms are words that share the same spelling and pronunciation but have different meanings as in *play (V, N); lead (Past, Present); ring (N, V); fly (N, V); saw (V, N) &* in Arabic عين *eye (spring of water,*

spy); فتح *(n/v) (to open, victory;* نجم *(N, V) (star, to emerge or appear);* جسر *(N, V) bridge, bold or courageous)* ملك *(N, V) king, to own or possess.*

A contrastive analysis of English and Arabic polysemes showed three types of polysemes: (i) polysemes with the same range of meanings in both languages: *Program* برنامج (computer, T.V.); *rehabilitation*تأهيل , *training* تدريب,. (ii) Arabic polysemes that have several English equivalents, i.e., an equivalent for each meaning (one to many) as in جناح عين صوت جدول تعاون اعلان. (iii) English polysemes that have several Arabic equivalents, i.e., an equivalent for each meaning (one to many) as in (*system, Free, intensive care, parliament, lab)* (Al-Jarf, 2022c; Al-Jarf, 2022b; Al-Jarf, 2011; Al-Jarf, 1996; Al-Jarf, 1995; Al-Jarf, 1994).

In translation, English and Arabic polysemes pose numerous problems for human translators as well as artificial intelligence (AI). Due to the latest advancements in artificial intelligence (AI), AI tools, assistants and chatbots have been used to perform tasks in a variety of domains, including translation. Some researchers and graduate students use Google Translate, ChatGPT, Smartling, QuillBot, and DeepL to translate research articles from Arabic to English for their theses or assignments as AI saves them time and effort (Al-Jarf, 2024b). Although AI translation of full texts sounds natural, and uses good style and sentence structure, there are still contextual and semantic inaccuracies. A review of the literature revealed numerous studies that evaluated the translation of texts of genres from English to Arabic and Arabic to English using a variety of machine translation systems and AI tools and assistance to find out the challenges that confront AI in translation texts. Examples of these studies are evaluating the accuracy of ChatGPT in Arabic-English translation (Khoshafah, 2023); comparison of Reverso Context and GT in translating expressive and descriptive texts from Arabic to English and English to Arabic (Benbada and Benaouda, 2023); MT errors in translating English literary texts to Arabic (Tahseen, 2024); the Arabic-English AI versus human translation of poetry (Alowedi & Al-Ahdal, 2023); English-Arabic translation of heavily loaded ideological messages (Ahmed, 2022); English-Arabic translation of dialogues (Qassem & Aldaheri, 2023); evaluation of GT, Microsoft Bing, and Ginger translating of UN records from English to Arabic (Ali, 2020); and automatic Arabic-English translation of the educational content of the Khan Academy (Bendou, 2021. Almahasees (2021) and Almahasees (2020) compared and evaluated Google Translate (GT), Microsoft Translator, and Sakhr in English-Arabic translation of a large corpus taken from Petra News Agency reports, the United Nations, the World Health Organization, the Arab League, and two literary texts: *The Old Man and the Sea* and *The Prophet*. The holistic scales of the Translation Automation User Society were utilized to assess the output adequacy, efficiency and fluency of the three systems and the orthographic, lexical, grammatical, and semantic errors they make.

Another group of studies focused on the semantic and contextual challenges that AI has in translating English and Arabic fixed expressions (proverbs) by Google Translate (GT), Reverso, Systran, Yandex, and Bing and evaluated their accuracy (Jibreel, 2023); Translation of proverbs by AI (Hamdi, Hashem, Holbah, Azi & Mohammed, 2023); translation of idiomatic expressions (Almaaytah, 2022); and cultural perspectives on the translation system of political text metaphors using Artificial Intelligence research (He & Jiang, 2024).

More studies focused on lexical ambiguity and polysemy in machine and AI translation in numerous language as Croatian, Hindi, English, Spanish, Georgian, Arabic, Kannada and Indonesian as Chinese-English machine translation and cultural terminology translation with a focus on homographs and polysemous words (Yang, & Zhang, 2024); homonym and polysemy approaches in term weighting in Indonesian-English machine translation (Abdullah, Sarno, Purwitasari & Akhsani, 2023); metaphoricity and polysemy assessment in machine translation output to achieve higher translation quality (Boieblan, 2022); rectifying incorrectly part of speech-tagged polysemous words in Kannada language machine translation (Desalli, Anirudh, Prajwal Pai, Rajeshwari & Kallimani, 2020); polysemy in machine translation exemplified in English and Georgian (Akhobadze, 2019); machine translation of polysemous Croatian words in various text genres (Tudor, 2017); word sense disambiguation applied to Hindi-English machine translation (Mall & Jaiswal, 2017); using verb-noun collocations for disambiguating verb polysemy in English-Arabic statistical machine translation (Hussein Soori, 2015); and lexical ambiguity in machine translation using frame semantics for expressing systemacies in polysemy (Pedersen, 2001).

The literature review showed a lack of studies that explore the use of AI in translating educational full text articles and how polysemous educational terms are translated in context. Therefore, this study seeks to translate a sample of full-text research articles in education from Arabic to English using Google Translate (GT) to find out which educational polysemous terms are mistranslated by GT, whether there are inconsistencies in translating the same polysemous educational terms, the strategies that Gt utilizes in translating educational polysemes and why GT mistranslates educational polysemes.

This study is significant for graduate students and researchers who use AI in translating full-text education articles from Arabic to English, whether in part or in full, the challenges and weaknesses that AI has in translation polysemous educational terms.

In addition, this study is part of a series of studies that focus on the translation of specialized terms and text from English to Arabic and Arabic to English using AI and the use of AI in educational settings such as translation of the Gaza-Israel war terminology by AI (Al-Jarf, 2025); translation of medical terms by Microsoft Copilot and Google Translate (Al-Jarf, 2024c); Google's English-Arabic translation of technical terms (Al-Jarf, 2021; Al-Jarf, 2016a).

2. Definition of Terms

2.1 Google Translate

Google Translate[1] (GT) is a multilingual translation service that translates text, documents and websites from one language into another. It was Launched in 2006 as a statistical machine translation service. It first translated text to English and then to the TL in most of the language combinations. In 2016, GT switched to a neural machine translation engine whereby it translates whole sentences at a time, rather than segment by segment. It uses the broader context to help it figure out the most relevant translation, which it then rearranges and adjusts to be more like a human speaking with proper grammar.

3. Data Collection and Analysis

A sample of 99 Arabic polyseme translation errors was collected from the Arabic-English translation of seven Arabic education articles. They contain single words and compounds. 28% have 2 or more errors. The mistranslated Arabic education polysemes have different English equivalents with different shades of meaning (one to many). The seven Arabic education research articles were the author and were about the following topics: *(i) Should English be taught to children under the age of 6? (ii) Challenges Faced by Arab Peer-Reviewers; (iii) MA and Ph.D. Thesis Evaluation at Saudi Universities: Problems and Solutions; (iv) Global Themes in Singaporean Secondary Social Studies Textbooks; (v) Requirements for Implementing Moodle e-Courses in Saudi Public Schools; (vi) The Global Dimension in the Saudi history textbooks for Grades 4-12; (vii) College students' attitudes towards using English and Arabic in university education.* All the articles were translated to English using Google Translate.

Mistranslated Arabic educational polysemous terms were compiled and subjected to further analysis. The context in which each Arabic polyseme occurred was examined and classified into a general context or a specialized domain, whether the meaning is an overgeneralization, and whether there are inconsistencies in the translation of the same polysemous term. The mistranslated educational polysemes were classified according to the type of mistranslations and why GT misinterpreted Arabic educational polysemes.

The mistranslations of the Arabic polysemic terms were marked by the author. Polysemes with repetitive identical translations were excluded from the sample. The contexts in which the same polyseme was translated correctly or incorrectly were noted.

Only semantic errors in polyseme translation and some grammatical errors that affect meaning were the focus of the analysis. Grammatical errors that do not affect meaning such as adding or deleting the definite article or using the wrong **tense** were not analyzed.

The strategies that GT used in translating each Arabic were classified into: (i) literal translation, i.e., word-for-word translation; (ii) selecting an Arabic equivalent that does not collocate with the noun in a particular context; (iii) selecting an equivalent that is used in a domain or context other than the educational context; (iv) selecting an Arabic equivalent that is not commonly used in the educational domain or educational research articles or educational context in the target language (English); (v) overgeneralizing a single meaning that does not fit a particular context; (vi) giving an English equivalent where the syntactic structure does not match the meaning.

Identification of the GT's Arabic polyseme translation error sample and each polyseme and its mistranslation were verified by a colleague who has a Ph.D. in translation. She went through the list of Arabic polysemous terms in the sample and their English equivalents and made judgments regarding the accuracy of the translation equivalent. Both classifications were compared. There was a 97% agreement between the two evaluators. Disagreements were solved by discussion.

Results of the analysis of the GT's Arabic polyseme translation error data are reported qualitatively.

4. Results

Data analysis has shown that GT has difficulty translating some Arabic educational polysemes to English. Examples of those mistranslated educational polysemes are given in Table 1. The first polysemous term is رسالة which has 4 distinct meanings in Arabic: *letter, mobile message, mission, thesis/dissertation,* with 4 equivalents in English, one for each, depending on the context. In examples 1 to 6, taken from the article bout MA & Ph.D. students' theses, رسالة was translated to "*message*", rather than "*thesis*",

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

especially when no adjectives, appositive nouns, or disambiguating contexts were used with it. Even in الرسائل العلمية (pl.) in example 3, & الرسالة العلمية (sg.) in example 4 which literally mean '*scientific thesis/ scientific theses'*, it was translated as '*message'* and '*scientific message'*. Only in examples 7, 11 & 16 رسائل الماجستير والدكتوراه was correctly translated into "*master's and doctoral theses*", as the addition of *Master's* & *Doctoral* helped disambiguate the context and hence رسائل was correctly translated to *theses*. But the addition of علمية *scientific* in examples 3 & 4 did not disambiguate the term الرسالة العلمية.

Another term related to the "M.A. and Ph.D thesis" terms is مناقشة الرسالة in example 2 which was literally translated into *"discussing the message"* rather than "*defense*", *thesis de*fense" or "*viva*". In Arabic, مناقشة has a general meaning *"discussion"* used in daily conversation and a specialized meaning related to "*thesis defense*", but 2 English equivalents are used, one for each usage.

In examples, 10, 12, 13, 14 لجنة المناقشة & لجنة الحكم were literally translated to *discussion committee & judging committee* rather than *defense committee* for both, as they mean the same. Interestingly, لجنة الحكم was translated to *evaluation committee* in example 14, which is acceptable. This is an example of GT's inconsistent translations. It seems that the whole phrase أعضاء لجنة الحكم على الرسالة disambiguated the meaning of the terms رسالة & لجنة الحكم and helped GT correctly translate it into "*members of the <u>thesis</u> evaluation <u>committee</u>*".

In example 5, المشرفون المساعدون was literally translated to *assistant supervisors* rather than the English technical equivalent *co-supervisor or co-advisor*, which is usually used in the context of Master's and Doctoral theses.

Similarly, تحكيم , محكم , محكمون & حكم in Arabic are used in a variety of contexts as thesis evaluation, research paper evaluation, sports, and law, each of which has an equivalent in English: *referee* in sports, *arbitrator & arbitration* in law, *peer-reviewer & peer-reviewing* in academic research, *evaluation & evaluator* in theses. In the MA & Ph.D Theses article, all occurrences of تحكيم / محم/ محكمون were translated to "*arbitrator & arbitration*" as in examples 6, 11, 15, 16, 17, 18, 19. On the contrary, In the article about "peer-reviewing", all occurrences of تحكيم، محكم، محكمون were correctly translated to *peer-reviewers & peer-reviewing* as in examples 20 & 21. In the context of instrument validation in research, GT translated المحكمين in examples *28 & 29* into *referees* (*The referees were also asked to make the necessary amendments & after reviewing the referees' comments)* rather than *evaluators* or *reviewers,* which is also one on the meanings of محكم & محكمين that is used in a sports context. In example 26, تحكيمها was translated into *judging the thesis* rather than *evaluating the thesis*. Here رسالة was correctly translated to *thesis*. In example 27, إجازة الرسائل was correctly translated to *theses* as well.

In describing the evaluation criteria, the adjective مطاطة was used in example 8, which can be used to describe many things as a *rubber band*. Here GT gave two literal translations of مطاطة *elastic* and *flexible,* used to describe a rubber band rather than *too board, with multiple interpretations* which is the underlying meaning of مطاطة when it is used to describe *evaluation criteria* . *Elastic* and *flexible* do not collocate with *criteria* and do not covey the intended and underlying meaning of the Arabic expression.

A term related to thesis preparation is الخطة in example 29, which was literally translated to *plan* rather than *proposal. In Arabic* خطة is used in general as well as specialized contexts, unlike English which uses *plan* in a general context and *proposal* in contexts related to thesis preparation, conferences, grants and so on.

عدم تمكن in example 22 was literally translated into *inability to master* rather than *has not mastered* which reveals a GT's syntactic problem as the literal translation given by GT conveys the future, whereas the actual Arabic meaning is *judgement of the students' unsatisfactory current performance*.

البحث الالكتروني in example 23 was translated to *electronic research* skills rather than *electronic searching* skills because in Arabic, the same polyseme البحث is used for *research* skills and *searching* skills.

مجلس القسم in example 24 was translated to *department council* rather than *department board,* which is the technical term used in English. In Arabic, مجلس is used in many contexts as college council, university council, school council, city council, advisory council, Security Council, where the Arabic term and the English TL term are the same. However, مجلس الآباء is equivalent to the English term *Parent-Teacher Meeting*.

التباطؤ in example 25 was translated to *slowing down in reading* rather than *taking a long time in reading*. Here again, GT is having difficulty matching the syntactic structure in English with the intended meaning in Arabic. *Slowing down* is the meaning of the verb يبطئ , not the action noun تباطؤ.

In example 28, الضوابط العلمية was literally translated to *scientific controls*, not *quality control*.

Moreover, GT has difficulty translating some of the standard terms that refer to the structure of research articles. أهمية الدراسة in example 30 was literally translated to *importance of the study* rather than the English equivalent *significance* which is commonly used in research papers. Unlike English, أهمية in Arabic is used in general and specialized contexts. Similarly, GT mistranslated هدف الدراسة in example 31, الدراسات السابقة in example 33, to *study objective, & previous studies* rather than the English terms, typically used in the research context, *Aims of Study, & literature review* respectively. GT translated ومجتمعها in example 35 to *communities,* not *populations*, and افراد العينة in example 36 to *sample members* rather than *subjects* which are typically used in the research context in English. In those examples, Arabic and English have different ways for expressing the same concepts.

In talking about research instruments, GT translated أداة البحث in example 32, طريقة البحث والتحليل in example 34 as *research tool* and *method of application and analysis respectively*, not *Research Instrument or instrument,* and *data collection and analysis*. مقياس متدرج in example 37 was translated to *graduated scale* and *sliding scale* instead of *graded scale*. المحاور in examples 40 & 41 was translated into *topics* rather than *items or strands.* تحكيم أدواتهم in 42 was translated to judge their tools rather than give feedback or make comments. ولا يعدلون الأدوات in 44 was translated to do not modify the tools rather than *Amend, fix, or revise.* Likewise, طبقوا الأداة in example 45 was translated to *applied the tool* rather than administered the instrument which are typically used in English in the context of research.

ملاحظات in Arabic has several meanings *(comments, notes, observations).* It was correctly translated to *comments* in example 39, but incorrectly translated to *notes* in example 43, although in both it is used in the context of instrument validation in research.

The terms صدق, ثبات and their types, in examples 46, 47, 48, 49, 50, were mistranslated as GT gave the general denotation (honesty) rather than the technical equivalent (validity) that is typically used in the research context. In Arabic ثبات & صدق are polysemous and they mean *truth, honesty &* ثبات means *stability* and *steadfastness. GT mistranslated the types of* صدق *(validity).* صدق القائمة was translated *believe the list* rather than *instrument validity*. Although صدق القائمة was used as a heading in the articles, it was translated as a verb (*believe)*. This means that GT cannot distinguish nouns and verbs and where they occur. in the case of صدق, the verb and the noun have the same spelling but only differ in the diacritics which are not usually shown in Arabic orthography. التحقق من الصدق والثبات was literally translated into *verification of truth* and *stability* rather than simply saying *Validity & Reliability.* صدق المحك was literally translated to *the veracity of the test* not *criterion validity*; صدق المفهوم was literally translated to *conceptual validity,* not *construct validity* because المفهوم in Arabic means *concept & construct.*

In the curriculum context, GT mistranslated terms as المدخل المحوري & المنهج المحوري in examples 51 & 52 which GT literally translated as *axial curriculum & axial approach* instead of the technical terms *spiral curriculum & spiral approach.* In example *53,* تصورات (pl) was translated to *visions* not *models*. In Arabic تصور means *model, vision, imagination, visualization.* In the research context, the English equivalent *model* is used especially when talking about a curriculum model or teaching model. المادة العلمية in example 54 was literally translated to *scientific material* rather than *material, instructional material* or *course material.* مفردات is a polysemous word which refers to *lexemes* in a language context and *items* in the curriculum context. In example 55, مفردات (pl) was translated to *vocabulary* which sound funny and awkward. In a curriculum context, the English equivalent should be *item*.

In example 56, العبء in Arabic is polysemous. It literally means *burden* or *load* and is used in general and specialized contexts. But the compound term العبء التدريسي was mistranslated into *teaching burden*, rather than *teaching load*.

In addition, GT has difficulty translating denotations for grade levels in English and Arabic (especially the designations used in Saudi Arabia) where fixed expressions are commonly used in both language. Here again GT translated the "grade level" designations word for word. In example 57, الصف الثالث الثانوي was literally translated to th*ird grade of secondary school* instead of *12th grade*; الثالث المتوسط in example 58 was translated to *third middle* rather than *9th grade* in American English; الأول الثانوي in example 59 was translated to *first secondary grades* instead of *10th grade*. مرحلة التمهيدي والابتدائي والمتوسط والثانوي in example 60 was literally translated to *Preparatory, primary, intermediate* and *secondary stages* instead of *KG, primary, junior high, & secondary stages. In example 53,* للمراحل المختلفة was translated to *different levels* rather than *different stages* or *different grade levels* (incomplete translation). مراحل التعليم العام in example 61 was literally translated to *stages of general education* instead of *grades K-12*.

مناطق تعليمية & إدارة تعليمية in examples 62 & 63 were word-for-word translated by GT into *educational regions & educational district*, rather than using the English fixed expression *school districts* for both.

For professors, instructors and teachers, several terms are used in Arabic. أستاذ, in particular, is a general term that refers to anybody who teaches at the elementary, junior high, high school or university. أستاذ was translated to *professor* instead of *teacher* in example 64. In English, those who teach in a school are called *teacher*, whereas those who teach at the university level are called *instructor* or professor with *professor* referring Ph.D. holders. In example 65, أستاذ كرسي was mistranslated to *chair*

professor instead of *full professor*. When full Professor was back translated, GT literally translated it as أستاذ كامل. The Arabic term and the English term are fixed expressions and cannot be literally translated.

كتاب علمي منهجي in example 66 was literally translated *scientific systematic book,* instead of *scientific textbook*.

منهجا في الحياة in example 67 was literally translated to *method of life* instead of *way of life* as the former is not typically used in English. *Method* does not collocate with *life*. In Arabic, the synonymous compounds أسلوب حياة & منهجا في الحياة or نمط حياة where three words collocate with *life*.

كلية الطب البشري in example 68 was literally translated to *faculties of human medicine not Faculties of medicine.* البشري human is added in Arabic to distinguish it from الطب البيطري veterinary medicine as Arabic does not use a single distinct term to refer to each, so it uses a compound with a descriptor that refers to human or veterinary medicine.

All compound terms in the sample containing تعليمي were translated to *educational*. For example تفريد التعليم *Individualization of education* in example 69; المحتوى التعليمي *educational content*; in example 70; لغة التعليم *language of education* in example 71; & مخرجات التعليم *education outcomes* in 72, instead of *individualized instruction, instructional content, language of instruction or medium of instruction, & Learning outcomes* respectively. In التعليم التعاوني In example 73, تعليم was correctly translated, but GT translated تعاوني as *cooperative* rather than *collaborate*.

Moreover, GT had problems in translating some technology and e-learning terms. In example 74, البنك الآلي السعودي للمصطلحات was translated to *Saudi automated terminology bank* rather than the *Saudi Terminology Databank*. In example 75, تفعيل مودل was translated to *activating Moodle e-courses* instead of *implementing*. تطبيق البرنامج in example 76 was translated to *program application* instead of *implementation. In example 77,* الفصل الالكتروني was translated to *electronic chapter*, not *classroom* as فصل in Arabic *means chapter,* or *class* each of which has a different English equivalent. In example 78, الدليل الإرشادي الإلكتروني was translated to *electronic guidance guide, not electronic guide. In Arabic* دليل can refer to a person or a thing. Use of الدليل in this context requires the use of الإرشادي. In English, it is sufficient to say *guide* only as adding *guidance* is redundant and *guidance guide* sounds awkward. Words like *teaching guide, training guide, manufacturer's guide* can be used. المقرر الالكتروني in example 79 was translated to *electronic course* rather than *e-course*. النقاشات الالكترونية in example 80 was translated to *electronic discussions* instead of *online discussions*; التعليم الالكتروني in example 81 was translated to *electronic teaching* instead of *online teaching*; التدريب الالكتروني in example 82 was translated to *electronic training* instead of *online training*; المقرر الإلكتروني المعتمد على الإنترنت in example 83 was translated to the online electronic course instead of *Internet-based e-course;* برامج الكترونية in example 84 was translated to *e-learning programs* instead of *software*. التقنيون والفنيون in examples 85 and 86 were translated to *technicians and technicians* which is awkward due to conjoining 2 identical terms rather than saying *technologist & technician.* Here, even human translators confuse التقنيون والفنيون and the use the same English equivalent for both.

تدريب المعلمين المدربين in example 87 was translated to *training trained teachers* whereas it actually means *training* teacher trainers. The cause of the mistranslation here is orthographic as المدربين is pronounced with a different short vowel /ra/ or /ri/ which makes one pronunciation refer to *trainees* and the other to the *trainers* due to the absence of the diacritic in the printed form, although there is a whole paragraph in the article about teacher trainers and training teacher trainers. It seems that GT does not connect paragraphs and terms within them together.

Further educational polysemes are وعلى المعلم أن يستخدم طرقا مختلفة لشغلهم in example 88 which was translated to *occupy the students* rather than *engaging the students*. In 89, ميول was translated to *tendency* rather than *students' interests*.الارشاد الاكاديمي in example 90 was literally translated to *academic guidance,* not *academic advising.* جامعة عالمية in example 91 was translated to *universal & global university* rather than *world-class university.* بناء المناهج in example 92 was literally translated to *curriculum construction*, not *curriculum development.* Other Arabic terms that refer to the same concept exist with similar English equivalents as *curriculum design* تصميم المناهج and *curriculum development* تطوير المناهج.

Furthermore, GT had problems in translating types of translation and interpreting. In Arabic, the same term ترجمة is used for written translation and interpreting, i.e., oral translation. Its usage in a compound makes it clear whether ترجمة refers to written translation or oral interpreting. The types of interpretation (oral translation) were mistranslated as in الترجمة الثنائية in 93 and 94 which was literally translated to *binary translation*, instead of *Liaison interpreting;* الترجمة المنظورة in 95 & 96 to *visual translation* rather than *by sight interpreting;* الترجمة الفورية in 97 & 98 was translated to *instant translation*, rather than the English term *simultaneous interpreting;* ترجمة المؤتمرات in 99 was translated to *conference translation* instead of the English equivalent *conference interpreting.*

Table 1: Arabic Educational Polyseme, Their GT's Faulty Translation, and Correct Equivalents

Arabic Polysemes	GT translation	Correct Equivalent
1. رسالة	Letter & message	thesis, mission message & letter
2. **مناقشة** الرسالة	**Discuss** the message	defense/viva
3. الاشراف على المشاريع **والرسائل العلمية**	supervising projects and **messages**	theses
4. الرغبة في إجازة **الرسالة العلمية** رغم ضعفها.	The desire to approve the scientific message despite its weakness.	thesis
5. ما المشكلات التي يواجهها المشرفون والمشرفون المساعدون 6. في **تحكيم** 7. رسائل الماجستير والدكتوراه؟	- What are the problems faced by supervisors and assistant supervisors - in **arbitrating** - master's and doctoral **theses**?	correct
8. المعايير عامة وضبابية **ومطاطة** 9. ولا تحدد مواصفات **الرسالة** الضعيفة والمتوسطة والممتازة.	- The criteria are general, vague, and **elastic**, and do not specify the specifications of a weak, average, or excellent message. - The criteria are general, vague and **flexible**	Too board with multiple interpretations thesis
10. ما المشكلات التي يواجهها أعضاء **لجنة المناقشة (الممتحنون)** 11. في **تحكيم رسائل** الماجستير والدكتوراه؟	- What are the problems faced by members of the **discussion committee** - in **arbitrating** master's and doctoral theses?	Examiners correct
12. لجنة المناقشة	discussion committee	Defense committee
13. لجنة الحكم	judging committee	Defense committee
14. أعضاء **لجنة الحكم** على **الرسالة**	members of the thesis **evaluation** committee?	correct
15. التحكيم والمحكمون	- in the **arbitration** and evaluation of master's and doctoral **theses**. - are used in legal, sports and research contexts, but AI gave the equivalent used in legal contexts (**arbitration & arbitrators**)	reviewing & reviewers
16. **تحكيم** رسائل الماجستير والدكتوراه وتقويمها	**arbitration** and evaluation of master's and doctoral **theses**	reviewing
17. وحيث إن **المحكمين** يختارون من الخبراء في مجال البحث المقدم **للتحكيم**	Since the **arbitrators** are chosen from among the experts in the field of research submitted for **arbitration**.	(reviewers/peer-reviewers)
18. وعلى الرغم من أهمية **التحكيم** لكل من المؤلفين والقراء، إلا أن إجراءات **التحكيم** لا تخلو من السلبيات والمشكلات التي خضعت لدراسات موسعة في المجال الطبي الحيوي. وهناك سلسلة منتظمة من المؤتمرات الدولية حول **التحكيم** العملي في العلوم الطبية الحيوية والتي تنشر تقارير عنها في أعداد خاصة من مجلة الجمعية الأمريكية الطبية	Despite the importance of **arbitration** for both authors and readers, **arbitration** procedures are not without drawbacks and problems that have been extensively studied in the biomedical field. There is a regular series of international conferences on practical **arbitration** in biomedical sciences, reports of which are published in special issues of the Journal of the	

	American Medical Association (JAMA) (1990, 1996, 1998).	
19. وعلى الرغم من وفرة الأبحاث والتقارير والمؤتمرات الأجنبية التي تدور حول مشكلات **تحكيم** أبحاث المنح وأبحاث الدوريات وغيرها، فلم تعثر على أبحاث عربية تدور حول المشكلات التي **تواجه المحكم للمؤسسات الأكاديمية المحلية والعربية**. أي أن هناك نقص في الأبحاث العربية في هذا المجال. إضافة إلى أن واقع تحكيم الأبحاث غير مرض وبعض الممارسات التحكيمية مثل إضاعة الأبحاث، واستغراق وقت طويل في **عملية تحكيم البحث** وغيرها من الممارسات غير مرضية، ونحتاج إلى أن ننظر إلى واقع التحكيم في المؤسسات الأكاديمية المحلية نظرة حيادية، **ونضع معايير تحكيم** قابلة للتطبيق ونطور إجراءات التحكيم لاختصار الوقت وجعله أكثر موضوعية وفائدة.	Despite the abundance of foreign research, reports and conferences that revolve around the problems of **arbitrating** grant research, journal research, and others, but did not find any Arab research on the problems facing **arbitrators for local and Arab academic institutions**. In other words, there is a shortage of Arab research in this field. In addition, the reality of research **arbitration** is unsatisfactory, and some **arbitration** practices, such as wasting research, taking a long time in the research **arbitration** process, and other unsatisfactory practices, we need to look at the reality of **arbitration** in local academic institutions from a neutral perspective, and set applicable **arbitration** standards and develop **arbitration** procedures to shorten the time and make it more objective and useful.	review
20. ولم يعتبر **المحكمون** الحوافز شيئا أساسيا ولكنه لا مانع منها، واقترحوا إعطاء **المحكمين** خصومات على الكتب وحبر الطابعات. 21. ومما يشهد **بأهمية التحكيم** أن الفرضيات العلمية التي تقدم للعالم يتجاهلها جمهور العلماء إلا إذا نشرت في دوريات علمية محكمة Mulligan (2004) .	The **reviewers** did not consider incentives essential, but they did suggest that **reviewers** should be given discounts on books and printer ink. What testifies to the importance of **peer review** is that scientific hypotheses presented to the world are ignored by the scientific public unless they are published in **peer-reviewed** scientific journals Mulligan (2004).	correct
22. **عدم تمكن** الطالب من مهارات البحث الالكتروني 23. عدم تمكن الطالب من مهارات **البحث الالكتروني**	The student's **inability** to master **electronic research** skills	Has not mastered Electronic searching
24. **مجلس القسم**	department or college **council**	Department board
25. **التباطؤ** في قراءة الرسالة وتحكيمها 26. التباطؤ في قراءة الرسالة **وتحكيمها**	**Slowing** down in reading and **judging** the thesis.	Taking a long time in reading and evaluating the thesis
27. الاعتماد على الأهواء الشخصية والمجاملات في إجازة **الرسائل** 28. وليس **الضوابط العلمية** الموضوعية	Reliance on personal whims and compliments in approving theses and not objective **scientific controls**	Quality control
29. **الخطة يحكمها ويراجعها** ويصححها أناس بعيدون عن التخصص	The **plan** is **controlled**, **reviewed** and corrected by people who are not specialists.	proposal
30. أهمية الدراسة	**Importance** of the study	significance
31. هدف الدراسة	Study objective	Aims of Study
32. أداة البحث	Search tool	Research Instrument
33. الدراسات السابقة	Previous studies	Literature review

34. **طريقة البحث** والتحليل	**Method of application** and analysis	data collection and analysis
35. **عينات الدراسة ومجتمعها**	Study Samples and **communities**	I. POPULATION
36. **افراد العينة**	sample members	Sample/subjects
37. باستخدام **مقياس متدرج** يتكون من "مهم جدا، مهم، متوسط الأهمية، وغير مهم". 38. كما طلب من **المحكمين** أن يجروا التعديلات اللازمة. 39. وبعد **الاطلاع على ملاحظات** المحكمين، 40. حذفت **المحاور** التي لا تتناسب مع البعد العالمي و التي اعتبرها المحكمون "غير مهمة" أو "متوسطة الأهمية"، 41. **وابقي** فقط على **المحاور** التي اعتبرت "مهمة جداً" أو "مهمة".	- using a **graduated scale** consisting of "very important, important, medium importance, and unimportant". - The **referees** were also asked to make the necessary amendments. - After **reviewing the referees' comments**, the **topics** that did not fit the global dimension and that the referees considered "unimportant" or "medium importance" were deleted, - and only the **topics** that were considered "very important" or "important" were **kept**. using a **sliding scale** consisting of "very important," Important, moderately important, and unimportant.	A graded scale
42. طلب الطلاب من متخصصين **تحكيم** أدواتهم، 43. ولكنهم لا يلتزمون **بالملاحظات** 44. ولا **يعدلون** الأدوات 45. بحجة أنهم **طبقوا الأداة**.	Students ask specialists to **judge** their **tools**, but they do not adhere to the **notes** and do not **modify** the tools under the pretext that they have **applied the tool.**	• make comments on the instrument • Comments • Amend/fix/revise/ • administer the instrument
46. صدق القائمة	Believe the list	Instrument Validity
47. صدق	honesty	*validity*
48. التحقق من الصدق والثبات	Verification of truth and stability	Validity & Reliability
49. صدق المحك	The veracity of the test	Criterion validity
50. صدق المفهوم	Conceptual validity	construct validity
51. المنهج المحوري 52. بضرورة اتباع **المدخل المحوري** في تدريس تاريخ	axial curriculum. axial approach	spiral curriculum Spiral approach
53. ووضع آخرون **تصورات** وخططا ومعاييرا لتدريس البعد العالمي في الدراسات الاجتماعية **للمراحل المختلفة**.	Others developed **visions**, plans and standards for teaching the global dimension in social studies at **different levels.**	Models Grade levels
54. المادة العلمية	scientific material	instructional material/material course material
55. مفردات	students in the same grade level in all schools and all **school districts** use the same textbook and the same **course vocabulary**	Course items

56. العبء التدريسي	teaching **burden**	teaching load
57. الصف الثالث الثانوي 58. الثالث المتوسط 59. الأول الثانوي	• studying in kindergarten through **third grade of secondary school** in 27 learning centers. • in the **third middle** • **first secondary grades**	12th grade 9th grade 10th grade
60. مرحلة **التمهيدي** والابتدائي **والمتوسط** والثانوي	Preparatory, primary, intermediate and secondary stages	KG, primary, junior high, secondary stages
61. مراحل التعليم العام	Regarding the use of e-courses in the **stages of general education** in the Kingdom	K-12 grades
62. إدارة تعليمية 63. مناطق تعليمية	**educational regions** Educational district	school districts
64. أستاذ	**Professors** of e-courses (even if they are for the same subject and for the same grade) should design and use an e-course accompanying their subject in a form and content that differs from other **professors.**	teachers
65. أستاذ كرسي	Chair professor full Professor	Full professor
66. كتاب علمي منهجي	scientific systematic book	scientific textbook
67. **منهجا** في الحياة	method of life	way of life
68. كلية **الطب البشري**	faculties of human medicine	Faculties of medicine
69. تفريد **التعليم**	Individualization of **education**	Individualized instruction
70. المحتوى **التعليمي**	**Educational** content	instructional content
71. لغة **التعليم**	Language of **education**	Language of instruction medium of instruction
72. مخرجات **التعليم**	**Education** Outcomes	Learning outcomes
73. التعليم **التعاوني**	Cooperative learning	Collaborative learning
74. البنك **الآلي** السعودي للمصطلحات	Saudi **automated** terminology bank	Saudi Terminology Databank
75. مودل **تفعيل**	**activating** Moodle e-courses	implementing
76. البرنامج **تطبيق**	Program application	Program implementation
77. الالكتروني **الفصل**	Electronic chapter	classroom
78. الدليل **الإرشادي** الإلكتروني	electronic **guidance** guide	Electronic guide
79. **المقرر الالكتروني**	electronic course	e-course

80. **النقاشات الالكترونية**	Electronic discussions	online discussions
81. التعليم الالكتروني	electronic teaching	online teaching
82. التدريب الالكتروني	Electronic training	online training
83. المقرر الإلكتروني المعتمد على الإنترنت	The online electronic course	Internet-based e-course
84. برامج الكترونية	E-learning programs	software
85. **التقنيون** والفنيون العاملون في المعمل 86. التقنيون **والفنيون** العاملون في المعمل	**Technicians** and **technicians** working in the laboratory	Technologist & technician
87. تدريب المعلمين المدربين	training trained teachers	Training teacher trainers
88. وعلى المعلم أن يستخدم طرقا مختلفة **لشغلهم**	The teacher must use different methods to **occupy** them	engaging
89. **ميول**	Students and children currently have a strong **tendency** to use computers and games.	interest
90. **الارشاد الاكاديمي**	Academic guidance	Academic advising
91. **جامعة عالمية**	universal or global university	world-class university
92. **بناء** المناهج	Curriculum **construction**	Curriculum development
93. **الترجمة** الثنائية 94. الترجمة **الثنائية**	Binary **translation** **Binary** translation	Liaison interpreting
95. **الترجمة** المنظورة 96. الترجمة **المنظورة**	Visual **translation** **Visual** translation	By sight interpreting
97. **الترجمة** الفورية 98. الترجمة **الفورية**	Instant **translation** **Instant** translation	Simultaneous interpreting
99. **ترجمة** المؤتمرات	Conference **translation**	Conference interpreting

4.1 Types of Mistranslations by GT

GT tends to give a literal, word-for-word translation, not conceptual, commonly used or technical English equivalents to Arabic terms and those used in a particular domain as (*validity, reliability*). The Arabic term is used in several contexts with a different English equivalent for each (محكم *referee, judge, arbitrator, peer reviewer*; تصور *vision, model*). GT does not seem to recognize that a word is polysemous, and it translates it with a single meaning. It seems that the exact contexts in which polysemous terms are used are not specified. GT seems to overgeneralization one equivalent as *arbitration*, & *message* to most of the context in the corpus. GT is also inconsistent in translating the same term. In some cases, رسالة was correctly translated (*thesis)* in a particular context, but to *message* in most occurrences in the article where there are no disambiguating words. Similarly, محكم was as translated to *peer reviewer, referee* and *arbitrator*. It seems that GT does not connect the occurrences of a particular term with the overall topic of the article and with the successive paragraphs. GT does not seem to distinguish the cultural differences in translating terms such as how grade levels and school districts are called in USA, UK & Saudi Arabia.

5. Discussion

5.1 AI's Ability to Translate Polysemes

This study found that Arabic educational polysemes in full-text articles posed several problems in Arabic-English translation by GT. This finding is similar to findings of other prior studies in the literature using GT or other AI tools in translating polysemes and homonyms in numerous language pairs. For example, in Chinese-English MT, Yang & Zhang (2024) found language ambiguities, polysemes, homographs, idioms, and proper nouns to be challenging for MT. There is a lack of extraction methods developed to solve homonyms and polysemes ambiguities in Indonesian-English MT of sentences (Abdullah, Sarno, Purwitasari & Akhsani (2023). In Kannada language in India, the occurrence of polysemes in sentences led to ambiguity and was often a nuisance in translation to English due to MT's incorrect interpretation of the sentences as MT could not correctly identify the polysemes' part of speech (Desalli, Anirudh, Prajwal Pai, Rajeshwari & Kallimani, 2020). Similarly, MT had problems with English-Georgian translation of words with different meanings (Akhobadze, 2019). In Croatian language, polysemes with multiple meanings *in various text genres* constituted a main problem that MT failed to handle (Tudor, 2017). In Hindi, Word Sense Disambiguation was one of the biggest challenges that MT faced where MT chose the wrong equivalent verb (Mall & Jaiswal, 2017). In Spanish, Systran, Deepl, and Google Translate could not make use of the contextual cues in the English text that were important for disambiguating the meanings of metaphors and polysemes and produce suitable linguistic units in Spanish (Boieblan, 2022). In a translation of medical terms by Microsoft Copilot (MC) and GT, Al-Jarf (2024) detected that in 9% of the medical terms in the sample, MC and GT gave equivalents that did not fit the medical context, especially in the case of terms that are polysemous whether in Arabic or English. For example, نهجة was translated into *approach* (by MC) & *method* (by GT). When a context was provided, GT translated it correctly (*shortness of breath*), whereas MC still gave the same faulty meaning (*approach to breathing*). الركاب was mistranslated to *passengers* even when a context was provided. In translating the Gaza-Israel terminology, GT gave more faulty equivalents than MC, especially in the case of polysemes. Errors in translating polysemous terms constituted 18%. GT gave equivalents that were not related to the Gaza-Israel War context. The literal translation given by GT was funny and extraneous as in giving the equivalent أريكة for *Sofa* شجيرة *Bush* rather than أحراش صوفا. *Baha timing* was translated as توقيت الباحة which refers to a city in Saudi Arabia, rather than توقيت البهاء which metaphorically refers to a person. *Mortar* was translated into مونة الاسمنت is more used in a building and construction context rather than an equivalent used in a war context (Al-Jarf, 2025).

The mistranslations that Gt made in translating polysemous terms in the sample in the current study are similar to the translation errors that student translators made in translating polysemes from English to Arabic and Arabic to English. The students made more errors in the translation polysemous compounds than single-word polysemes where the equivalent compounds had collocation errors. The students utilized different faulty strategies in translating polysemes, especially in source texts which have one-to-many equivalents (*affairs, system*). They tended to overgeneralize the equivalent they know to all contexts (*system, develop*), not the one suitable for a particular context/domain (*chemical plants; under president*) (Al-Jarf, 2022c).

5.2 AI's Polyseme Translation Strategy

A second finding in the current study is that GT gave a literal word-for-for word translation to most educational polysemous terms in the sample. This finding is consistent with findings of other studies that investigated AI translation from English to Arabic and Arabic to English. For example, Jibreel (2023) found that the most common strategy that MT used in translating proverbs was literal translation. Both Bing and GT provided semantic equivalents, but Bing was more effective in providing communicative proverbial equivalents. In the translation of medical terms by AI, data analysis revealed that 12% of the medical terms were literally translated by both MC and GT. Examples of literal translations given by MC are *subpleural atelectatic bands* شرائط الانكماش الرئوي الفرعية*; irritable bowel syndrome* متلازمة الأمعاء العصبية*; transmitted spectral doppler flow pattern is suggestive of impaired lv relaxation* نمط التدفق الطيفي الدوبلر المنقول يشير إلى انخفاض استرخاء البطين الأيسر*;* نهجة *approach* rather than *breathing;* الهيئة الطبية *medical organization.* Examples of literal translations given to Arabic terms by GT were الشهاق السعال *inhalation cough instead of pertussis;* الإسهال المائي *watery diarrhea rather than aqueous diarrhea;* انيميا البحر المتوسط *Mediterranean anemia;* العظم الكلابي *hamatum;* العشى الليلي *night dinner;* العناية الفائقة *extreme care;* الذئبة الحمراء *the red wolf;* مرض الذئبة الحمراء *red lupus.* Examples of literal translations given to English terms by *GT hyperosmolarity without nonketotic* فرط الأسمولية دون غيبوبة*; hyperglycaemic-hyperosmolar coma* غيبوبة فرط الأسمولية اللاكيتون*; hyperosmolar non- ketotic diabetic coma* فرط سكر الدم-فرط الأسمولية غير الكيتونية*; spinous process* عملية شائكة*; multislice non enhanced CT of chest* متعدد الشرائح غير محسن بالأشعة المقطعية للصدر *marginal osteophytic lipping of opposing vertebral endplates* القذف العظمي الهامشي للصفائح الطرفية الفقرية المتعارضة *(Al-Jarf, 2024).*

In the translation of polysemous Gaza-Israel War Terminology, literal translation was the most common strategy especially in the translation of polysemes and metaphors. Both MC & GT gave literal translations to the following: *Carpet bombing* تفجير السجاد by GT instead of القصف السجادي. MC mistranslated *Al-Aqsa flood* as فيضان الأقصى rather than طوفان الأقصى because flood is a polysemous word. MC translated *Hannibal's plan* as حلاف حنيبعل; *Breaking Dawn* as فجر اليوم; instead of بزوغ الفجر& خطة respectively. Likewise, GT translate *Al-Yassin mortar* as ملاط الياسين; *prison whitewashing* غسيل السجن باللون الأبيض which actually means clearing prisons by releasing all Palestinian prisoners (Al-Jarf, 2025).

Furthermore, the strategies that GT utilized in translating educational polysemes in the current study are similar to those used by translation students. In Al-Jarf study (2022c), human translators resorted to literal translation, i.e., word for word translation rather than using equivalents that do not match the source polyseme. They also overgeneralized the same equivalent to all contexts (*develop, system; association*), although each shade of meaning has a different equivalent.

5.3 Why GT Misinterprets Some Polysemes

AI models struggle with ambiguity for several reasons. First, GT is trained on vast amounts of bilingual text data (datasets), which include numerous examples of polysemous words in different contexts but may not cover all possible uses of polysemous words. The attention mechanisms in transformer models allow AI to focus on relevant parts of the sentence to determine the meaning of a polysemous word. They use context windows to consider a certain number of words before and after the target word to infer its meaning and semantic similarity measures to determine how closely related different meanings of a word are based on context. AI models have a limited context window, meaning they can only consider a certain amount of text before and after the word. GT may not always have access to enough surrounding context to accurately determine the meaning of a polysemous word. GT continuously learns from user feedback and new data, refining its understanding of polysemous words over time. AI, in general, has contextual limitations and tends to overgeneralize the most common meaning of a word. AI might not fully grasp cultural nuances that affect the meaning of words as in the case of translating terms used for *grades* in Saudi Arabia, USA and UK.

6. Recommendations

Some researchers and graduate students use Google Translate, ChatGPT, Smartling, QuillBot, DeepL and other AI tools to translate research articles from Arabic to English for their theses, term papers and/or assignments. This study found that in translating a sample of full-text research papers from Arabic to English, GT has some difficulties with some educational polysemous terms which either have several meanings in Arabic, each of which is used in a different domain with an English equivalent used for each meaning and each domain. The other source of difficulty is that the Arabic educational polyseme has two or more English equivalents: one used in general contexts and the other used in education, as a specialized domain/context. Therefore, researchers and students should use AI in Arabic-English translation of full text articles in education with caution. They should pay attention to and use English equivalent terms that are commonly used in educational contexts. This requires that researchers and graduate students post-edit the English translation output of educational articles/text to correct any lexical and syntactic inaccuracies including those related to polysemous terms. They substitute incorrect literal translations of polysemous terms with conceptual translation and with equivalents that are commonly used by the educational community (Al-Jarf, 2024a).

Moreover, they need to ensure that the AI translation tool to be used in translating full-text articles consider the broader context of the sentence or paragraph. AI models like BERT (Bidirectional Encoder Representations from Transformers) and GPT (Generative Pre-trained Transformer) can be utilized because they use contextual embeddings to understand the meaning of words based on their context. They can simplify or clarify the source text before having AI translate it, i.e., specifying the meaning of polysemous words in parentheses such as adding (MA and Ph.D. before رسالة *thesis,* تحكيم *review/evaluate,* مناقشة رسالة الماجستير والدكتوراه *thesis/viva defense*).

Researchers and graduate students may use glossaries and translation memories to ensure consistency in translating specific terms. They may use tools like SDL Trados, MemoQ or OmegaT to store translations of polysemous words in different contexts (Al-Jarf, 2009; Al-Jarf, 2017a). If they do not know the exact equivalents, they may check the correct equivalents of polysemous educational terms in online dictionaries such as Al-Maany multi-lingual dictionaries and other online or mobile educational dictionary apps (Al-Jarf, 2022c; Al-Jarf, 2020; Al-Jarf, 2014). Researchers and graduate students may consult professional translators of educational texts and terminology who can provide the nuanced understanding that AI might miss.

To improve AI translation of educational polysemes in Arabic full-text articles, the collaboration between linguists, lexicographers, software and AI specialists is a priority. The English-Arabic dictionaries, and Arabic-English corpus alignment should be updated. AI models can be fine-tuned on specific datasets to improve their understanding of polysemous words in particular domains. User feedback and corrections can be incorporated to continuously improve the AI translation tool as GT. Feedback to the AI translation tool when it misinterprets a polysemous word can be provided to help it learn and improve. The translation model can be regularly updated with new data to keep it up to date with language changes and new usage patterns.

To improve AI Arabic-English translation of educational polysemes, linguists, lexicographers, and AI specialists can adopt the suggestions given by some researchers in the literature for improving AI translation between English and other languages such as Indonesia, Georgian and Kannada. For example, Abdullah, Sarno, Purwitasari & Akhsani, (2023) proposed word feature extraction of homonyms and polysemy in Indonesian to improve Indonesian-English Nural Machine Translation accuracy. Akhobadze (2019) added that systematizing language vocabulary can be helpful in solving translation problems of polysemous words in English-Georgian translation. MT systems output may be improved through the identification of the conceptual constructs in the source

text (SL) and evaluating their adequacy and fluency in the target text (TL) (Boieblan, 2022). An algorithm focusing on a few examples can identify the wrong Part-of-Speech-tagged word in a sentence. The Part-of Speech-tagged sentence is obtained as input through Shallow parser, and then the algorithm can identify the incorrectly tagged word by referring to the structure of Kannada language (Desalli, Anirudh, Prajwal Pai, Rajeshwari and Kallimani, 2020). Parsing and Word Sense Disambiguation were utilized for Hindi-English Language translation. The Lesk algorithm, which used WordNet tools for Word Sense Disambiguation, was developed and modified. Parsing is an extension based on the Shallow Parser method that creates groups of word which are essential for Machine Translation using Monolingual Hindi and English corpora. A machine learning technique such as a supervised approach used to disambiguate the multiple tags in the context label with the correct tag. The Unsupervised method was also used to update the sentence with the correct sense and parts of speech tag. The Knowledge based methods that uses English and Hindi WordNet tools and domain specific sense with the help of were used as well (Mall & Jaiswal, 2017)

Finally, this study recommends that future studies explore the translation of different kinds of metaphors and fixed expressions such as zero expressions, numeral-based English and Arabic formulaic expressions, time metaphors, ibn (son) and bint (daughter) and dar (house) and bayt (home) expressions, common names of chemical compounds, color-based metaphorical expressions, om- and abu-expressions, binomials and others from English-Arabic and Arabic-English by a variety of AI tools and assistance such as DeepSeek, Copilot, Gemini, ChatGPT. The difficulties that AI has in translating these metaphors and formulaic expressions from English to Arabic and Arabic to English can be compared with the difficulties that translation students have in translating the same types of metaphors and formulaic expressions (Al-Jarf, 2023a; Al-Jarf, 2023b; Al-Jarf, 2023c; Al-Jarf, 2022a; Al-Jarf, 2022d; Al-Jarf, 2019; Al-Jarf, 2017b; Al-Jarf, 2016b).

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ORCID ID: https://orcid.org/0000-0002-6255-1305

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