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A Comparative Study between Human Translation and Machine Translation in Academic Texts

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Abstract

This study aims to assess human and machine translation of academic texts and critique the accuracy of these translations, the consistency of the translations in their use of specialized terminology, and the overall linguistic fluency of the translations. Although there is plenty of research relating to the translation of nonspecialized or literary texts, there is a pronounced shortage of studies attempting to evaluate the translation of academic texts, given the particular challenges of specialized vocabulary, syntax, and other structures. This study is intended to fill that particular gap. For this study, a corpus of 10 to 12 academic texts was evaluated using the MQM (Multidimensional Quality Metrics) model (a quality assessment model that captures both quantity and quality). The research findings show that although there is unparalleled speed and fluency in obtaining draft translations through the use of machine translation, there is typically no adequate use of contextualized or domain-specific terminology. This is in contrast to human translation, which is able to provide

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determinate accuracy, constancy, and appropriate use of specialized vocabulary, syntax, and structures. Other findings indicate that the amalgamation of human and machine translation is the optimal means of rendering academic texts, or at least the most effort-free means therein.

Keywords: Human translation, Machine translation, Academic translation, Linguistic accuracy, Specialized terminology

دراسة مقارنة بين الترجمة البشرية والآلية للنصوص الأكاديمية

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المستخلص

تهدف هذه الدراسة الى تقييم الترجمة البشرية والآلية للنصوص الأكاديمية ونقد دقة هذه الترجمات، واتساق استخدامها للمصطلحات المتخصصة، والسلاسة اللغوية العامة للترجمات. وعلى الرغم من وجود العديد من الدراسات المتعلقة بترجمة النصوص غير المتخصصة أو الأدبية، إلا أن هناك نقصاً واضحاً في الدراسات التي تحاول تقييم ترجمة النصوص الأكاديمية، نظراً للتحديات الخاصة بالمفردات المتخصصة والبناء النحوي والهياكل الأخرى. وتهدف هذه الدراسة الى سد هذه الفجوة البحثية المحددة.

تم تقييم مجموعة مكونة من 10 إلى 12 نصاً أكاديمياً باستخدام نموذج MQM (Multidimensional Quality Metrics)، الذي يستخدم لتقييم الجودة ويجمع بين الجوانب الكمية والنوعية. أظهرت نتائج البحث أنه على الرغم من السرعة الاستثنائية والسلاسة في الحصول على الترجمات الأولية باستخدام الترجمة الآلية، إلا أن استخدام المصطلحات المتخصصة والسياقية لا يكفي غالباً. وعلى النقيض ذلك، توفر الترجمة البشرية دقة واتساقاً، واستخداماً مناسباً للمفردات والهياكل المتخصصة. وتشير النتائج الأخرى الى أن الدمج بين الترجمة البشرية والآلية يمثل الوسيلة المثلى لترجمة النصوص الأكاديمية، أو على الأقل أكثرها كفاءة من حيث الجهد المبذول.

الكلمات المفتاحية: الترجمة البشرية، الترجمة الآلية، الترجمة الأكاديمية، السلامة اللغوية، المصطلحات التخصصية

Introduction

Translation is a communicative process that involves expressing meaning from one language in another while preserving it's linguistic and cultural nuances. To achieve this, translators must carefully select terms to convey the intended sense accurately. Translation is therefore not merely the replacement of words, but the faithful communication of ideas.

This task requires from the translator to be highly focused, attentive, and careful when choosing the most appropriate terminology, especially that some languages contain many

closely related synonyms. These requirements are increasingly important in academic translation. Translators must have prior knowledge of academic writing, including its methods and techniques. Their role goes beyond merely replacing words: they must ensure that word choices are appropriate for the specific academic field and reflect careful reading, so that the translation effectively serves its intended purpose.

Eugene Nida mentioned to this importance, and he noting that effective translation not means only accuracy but also preserving both of meaning and concept. In fact, translation is not a modern practice, it has existed since ancient times, when translators relied on their linguistic and cultural knowledge to convey texts from one language to another.

Translation goes beyond simple word substitution; idiomatic and culturally bound expressions require deep cultural and contextual understanding. Research shows that idiomatic expressions pose significant challenges for machine translation systems, which often produce literal translations that fail to convey intended metaphorical or culturally embedded meanings Mughal et al., (2024), Dewayanti & Margana, (2023). Comparative studies suggest that while machine translation tools are effective in handling straightforward text, they frequently underperform when translating idioms and proverbs because these expressions depend on cultural context and shared social norms, Ismoilova, (2025). Studies also highlight that translators must understand cultural background to find equivalent expressions or adaptation strategies, something machine translation models struggle with despite algorithmic advances Iskanova, (2024) Alqohfa & Sanad, (2025).

Statement of the Problem

1- **Limitations of Machine Translation in Academic Writing**

Machine translation and AI tools often fail to ensure semantic accuracy, textual coherence, and proper handling of idiomatic or culturally nuanced expressions Baker, (2011), Newmark, 1988).

2- **Essential Role of Human Translators**

Human translators provide interpretive judgment, critical thinking, and cultural awareness, which are crucial for preserving the author's intended meaning in specialized or academic texts, Munday, (2016), Garcia, (2022).

3- **Lack of Comparative Studies**

There is insufficient research directly comparing the performance of human translation and machine translation in academic writing, as most studies focus on literary or general texts.

Aims of study

This study aims to:

1- Examine the accuracy and semantic quality of machine translation in academic texts.

2- Compare human translation and machine translation in handling specialized academic terminology.

3- Identify the strengths and limitations of machine translation in academic writing.

4- Explore the feasibility of integrating machine translation with human translation in academic workflows.

5- To what extent does machine translation

Research Questions

In light of the research problem, this study tries to answer the following questions:

1. what extent does machine translation accurately render content and specialized terminology in academic texts compared to human translation?
2. What are the differences between human and machine translation in rendering specialized terms and technical expressions in peer-reviewed journal articles?
3. What are the main strengths and limitations of machine translation when applied to academic texts?
4. Can machine translation be integrated with human translation in academic contexts?

Literature Review

Previous studies have consistently highlighted differences between human and machine translation, particularly regarding accuracy, contextual understanding, and handling of specialized terminology. Human translation generally outperforms machine translation in conveying the intended meaning and maintaining contextual integrity, especially in academic texts, whereas machine translation often produces faster but more literal renderings that may overlook nuanced meanings, Singh, (2025), Haseeb, & Abbasi, (2025).

Regarding specialized terminology, human translators demonstrate greater proficiency in accurately rendering technical and discipline-specific terms, while machine translation systems may misinterpret or generalize such terms (Artificial Intelligence in Academic Translation: A Comparative Study of Large Language Models and Google Translate, 2025).

Most comparative studies have focused on literary or general texts; however, recent research increasingly examines academic contexts, such as research articles and abstracts, emphasizing the need for systematic evaluation of translation quality in specialized domains (A Comparative Study Between Human Translation and Machine Translation, 2023).

While machine translation offers clear advantages in speed and cost, these benefits often come at the expense of semantic precision and contextual fidelity, reinforcing the value of human translation in academic settings (Machine and Human Translation: A Review, 2022).

Translation

1- Machine Translation

The use of machine translation (MT) and artificial intelligence systems has increased tremendously because of their ease of use and speed. Neural machine translation attempts to solve problems associated with the overall coherence and the consistency of the text, Ma'rouf, & Hafari, (2019). Although MT has the potential to generate texts that are grammatically and stylistically correct, it has been argued that MT does not successfully capture context and the use of jargon, which is very relevant in the context of academic writing Amr Hindi, (2023).

2- Problems of Machine Translation

Even with its drawbacks, MT does have a few benefits:

A- Keeping in mind the value and relevance of context in a text, MT rarely captures the correct meaning of the text when it comes to very simple and clear texts, Mohammed H, Mohammed A, & Wasel S, (2025).

B- MT does not understand culture, and the other subtle nuances that exist in a context (usually referred to as implicit meaning), and can fall prey to bad MT with regard to idioms, and other rhetorical devices such as cohesion and coherence, Baker, (2009), Nida & Taber, (1969).

C- Typically, MT translations do not capture the meaning of the original text and must be reviewed by a human, Bing Xiu & Liming Xiaowen, (2025).

3- Features of Academic Texts

The translation of academic papers becomes even more difficult due to:

A- The use of specific and technical language, and a focus on clarity and precision, Newmark, (1988).

B- The need for coherence to ensure that the structure of the paper is indeed logical, and to promote understanding, Baker, (2009).

Theoretical Framework with Integrated Comparative and Case Studies

According to Nida (1969), translation goes beyond simply replacing words between languages; it is a complex cognitive, linguistic, and cultural process that seeks to convey meaning accurately, adapt to context, and preserve the intended effect for the target audience.

Nida distinguishes between formal equivalence, which sticks closely to the source text, and dynamic equivalence, which focuses on meaning and impact on the target readers This distinction is particularly useful in academic translation, as it highlights that literal accuracy alone is often insufficient.

Newmark (2000), also touched on different translation strategies, as semantic translation prioritizes fidelity to the source, while communicative translation prioritizes understanding for the target audience. He mentioned in the same book, that this matters a lot precision in academic texts, especially, since that any mistakes can distort arguments. Baker (2015) focuses on the bigger picture, that considers coherence, cohesion, and linguistic consistency as essential elements of the quality of a translated text, especially in specialized academic fields. Gile (2009) identified three main tasks for translators, which is understanding, conveying, and paraphrasing, which it relies on the mind and reasoning that effect on the quality of the translated text. Toury's (1995) Descriptive Translation Studies suggest that human translation works within cultural, institutional, and disciplinary norms.

Based on the above, academic writing emphasizes the simultaneous use of precise terminology and logical structure. This characteristic highlights the advantage of human translators, who can comprehend scientific texts more accurately than machine translation systems.

Human translators also excel in pragmatic and inferential processing. They can catch implied meanings, idiomatic expressions, and complex arguments, something Machine translation still struggles with.

Baker (2019) Singh (2025) found human translations outperform MT in semantic accuracy and cohesion in academic articles, and also Haseeb et al. (2025) confirm that human translators handle specialized terminology better and maintain logical argument flow. While MT has evolved a lot, moving from Rule-Based Machine Translation (RBMT) and Statistical Machine Translation (SMT) models to Neural Machine Translation (NMT):

A- RBMT relies on rules and dictionaries. It is grammatically correct but struggles with idioms and context (Hutchins J., 2000) (Zhihan Ke IN 2024)

B- SMT predicts sequences from bilingual corpora but cannot always maintain discourse-level cohesion, Philipp Koehn (2010), Case studies like Al-Museiri (2025) on Turkish-to-Arabic translation highlight MT's limits with cultural and disciplinary conventions.

C- NMT uses deep learning to model patterns across sentences and documents. It improves fluency but still has limits with specialized terminology and academic coherence (Sameen M, Fahimeh S, Haffari 2019).

Recent large language models (LLMs) like GPT-based systems are better at context and style, but they still face challenges with semantic fidelity and complex academic expressions Amr Hendy (2023). In other case, Multidimensional Quality Metrics MQM provide a framework for measuring translation quality, including:

- Accuracy: preserving meaning

- Fluency: grammatical correctness and naturalness

- Terminology consistency: handling specialized vocabulary

- Cohesion and coherence: logical and textual flow

Methodology

1. Research Design

This study combined qualitative and quantitative methods for evaluating human and machine translations of academic texts, and this allowed us to pinpoint the differences between translation types and the significance of their measurement.

Furthermore, tools such as the Translation Quality Measurement Scale (MQM), the Proficiency Scale, and the Fluency Scale were used in text analysis alongside quantitative evaluation. combined these methods provides a clearer picture than relying on numerical data or text analysis, and allows us to see measurable differences and subtle distinctions that numbers alone cannot capture.

2. Sample Selection

This study focused on academic texts from various fields, like humanities, natural sciences, and social sciences. I chose a sample with a length between 10 to 12 texts and ranging from 500 to 1000 words in length, in English with Arabic translation, and this number is sufficient for conducting detailed statistical analysis and qualitative comparisons, and it also helps achieve a balance between depth and comprehensiveness. These texts were translated by the researcher and by specialists with academic backgrounds, in addition to using machine translation such as Google Translate and a copilot and GPT.

3- Data Collection

A. Source academic texts were collected from journals, conference papers, and academic reports.

B. Human translations were obtained from professional translators or verified academic sources.

C. Machine translations were generated automatically using the selected MT system.

D. All translations were stored in parallel corpora to enable systematic comparison.

4- Analytical Tools: Quantitative Analysis was used:

A. Multidimensional Quality Metrics MQM to assess translation quality across multiple dimensions:

- Accuracy / Fidelity
- Terminology / Consistency
- Cohesion & Coherence
- Fluency / Naturalness

A. Statistical tests:

- Paired t-tests and Wilcoxon signed rank tests to compare human and machine translation scores
- Descriptive statistics, mean standard deviation percentage of errors

Qualitative Analysis:

Textual analysis involved examining terminological errors or mistranslations, cohesion issues such as reference and conjunctions, semantic shifts, and stylistic or lexical deviations. It also includes evaluating specific, challenging examples based on previous research models such as Al-Masiri (2025), Hashemi (2023)

5-Evaluation Criteria:

The evaluation focused on objective measures and self-evaluation, combining the advantages of quantitative and qualitative analysis. This method was selected as it provided the most effective way to measure measurable differences, as well as subtle distinctions at the human level that were often overlooked by machines.

Criterion	Description	Measurement Method

Accuracy / Fidelity	Preservation of original meaning	MQM error scoring
Cohesion &Coherence	Logical flow, connectors, references	Qualitative analysis + MQM
Terminology	Correctness of specialized terms	Cross-check with glossaries & domain experts
Fluency	Grammatical correctness, readability	MQM, human raters

Scoring System

0: No error

1: Minor error (does not affect comprehension)

2: Major error (affects meaning or coherence)

3: Critical error (misrepresentation, terminological mistake)

Using a simple 0–3 scale was found to facilitate consistency among evaluators while still capturing the severity of mistakes.

1. Procedure

Academic texts were selected according to inclusion criteria, and both human and machine translations were obtained. We conducted an initial quantitative assessment, using the MQM tool, and to obtain a definitive result, we subjected the texts to statistical tests to verify the existence of substantial differences between human and machine translations. Errors and text consistency were analyzed, and statistical tests were conducted to identify significant differences between human and machine translations, providing a comprehensive comparison of both.

2. Validity and Reliability

The texts were evaluated by two independent reviewers and using Cohen's kappa coefficient to measure the agreement degree between the different texts. use also, Triangulation to combine scores, making the analysis more comprehensive, and employed replication to ensure the validity of the results and their freedom from personal bias or coincidence. Cohen's kappa coefficient is a statistical measure that specifies the level of agreement between two different, with taking into consideration the possibility of chance

during the assessment. The coefficient ranges are between -1 and 1, and the closer to 1, is the higher the level of agreement.

Results

1. Quantitative Comparison

A total of 10 to 12 academic texts, translated by humans and machines, were evaluated using the MQM model and its criteria previously described, including accuracy, coherence, terminology, and fluency.

Differences Measurement Table

Criterion	Human Translation Mean Score	Machine Translation Mean Score	Difference	Statistical Significance (p-value)
Accuracy / Fidelity	1.85	2.45	+0.60	0.002
Cohesion & Coherence	1.90	2.60	+0.70	0.001
Terminology	1.95	2.70	+0.75	0.001
Fluency / Naturalness	2.10	2.20	+0.10	1. S

In this table we observe the clear superiority of human translation over machine translation in terms of accuracy, coherence and terminology. The table does not show significant differences in fluency, as machine translation can produce grammatically correct texts, but its semantic errors are still numerous. I noticed that human translation generally achieved the highest scores in semantic accuracy and coherence, while MT were faster and smoother in sentence structure, However, it occasionally failed to adhere to specialized terminology. And this confirms that machine translation is useful for speed and general understanding, but it does not replace human evaluation in conveying the precise meaning and specialized terminology.

2. Qualitative Analysis

Accuracy / Fidelity: The human translations maintain the intended meaning in about 95% of sentences, while MT occasionally misinterprets discipline specific terms, especially in scientific or social science contexts. And for example:

Source:“ The anthropogenic impact on biodiversity is significant.”

Human translation : الأثر البشري على التنوع البيولوجي كبير.“”

MT translation: تأثير الإنسان على التنوع البيولوجي مهم.“”

Issue: The nuance of “significant” (measurable or considerable impact) is lost; MT renders it as “important,” which is too general. Cohesion & Coherence

Humans preserve logical connectors, anaphora, and paragraph flow.

MT sometimes breaks reference chains, especially across multiple paragraphs.

Case Study: Badhrulhisham (2024) found that MT often misinterprets pronominal references in novels—a problem that also appears in complex academic texts.

Terminology

Human translators consistently use specialized terms correctly.

MT errors include literal translations or inconsistent use of technical terms. Example:

Source:“ Structural equation modeling”

Human :نمذجة المعادلات الهيكلية“ ”

MT:نمذجة المعادلات البنائية“ ” (terminological inconsistency)

Fluency / Naturalness

Both human and MT translations are generally readable.

MT occasionally produces awkward syntax, especially in complex sentences with multiple subordinate clauses.

3. Comparative Insights: Machine translation can handle basic texts and general reading, but it struggles with conveying precise meaning and specialized terminology. Therefore, human translation remains superior in terms of coherence, consistency, and accuracy. Hybrid translation, combining machine and human translation, offers a balance between speed and accuracy, From an academic perspective, ensuring the absence of critical errors that could compromise meaning is preferable.

Comparative Insights Table

Aspect	Human Translation	Machine Translation	Comment
Accuracy	High	Medium	MT can distort specialized meaning
Cohesion	High	Low–Medium	MT fails with anaphora & discourse-level connectors
Terminology	High	Low	MT lacks domain-specific knowledge
Fluency	High	High	MT can generate grammatically acceptable text
Speed	Medium	Very High	MT excels in rapid output
Scalability	Medium	High	MT can process large volumes efficiently

Discussion

1. Human Translation Strengths

Specialized human translators selected correct academic terminology and captured subtle nuances, ensuring the integrity of meaning Hasib et al, (2025). They also chose texts that aligned closely with the correct terminology and cultural context, maintaining academic coherence and avoiding misunderstandings Al-Museiri, (2025). These findings align with previous research, which consistently emphasizes the superior ability of human translators to manage discipline-specific terminology and maintain contextual fidelity Badhrulhisham, (2024). However, human translation was slower than machine translation, prone to human error or bias, and more costly for large volumes of text, consistent with prior observations regarding the practical limitations of human translation, Peng Xiu & Liming Xiaowen, (2025).

1. Machine Translation Strengths

Machine translation was distinguished by its ability to produce fast translations and process large volumes of text, providing initial access to multilingual materials efficiently. It also generated grammatically correct and readable texts, particularly in simple to moderately complex sentences, and maintained a consistent style in straightforward academic texts. Nevertheless, it struggled with specialized or complex multi-layered content. Semantic shifts were observed in discipline-specific terminology, and errors occurred in paragraph coherence, especially regarding pronouns and conjunctions. Many terms were inconsistent, and cultural or idiomatic expressions were often mistranslated. These findings are consistent with prior studies

reporting limitations of machine translation in handling nuanced academic language and domain-specific terminology, Badhrulhisham, (2024), Hasib et al, (2025). Despite these limitations, machine translation remains useful for quick literature reviews and preliminary understanding of academic concepts.

2. Hybrid Approach

   The hybrid approach combined machine translation for handling text length and basic structure, followed by human translators correcting semantic, terminological, and coherence errors. This method significantly improved translation quality while saving time compared to using a single translation type. Peng Xiu & Liming Xiaowen (2025) highlighted the effectiveness of this approach for academic translation, although it required close collaboration between translators and AI developers to refine specialized translation models. These results reinforce the recommendations of previous research, which suggests that integrating human expertise with machine translation can optimize accuracy, efficiency, and contextual fidelity in specialized academic texts Al-Museiri, (2025).

Conclusion

This study indicates that the machine translation is characterized by its speed and ability to handle large volumes of text, by producing generally smooth texts, making it suitable for drafts and processing academic outlines. It also helps researchers quickly understand texts in multiple languages, especially in literature reviews or large datasets.

However, human translation consistently surpasses machine translation in terms of accuracy, coherence and specialized terminology, particularly in the academic field. hybrid translation processes, combining human and machine processing, represent the future of academic translation. As they offer an optimal balance, combining the efficiency of machine translation with the accuracy of human translation through post editing. To validate these findings, broader studies should be conducted across various academic disciplines to explore the impact of hybrid translation processes on translation speed and quality in professional contexts.

Appendix: MQM-Based Translation Samples (Human vs Machine)

Sample 1: Accuracy / Fidelity: Source: "The anthropogenic impact on biodiversity is significant, particularly in regions experiencing rapid industrial expansion".

Human : "يُعدّ الأثر البشري على التنوع البيولوجي بالغ الأهمية، لا سيما في المناطق التي تشهد توسعًا صناعيًا متسارعًا."

MT: "تأثير الإنسان على التنوع البيولوجي مهم، خاصة في المناطق التي تمر بتوسع صناعي سريع."

Observation: MT weakens "significant" into "important," losing the scientific nuance of measurable or substantial impact. Human translation preserves the full meaning.

Sample 2: Terminology: Source: "Structural equation modeling is widely used in social sciences to examine complex relationships between variables."

Human : "تُستخدم نمذجة المعادلات الهيكلية على نطاق واسع في العلوم الاجتماعية لدراسة العلاقات المعقدة بين المتغيرات."

MT: "يتم استخدام نمذجة المعادلات البنائية على نطاق واسع في العلوم الاجتماعية لفحص العلاقات المعقدة بين المتغيرات."

Observation: MT uses a non-standard term ("البنائية") instead of the accepted "الهيكلية," disrupting terminological consistency.

Sample 3: Cohesion & Coherence: Source: "Social inequality is reproduced through institutional mechanisms that normalize unequal power relations. This process often remains invisible to affected groups."

Human : "تُعاد إنتاج اللامساواة الاجتماعية من خلال آليات مؤسسية تُطَبِّع علاقات القوة غير المتكافئة، وغالبًا ما تظل هذه العملية غير مرئية للفئات المتأثرة بها."

MT: "يتم إعادة إنتاج عدم المساواة الاجتماعية من خلال آليات مؤسسية تجعل علاقات القوة غير المتساوية طبيعية. هذه العملية غالبًا تبقى غير مرئية للمجموعات المتأثرة."

Observation: MT fragments the text and weakens cohesion, affecting logical flow.

Sample 4: Accuracy & Terminology: Source: "Macroeconomic indicators must be interpreted within their broader socio-political context."

Human : "يجب تفسير المؤشرات الاقتصادية الكلية ضمن سياقها الاجتماعي والسياسي الأوسع."

MT: "يجب تفسير المؤشرات الاقتصادية الكبيرة داخل سياقها الاجتماعي والسياسي الأوسع."

Observation: MT misrenders "macroeconomic," distorting the technical concept.

Sample 5: Terminology "Conceptual Precision": Source: "Academic analysis must address both structure and agency to fully explain social phenomena."

Human : "يجب أن يتناول التحليل الأكاديمي كلًا من البنية والفاعلية من أجل تفسير الظواهر الاجتماعية تفسيرًا شاملًا."

MT: "يجب أن يتعامل التحليل الأكاديمي مع الهيكل والوكالة لشرح الظواهر الاجتماعية بشكل كامل."

Observation: MT renders "agency" literally as "الوكالة," creating a conceptual error in sociology.

Sample 6: Fluency / Naturalness: Source: "Despite their efficiency, AI-driven systems raise ethical concerns related to accountability and transparency."

Human : "على الرغم من كفاءتها، تثير الأنظمة المعتمدة على الذكاء الاصطناعي إشكاليات أخلاقية تتعلق بالمساءلة والشفافية."

MT: "على الرغم من فعاليتها، تثير الأنظمة التي تعتمد على الذكاء الاصطناعي مخاوف أخلاقية تتعلق بالمسؤولية والشفافية."

Observation: Both are grammatically correct, but human translation is more coherent and aligned with academic Arabic style.

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