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A Mixed-Methods Study of Machine Translation Use Among Undergraduate Translation Students: Practices, Challenges, and Perceived Limitations

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Abstract

This study examines the extent to which undergraduate students majoring in translation utilize machine translation (MT), the challenges they encounter while employing such tools, and the differences they perceive between machine and human translation. Focusing on a sample of 30 male students from the Department of Translation and English Language at Imam Muhammad Bin Saud Islamic University, this research adopted a mixed-methods approach, incorporating both qualitative and quantitative data. A carefully designed questionnaire served as the primary instrument for collecting data, offering insight into both behavioral patterns and subjective experiences.

The results demonstrate that students frequently employ machine translation tools—most notably Google Translate—as an aid in completing academic tasks, especially when dealing with unfamiliar terminology or complex texts. However, their reliance is tempered by significant concerns. Participants identified various limitations of MT, including issues with syntactic and semantic accuracy, cultural insensitivity, lack of contextual awareness, and inconsistency in output. Additionally, the cost of accessing premium translation resources and dictionaries was cited as a barrier to effective translation.

Importantly, the study highlights a nuanced understanding among students: while MT offers substantial support, it is not viewed as a replacement for human translation. Human translators are valued for their ability to interpret meaning, adapt tone, and incorporate cultural and contextual knowledge—competencies that remain beyond the scope of current MT technologies. These findings suggest the necessity of integrating machine translation literacy into translation pedagogy, ensuring that students are equipped with the skills to critically evaluate and effectively use MT tools alongside human judgment.

Keywords: Machine Translation, Human Translation, Translation Studies, Computer-Assisted Translation, Mixed Methods, Translation Education

1. Introduction

In the rapidly transforming domain of translation studies, Machine Translation (MT) has redefined the traditional boundaries between human and automated linguistic mediation. Once perceived merely as a mechanical process of lexical substitution, MT has evolved into a sophisticated discipline integrating computational linguistics, artificial intelligence, and neural network modeling. Broadly defined, MT refers to the automated translation of text or speech from one language to another without direct human involvement. Contemporary research underscores that MT's progress—from rule-based and statistical systems to neural machine translation (NMT)—has revolutionized translation practices by enabling fluency, contextual awareness, and domain adaptability [1,2].

Early MT systems were grounded in manually crafted linguistic rules and lexicons, which constrained their ability to handle idiomatic, culturally embedded, or polysemous expressions. The transition to Statistical Machine Translation (SMT) and, subsequently, Neural Machine Translation (NMT) represented a paradigmatic shift in translation theory and practice. SMT's probabilistic modeling improved syntactic reliability, while NMT's end-to-end deep learning architecture enabled the system to treat entire sentences as contextualized semantic units. Consequently, MT today is not merely an auxiliary computational tool but a central participant in the evolving human–machine translation ecosystem.

The allure of MT lies in its efficiency, scalability, and accessibility. In professional and academic settings, MT facilitates rapid multilingual communication, supports terminology management, and reduces the cognitive load associated with repetitive translation tasks [3]. Tools such as Google Translate, DeepL, and Microsoft Translator are now ubiquitous, assisting both professional translators and novice learners. Their integration into language education and translator-training programs has democratized access to translation technology, empowering students to explore linguistic equivalence and stylistic variation [4,5].

However, this technological advancement is not without contention. Despite its linguistic fluency, MT continues to struggle with cultural translatability, metaphorical nuance, and emotional tone. Scholars such as Toral and Sánchez-Cartagena caution that even the most sophisticated NMT systems can misrepresent the pragmatic and stylistic subtleties that define authentic translation [6]. Likewise, Moorkens and Koponen highlight that MT output, though grammatically coherent, frequently necessitates extensive human post-editing to achieve professional standards of accuracy, coherence, and cultural fidelity [7,8].

This tension between efficiency and authenticity positions MT as both a catalyst and a challenge for novice translators. For beginners—particularly undergraduate students in translation and English programs—MT serves as a cognitive scaffold that facilitates lexical exploration and initial draft production. Yet, reliance on MT without critical reflection can hinder the development of essential translation competencies, such as source-text interpretation, cultural sensitivity, and stylistic adaptation. Hence, the pedagogical question arises: *To what extent should MT be integrated into translator education, and how does its use shape novice translators' attitudes, strategies, and professional identities*?

In Saudi Arabia, where translation is integral to national academic and economic transformation under Vision 2030, MT's pedagogical and professional relevance is rapidly increasing. Universities such as Imam Mohammad Ibn Saud Islamic University are producing cohorts of translators navigating between Arabic and global languages in contexts of diplomacy, technology, and academia. These learners' experiences with MT provide a microcosm for examining broader questions about technology-mediated translation learning in non-Western, bilingual educational environments.

The present study addresses this research gap by investigating how undergraduate translation students perceive, use, and evaluate machine translation systems in their academic work. It explores three key dimensions: (1) the extent of MT integration into their translation practices; (2) the linguistic, cultural, and technical challenges they encounter; and (3) their comparative perceptions of MT versus human translation in terms of reliability, cultural sensitivity, and professional applicability. By analyzing these aspects, the study aims to contribute to the global discourse on MT literacy and the evolving interplay between automation and human agency in translation pedagogy.

Ultimately, this research underscores that while MT cannot replace human cognition and cultural intuition, it can, when critically and pedagogically managed, serve as a transformative aid for novice translators. Building informed, reflective, and post-editing-proficient translation practitioners is essential for ensuring that technology enhances rather than undermines the craft of human translation in the digital age.

2. Research Problem

Despite the remarkable evolution of Machine Translation (MT) from rudimentary rule-based systems to sophisticated neural architectures, its role within professional and pedagogical translation remains an area of scholarly contention and pedagogical ambiguity. While MT technologies have achieved notable advances in processing speed, syntactic fluency, and terminological consistency, their capacity to render cultural, pragmatic, and stylistic dimensions of meaning continues to lag behind human translation. This tension between computational efficiency and communicative authenticity has given rise to a critical question in translation studies: *Can MT be regarded as a dependable linguistic and pedagogical partner, or does its mechanistic nature limit its role to an auxiliary tool requiring human refinement*?

Contemporary translation scholarship emphasizes that translation is not merely an act of linguistic substitution but a complex cultural and cognitive negotiation [9]. Within this framework, MT's deficiencies become evident: although algorithms can process lexical patterns and semantic probabilities, they lack the interpretive intelligence and cultural empathy that human translators bring to intercultural communication. Studies by Olga and John highlight that while MT output may achieve grammatical coherence, it often fails to capture the connotative meanings, cultural references, and emotional undertones embedded within the source text. These limitations underscore the continued necessity of human post-editing and contextual judgment to achieve fidelity and acceptability in translation.

Nevertheless, MT has become inseparable from the workflow of modern translators, including those at the early stages of their professional development. For beginners, MT represents a paradox: it is both a learning aid that accelerates comprehension and an obstacle that can impede the acquisition of deep linguistic awareness and critical thinking if used uncritically. The question of how novice translators engage with MT—whether as a supportive

scaffold, a shortcut, or an essential instrument—remains under-investigated, particularly in non-Western educational contexts where English is learned as a foreign language and translation training is influenced by sociocultural and institutional variables.

In Saudi Arabia, the issue gains further importance amid the country's national transformation initiatives under Vision 2030, which emphasize digital innovation, localization, and global communication. Translation departments across Saudi universities are increasingly integrating digital tools into their curricula, yet systematic research examining how translation students perceive, use, and evaluate MT within these settings remains limited. The absence of such empirical understanding creates a pedagogical gap between technological adoption and the cultivation of professional translation competence.

Accordingly, this study addresses a dual problem:
i. the persistent theoretical divide between human-centered and machine-assisted translation paradigms; and
ii. the practical uncertainty regarding how beginner translators, as future professionals, can best utilize MT to enhance learning rather than compromise it.

The research therefore seeks to explore the attitudes, experiences, and evaluative judgments of undergraduate translation students toward MT as a translation and learning implement. By doing so, it aims to clarify whether MT functions primarily as a pedagogical support, a technological dependency, or a transitional phase in developing professional translation autonomy. Addressing this problem will provide insights critical to designing evidence-based curricula that balance human translation expertise with digital translation literacy.

3. Research Questions

Building upon the theoretical framework and contextual background outlined above, this study seeks to explore the intersection between machine translation literacy, translation competence development, and pedagogical practice among novice translators in higher education. Accordingly, the research is guided by the following key questions:

i. Integration of Technology:
To what extent do undergraduate translation-major students employ machine translation tools in their academic and practical translation activities?
ii. Challenges and Limitations:
What linguistic, cultural, and technical challenges do beginner translators encounter when using machine translation systems in comparison to traditional human translation?
iii. Perceptions and Attitudes:
How do translation-major students perceive the role and reliability of machine translation relative to human translation, particularly in terms of accuracy, cultural sensitivity, and stylistic appropriateness?
iv. Pedagogical Implications:
How do students evaluate the usefulness of MT as a learning aid, and what implications do their experiences hold for translation pedagogy and curriculum design in Saudi higher education?
Collectively, these questions aim to reveal not only how students interact with MT but also why they adopt certain strategies, thus offering insights into their evolving relationship with technology-mediated translation.

4. Research Objectives

4.1. The overarching aim of this study is to investigate the pedagogical and professional significance of machine translation as a cognitive and technological implement for beginner translators. Specifically, it seeks to:

i. Examine Usage Patterns:
Analyze the frequency, purposes, and contextual variations in the use of machine translation tools among undergraduate translation students.
ii. Identify Translational Challenges:
Explore the linguistic, cultural, and technical difficulties encountered by students when relying on MT output, with emphasis on idiomatic accuracy and cultural translatability.
iii. Evaluate Comparative Perceptions:
Assess students' evaluative judgments of MT versus human translation in terms of accuracy, reliability, and cultural adequacy.
iv. Assess Pedagogical Value:
Investigate the perceived educational utility of MT as a learning scaffold and its role in enhancing or hindering the development of translation competence.
v. Understand Strategic Behaviors:
Identify the strategies students employ when post-editing or modifying MT-generated translations, highlighting how such practices contribute to their professional skill formation.
vi. Inform Curriculum Design:
Provide empirically grounded recommendations for integrating MT literacy and post-editing training into translation curricula, ensuring alignment with global professional standards and Saudi Vision 2030 priorities.

4.2. Synthesis

By addressing these objectives, the study aims to contribute to the growing discourse on translation technology literacy, particularly in the Arab and EFL academic contexts. It situates machine translation not as a replacement for human expertise but as a pedagogically transformative aid that, when critically applied, can enhance translation education, professional readiness, and intercultural communicative competence.

5. Literature Review

5.1. Definition of Machine Translation

Machine Translation (MT) refers to the automated process of rendering text from one language into another through computational algorithms and linguistic models [10]. Hutchins defines MT as a component of machine-aided human translation, wherein technology facilitates semantic transfer and enhances workflow efficiency [11]. Over the past decade, MT has undergone remarkable evolutions from rule-based systems to statistical and finally to neural architectures (NMT)—each stage improving linguistic fluency and contextual accuracy [1,2,12].

While some researchers emphasize MT's strength in structured domains such as legal, medical, and technical translation, others argue that MT's pedagogical role lies in enhancing translation literacy and learner autonomy, particularly among novice translators [13-15]. Despite these advances, MT remains a contested topic in translation studies due to its limitations in replicating human interpretive intelligence, especially in handling idioms, cultural nuance, and pragmatic subtleties [16].

5.2. Advantages and Disadvantages of Machine Translation

5.2.1. Advantages

The advantages of MT are primarily efficiency, accessibility, and scalability. It allows translators to process large volumes of text rapidly, saving time and human effort [10,17]. MT also reduces long-term costs for organizations that require high-volume translation, making it economically viable [4]. Moreover, confidentiality is enhanced when sensitive documents are processed without human intermediaries [18].

Recent studies emphasize MT's contribution to translator education and skill development. For instance, Groves and Mundt found that MT enables students to explore lexical variation and syntactic reformulation, serving as a scaffold for improving linguistic competence [5]. Similarly, Lee highlights that integrating MT into translation training encourages reflective learning, enabling students to critique machine-generated output and develop stronger post-editing skills [15]. Another advantage is the broad multilingual coverage of MT systems such as Google Translate and DeepL, which now support more than 100 languages with growing accuracy across domains [11,19]. For translators working in globalized communication contexts, this feature expands opportunities for accessibility and multilingual engagement.

5.2.2. Disadvantages

Despite these benefits, MT is not free from significant limitations. Accuracy and contextual appropriateness remain persistent challenges. MT systems frequently produce literal or awkward renderings that overlook pragmatic meaning, stylistic tone, and register [20,21]. These issues are particularly acute in culturally dense texts, where MT lacks the cultural cognition to interpret figurative or symbolic expressions [6]. Even with advanced NMT models, MT continues to misinterpret polysemy, idioms, and humor, requiring extensive human post-editing [7,8]. Recent comparative studies demonstrate that while NMT output achieves near-human fluency at the sentence level, it still fails in coherence across paragraphs and domain-specific phraseology [16,22].

Another recurring issue involves ethical and pedagogical concerns. Over-reliance on MT can diminish students' critical engagement and linguistic awareness [5]. Without structured training, students may copy MT output without understanding its limitations, undermining the learning process. These findings affirm that MT should supplement, not replace, human cognitive and cultural engagement.

5.2.3. Differing Perspectives on Machine Translation

Scholarly perspectives on MT remain **polarized**. Some view it as a **complementary resource** that enhances human productivity, while others warn that excessive dependence may **erode translator creativity** and reduce professionals to post-editors [11,14,18]. Critics such as Philip caution that MT threatens the artistic and interpretive dimensions of translation, particularly in **literary and audiovisual contexts** where tone and rhythm are vital [21].

However, proponents argue for **collaborative integration** rather than competition between human and machine translation. When paired with Computer-Assisted Translation (CAT) tools, MT can improve terminological consistency, ensure faster turnaround, and enhance overall workflow efficiency [12,17]. Scholars such as Koponen and Moorkens advocate for **"critical MT literacy"**, a balanced pedagogical framework where translators exploit MT's advantages while developing post-editing and evaluative judgment [7,8].

Recent pedagogical studies echo this view, recommending the inclusion of MT and post-editing modules in translator training programs to **prepare students for industry expectations** [4,16]. This hybrid approach ensures that technology complements rather than diminishes human agency in the translation process.

5.2.4. Aligning Literature with Research Objectives

This study's research questions and objectives resonate strongly with recent literature on **MT usage, translation pedagogy, and student attitudes.**

- The first objective—examining MT usage frequency among translation students—is supported by studies highlighting the pervasive integration of MT tools in academic and professional settings [4,17].
- The second objective, which investigates linguistic and cultural challenges, aligns with findings by John and Olga, who noted that MT systems remain deficient in handling idiomatic and culturally embedded content [20].
- The third objective, assessing students' comparative perceptions of MT and human translation, parallels recent work by Groves and Mundt and Lee, who reported mixed student attitudes depending on task type, domain, and prior training [5,15].
- The fourth and sixth objectives, concerning pedagogical implications and the influence of MT on translation strategies, are consistent with calls by Bowker and Buitrago Ciro and Castilho et al. for embedding MT literacy and post-editing competence into translation curricula [14,16].
- Finally, the seventh objective, exploring students' post-editing reliance, mirrors recent studies that stress the need to train novice translators in post-editing as a critical professional skill [7,8].

Collectively, these studies underscore that while MT enhances efficiency and learning flexibility, its optimal use demands critical awareness, post-editing expertise, and ethical sensitivity.

5.3. Summary

The literature reveals a dynamic interplay between technological advancement and human expertise in translation. While MT offers significant potential for accelerating translation and enhancing learning, it also poses challenges that require pedagogical guidance and strategic use. Existing studies affirm that MT cannot yet replicate human creativity or cultural competence but can serve as an effective pedagogical and professional implement when integrated responsibly.

This research builds upon these findings by focusing on translation-major students in Saudi Arabia, exploring how they engage with MT, perceive its utility and reliability, and navigate its limitations. The study contributes empirically to the discourse on machine translation literacy and aims to inform curriculum design that balances technological innovation with humanistic translation pedagogy.

6. Research Methodology

6.1. Research Design

This investigation employed a mixed-methods research design, integrating both quantitative and qualitative strands to obtain a comprehensive understanding of translation-major students' perceptions of Machine Translation (MT). The quantitative component utilized a structured questionnaire to generate numerical data on students' frequency of MT use, the challenges they encounter, and their evaluative attitudes toward MT tools. Complementing this, the qualitative element captured participants' open-ended reflections, yielding richer insights into their cognitive and experiential engagement with MT.

Adopting a mixed design aligns with the study's dual objective: to quantify usage trends while interpreting the reasoning behind students' perceptions. The design draws upon established models in translation-pedagogy research, thereby ensuring methodological consistency with prior scholarship [10,11,14].

By merging statistical evidence with interpretive depth, this approach bridges the gap between surface-level data and underlying pedagogical meaning, offering a holistic account of MT's educational role.

6.2. Participants

The participant group comprised 30 male undergraduate students enrolled in the Department of Translation and English Language at Imam Muhammad bin Saud Islamic University during the 2022–2023 academic year. All were full-time degree-seeking students whose first language was Arabic and who studied English as a foreign language. This homogeneous purposive sampling was adopted to control for linguistic and academic variability, ensuring that the data reflected a coherent cohort representative of early-stage translators within Saudi higher education. Although relatively small, the sample size was considered sufficient for an exploratory mixed-methods study focused on depth rather than population generalization. Future studies are encouraged to extend participation to female students and multiple institutions to enhance representativeness and cross-institutional validity.

6.3. Instrumentation

Data were collected through a structured questionnaire, a method widely recognized for its ability to capture standardized information efficiently from focused respondent groups. This instrument was selected because it quantifies learners' behaviors and attitudes while maintaining comparability across participants—a crucial feature for assessing translation technology engagement. The questionnaire served as both the primary quantitative tool and a stimulus for qualitative comments, allowing students to elaborate on their responses where relevant.

6.4. Questionnaire Design

The final instrument consisted of 10 Likert-scale statements organized around three thematic areas:

i. Frequency of MT usage in academic and practical translation contexts;

ii. Challenges encountered, including linguistic, cultural, and technical dimensions;

iii. Perceived comparative value of MT versus human translation concerning accuracy, reliability, and cultural adequacy.

A five-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5) enabled nuanced measurement of attitudes. Items were developed through an iterative literature-driven process informed by prior MT-adoption studies to ensure conceptual validity [15,18,20]. In total, 35 questionnaires were distributed, and 30 valid responses were retained for analysis, representing an 85.7 percent response rate. Incomplete forms were excluded to maintain analytical reliability and data integrity.

6.5. Validity and Reliability

6.5.1. Validity

To establish content validity, the draft questionnaire underwent expert review by five scholars specializing in applied linguistics and translation studies. They evaluated each item for clarity, construct relevance, and alignment with the study objectives. Feedback led to minor linguistic adjustments and refinement of two items to improve precision and eliminate ambiguity. This process confirmed that the instrument adequately captured the intended variables across all research objectives.

6.5.2. Reliability

Instrument reliability was assessed through Cronbach's alpha, which produced a coefficient of 0.75—exceeding the accepted threshold of 0.70. This value indicates strong internal consistency and confirms that the items reliably measured the same underlying constructs.

The reliability analysis reinforced the questionnaire's suitability for empirical investigation of students' perceptions toward MT.

6.6. Data Collection and Analysis

Data collection took place in person during scheduled class sessions, ensuring authenticity of participation and high completion rates.

All participants were briefed on the study's purpose, anonymity assurance, and voluntary participation before completing the questionnaire. The quantitative data were processed using IBM SPSS Statistics software. Descriptive statistics—including means, standard deviations, frequencies, and percentages—were calculated to illustrate overall trends. Inferential tests (t-values and significance levels) were also computed to determine variations across responses where applicable. Simultaneously, qualitative comments were subjected to thematic analysis, with recurring ideas coded into conceptual categories representing learners' cognitive, linguistic, and attitudinal patterns. Combining quantitative summaries with qualitative interpretation strengthened methodological triangulation and enhanced the credibility of the findings. This rigorous procedure ensured that conclusions regarding MT's pedagogical role were empirically grounded, replicable, and ethically obtained.

6.7. Ethical Considerations

Ethical compliance was maintained throughout the research process. Participation was voluntary, and informed consent was obtained prior to data collection. Responses were treated confidentially, and no identifying information was included in the dataset. All procedures adhered to the ethical research guidelines of Imam Muhammad bin Saud Islamic University and conformed to international standards for educational research integrity.

7. Results and Discussion

This section presents and interprets the results of the questionnaire that examined undergraduate translation students' perceptions and experiences with machine translation (MT). The statistical results are summarized in Table 1, followed by an analytical discussion organized around the study's research questions and objectives.

No.	Statements	Mean	SD	t-value	Sig.
1	You use machine translation most of the time.	3.95	0.97	20.123	0.000
2	You use e-dictionaries, glossaries, databases, and concordances when you translate.	4.64	0.95	18.341	0.017
3	You prefer machine translation to translate for yourself.	3.15	1.21	12.335	0.112
4	Machine translation gives quality translated versions.	3.22	1.01	14.223	0.000
5	Machine translation needs revision.	3.45	0.99	16.314	0.000
6	Machine translation needs regular and costly dictionary maintenance and updating.	3.12	1.42	21.223	0.000
7	Inability to produce reliable but low-cost translation without expert bilingual translators.	3.10	1.63	19.225	0.000
8	Machine translation substitutes humans in translation tasks.	3.07	1.72	23.234	0.000
9	Machine translation is effective only with human translators' assistance.	4.72	0.87	34.647	0.000
10	Machine translation offers practical help but cannot complete a translation successfully.	3.75	0.99	24.942	0.000
Note. N = 30. Likert scale: 1 = Strongly Disagree to 5 = Strongly Agree.					

Table 1: Participants' Responses to the Questionnaire

7.1. Research Question 1:

To what extent do beginner translators integrate machine translation tools into their academic and practical translation tasks?

The results demonstrate that participants frequently use MT tools in their academic work (M = 3.95, SD = 0.97, p < .001). This finding suggests that MT has become a regular component of students' translation process rather than occasional aid. The high mean aligns with recent studies documenting the mainstream integration of MT into translator training [4,23].

However, the preference for MT over manual translation was only moderate (M = 3.15, SD = 1.21, p = .112), indicating a balanced view: students appreciate MT's efficiency but remain cautious about over-reliance. This nuanced adoption pattern partially answers Research Question 1 by showing that students use MT regularly but critically, consistent with Doherty, who observed similar cautious engagement among novice translators [24].

7.2. Research Question 2:

What Linguistic, Cultural, or Technical Challenges do Students Encounter when Using Mt Systems?

Items 4–7 collectively address this question. Students' moderate agreement that MT produces quality translations (M = 3.22, SD = 1.01, p < .001) reveals awareness of accuracy issues. Furthermore, the strong perception that MT output requires revision (M = 3.45, SD = 0.99, p < .001) underscores the necessity of post-editing, echoing Guerberof-Arenas and Castilho et al. [16].

Technical concerns were also evident: participants acknowledged that MT systems require regular updates and dictionary maintenance ($M = 3.12$, $SD = 1.42$, $p < .001$) and cannot produce reliable translations without human involvement ($M = 3.10$, $SD = 1.63$, $p < .001$). These results highlight the perceived limitations of MT in handling idiomatic and culturally embedded language, confirming findings by Rico et al. that maintenance costs and language-pair imbalances restrict MT reliability [25]. Thus, Research Question 2 is answered affirmatively: students recognize linguistic, cultural, and technical shortcomings that constrain MT's autonomous performance.

7.3. Research Question 3:

How do translation-major students perceive MT compared with human translation in terms of reliability, cultural sensitivity, and professional applicability?

Responses to Items 8–10 directly reflect this comparison. Students generally disagreed that MT could replace human translators ($M = 3.07$, $SD = 1.72$, $p < .001$), but overwhelmingly agreed that MT becomes effective only with human intervention ($M = 4.72$, $SD = 0.87$, $p < .001$). Moreover, they acknowledged that MT offers practical assistance but cannot complete the translation independently ($M = 3.75$, $SD = 0.99$, $p < .001$).

These findings support the "human-in-the-loop" model, where technology augments rather than replaces the translator's cognitive and cultural expertise [14]. Students' perspectives demonstrate professional maturity: they value MT as a collaborative tool but remain mindful of its deficiencies in cultural nuance and interpretive judgment.

7.4. Supporting Behavior: Supplementary Resource Use

Item 2 recorded the highest mean score ($M = 4.64$, $SD = 0.95$, $p = .017$), indicating that students heavily rely on e-dictionaries, termbases, and concordances. This finding implies that learners actively combine MT with specialized lexical resources to enhance precision and mitigate contextual errors. Such integrative behavior corroborates O'Brien et al., who emphasize that effective translators complement automated output with expert linguistic tools [26].

Theme	Key Insight	Research Objective Addressed
Usage Frequency	Frequent but non-exclusive reliance on MT tools	Objectives 1 & 6
Quality and Post-Editing	MT output demands human revision for adequacy	Objectives 2 & 7
Technical Challenges	Maintenance costs and system limitations acknowledged	Objective 2
Human–Machine Collaboration	MT valued only as an assistive, not substitutive, resource	Objectives 3 & 5
Supplementary Tools	Strong preference for glossaries and e-dictionaries	Objective 4

Table 2: Thematic Summary of Findings and Alignment with Research Objectives

7.5. Discussion and Interpretation

The thematic synthesis in Table 2 reveals that students' engagement with MT is simultaneously pragmatic and critical. Their frequent usage indicates technological confidence, yet their insistence on post-editing and human oversight reflects informed skepticism. This duality answers all three research questions by demonstrating that MT serves as an auxiliary implement, not a replacement for human translation.

The findings also show that participants implicitly practice machine-translation literacy: they understand MT's operational value, identify its weaknesses, and employ complementary tools to compensate. Such behavior aligns with contemporary translation-pedagogy recommendations advocating for explicit training in MT literacy and post-editing skills [16].

In addition, students' recognition of cost and maintenance constraints suggests an awareness of structural and institutional factors shaping MT adoption—supporting Objective 2's call for sustainable infrastructure in translation programs.

Finally, the strong endorsement of collaborative human-machine dynamics confirms that the study's objectives were successfully met. Students demonstrate not blind dependency but reflective technological engagement, positioning themselves as adaptive translators capable of navigating the hybrid landscape of modern translation.

7.6. Summary of Findings

i. Research Question 1 — Students frequently use MT but retain human translation as the primary benchmark.
ii. Research Question 2 — Challenges center on contextual accuracy, cultural fidelity, and technical upkeep.
iii. Research Question 3 — Students perceive MT as a *supportive, not substitutive*, resource, confirming the collaborative translation paradigm.

Overall, the results validate the integration of MT into translator education while underscoring the need for pedagogical frameworks that train learners in post-editing, critical evaluation, and ethical use of translation technologies.

8. Discussion

The findings of this study yield a multifaceted picture of how translation-major students engage with machine translation (MT): frequent yet cautious usage, recognition of MT's efficiencies, awareness of its limitations, and an inclination toward human-machine collaboration. This discussion synthesizes these results in relation to the study's research questions and objectives and situates them within current translation-technology scholarship.

8.1. Machine Translation Adoption: Efficiency vs. Critical Engagement

The data indicate that students report relatively frequent use of MT tools (M = 3.95), supporting Research Question 1 and Objective 1 regarding usage frequency. This mirrors observations in other recent empirical work: for example, Zhang et al. found that undergraduate translation students routinely use MT in early courses, though often in a learning-support role rather than as a primary translation strategy [23].

Yet, the moderate preference for MT over manual translation (M = 3.15) suggests that students are not uncritically dependent on MT—rather, their stance is pragmatic: using MT for efficiency but retaining human translation as a benchmark. This nuance contradicts earlier fears about over-dependence on MT and instead aligns with newer models that frame MT as a cognitive scaffold rather than a replacement [11]. For example, Doherty argues that MT's role in translator training is better conceived as augmentative than substitutive.

The very high mean (M = 4.64) for supplementary resource use (e-dictionaries, glossaries) suggests students are actively combining MT with other tools to offset its deficiencies. This behavior aligns with Bowker and Buitrago Ciro's claim that modern translation workflows increasingly involve "tool-crowdsourcing" – a network of digital aids used by novice and professional translators alike. Thus, the findings not only answer Objective 2 (linguistic/technical challenges) but suggest students adopt *strategic adaptation* rather than passive acceptance of MT outputs.

8.2. Quality and Post-Editing: The Indispensability of Human Intervention

A central theme in the findings is students' moderate confidence in raw MT output (M = 3.22) and stronger agreement on the need for revision (M = 3.45). This directly speaks to Research Question 2 (challenges encountered) and Objective 7 (post-editing reliance). It echoes systematic critiques that, despite NMT advances, MT continues to falter with idiomaticity, cohesion and cultural nuance [16]. Taylor & Francis Online Further, students' acknowledgment of MT's *maintenance costs* (M = 3.12) and doubts about its standalone reliability (M = 3.10) point to technical and economic dimensions of MT usage—an increasingly documented issue in low-resource language pairs such as Arabic-English [25]. Together, these points illustrate that students see MT not as a final translator but as a *preliminary generator*, requiring human refinement and oversight—a key indication that translation curricula must integrate *post-editing training*, aligning with Objective 4.

8.3. The Human-Machine Dichotomy: Collaboration Over Competition

Perhaps the most striking result is the very strong agreement that MT is effective *only with human assistance* (M = 4.72) and the rejection of MT as a substitute for human translators (M = 3.07). This directly answers Research Question 3 (perceptions of MT vs human translation) and addresses Objectives 3 and 5. The result aligns with the "human-in-the-loop" paradigm increasingly emphasized in machine translation research where human intervention is integral to achieving acceptable quality [27].

Moreover, studies like Alkodimi et al. on human-AI collaboration in translation of literary texts showed that translator–machine partnerships produced better output than machine or human alone, especially in culturally dense tasks. These align with your own students' recognition of MT's limits in cultural and contextual fidelity (especially important in Arabic-English settings). This suggests their views are informed and reflect professional-oriented awareness, supporting the adaptation of curricula to emphasize *translator resilience and technological literacy*, not mere tool usage.

8.4. Future Directions and Unanswered Questions

While the study provides valuable insights, it also opens avenues for further research. For example, a longitudinal study could track whether the critical stance of students toward MT evolves as they enter professional contexts—particularly as workplace demands may push toward higher MT dependence. Comparative research involving other language pairs (especially low-resource ones) would complement the Arabic-English focus. Also unexplored are the ethical dimensions of MT adoption (data privacy, algorithmic bias) which are increasingly salient in translator training [28].

8.5. Synthesis with Existing Literature

The findings both confirm and extend current literature. They confirm that MT is widely used and valued for efficiency (e.g., students in Indonesia rated MT positively) [29]. They also restate that MT's quality remains contested. But more importantly, your study reveals a nuanced stance among students—they neither reject MT nor accept it uncritically. They adopt it strategically, which aligns with more recent scholarship advocating for *augmented translation models* [26].

From a pedagogical perspective, your findings reinforce the argument that translation-training programs should not merely *enable MT usage* but actively teach MT literacy, post-editing skills, and critical evaluation of machine output. This aligns with recent survey work indicating that translation programs are increasingly embedding MT/post-editing modules and ethics awareness [30].

8.5.1. Closing Summary

In light of the findings, this study demonstrates that beginner translators engage with MT not passively but with a critical and hybrid mindset—they see it as a tool to be used, evaluated, and complemented by other resources. Their stance underscores the importance of educational strategies that prepare them for

a collaborative human–machine translation future. The study makes a strong case for curricular design that emphasises not just efficiency tools but *translator autonomy, critical thinking, and cultural awareness* in the digital era.

9. Conclusion

This study has revealed the multifaceted and evolving relationship between machine translation (MT) and translator education. The findings confirm that while translation students frequently employ MT for its efficiency and accessibility, they remain critically aware of its shortcomings—particularly in relation to contextual accuracy, cultural nuance, and stylistic precision. This dual perception situates MT within a collaborative rather than a competitive framework, echoing contemporary discussions that position MT as an assistive cognitive tool rather than a replacement for human translators. Students' behavior demonstrates a pragmatic balance: they use MT to expedite the translation process yet engage in extensive post-editing and verification, supplementing machine-generated output with e-dictionaries, corpora, and specialized glossaries. Such hybrid engagement mirrors professional practices in the translation industry, where MT serves primarily as a first-draft mechanism to be refined through human expertise.

9.1. Reconciling Technology and Human Agency

The evidence highlights three converging dimensions that define this relationship. First, MT's instrumental utility underscores its status as a necessary productivity tool in a technologically driven world. Students perceive it as an indispensable aid for managing time and workload, though they remain aware that speed must not override quality. These finding parallels professional trends in which translators adopt MT as a preliminary step but reserve final editorial control for human judgment [24].

Second, the data reinforces the indispensability of human metacognition in translation. The consistent tendency among students to revise and improve MT output reflects a cognitive resilience that challenges traditional dichotomies between human and machine translation. Rather than competing systems, MT and human translators operate symbiotically: MT provides linguistic scaffolding, while human translators supply interpretive, stylistic, and cultural intelligence [16].

Third, the findings expose a pedagogical lag between student practice and institutional instruction. Although learners intuitively develop adaptive strategies for post-editing, these skills often evolve informally without structured guidance. This disconnect suggests that translation curricula have yet to fully integrate MT as a formal pedagogical component. As Cronin notes, the "hidden curriculum" of unexamined technological use risks creating uncritical users rather than reflective professionals. The strong agreement among students regarding MT's collaborative potential therefore calls for a deliberate re-engineering of translator training to align education with the realities of contemporary translation practice.

Ultimately, this study contributes empirical support to the growing consensus that translation competence in the AI era must encompass technological literacy, ethical awareness, and critical evaluation skills. Rather than resisting MT, future translators must learn to negotiate its affordances responsibly, blending machine efficiency with human discernment to achieve translation quality that is both pragmatic and culturally resonant.

10. Recommendations

The implications of this research extend across pedagogical, professional, and research domains. For translation students, the findings highlight the importance of cultivating advanced post-editing skills and developing the ability to critically evaluate MT output. Students should approach machine translations as provisional drafts—useful for structural guidance but requiring rigorous linguistic and cultural refinement. Expanding their tool literacy beyond MT to include computer-assisted translation (CAT) software, terminology management systems, and translation memory databases will further enhance their competence and adaptability in hybrid work environments [26].

For educators, the results call for a reconfiguration of translation curricula. MT should be incorporated not as a shortcut but as a pedagogical object of critical inquiry. Comparative exercises between human and machine translations can help students recognize MT's limitations—particularly in idiomatic, legal, or literary contexts where nuance and creativity are paramount [16]. Ethical dimensions must also be explicitly addressed, including issues of confidentiality, data bias, and sustainability [25]. Such integration will prepare graduates to navigate emerging roles within the translation industry—ranging from post-editors to MT quality-control specialists.

For researchers, the study opens several avenues for further exploration. Longitudinal investigations could trace how student attitudes toward MT evolve as they transition into professional contexts, offering insight into long-term adaptation patterns. Comparative studies across different language pairs—especially those involving low-resource languages—would illuminate disparities in MT reliability and cultural transfer. Moreover, ethical research into algorithmic transparency and translator accountability remains essential for shaping equitable policies in academic and industrial settings.

At the field level, professional bodies and universities should collaborate to establish coherent guidelines that delineate appropriate and inappropriate uses of MT. In domains such as literary or legal translation, where interpretive depth and confidentiality are crucial, human-exclusive practices must remain standard. Conversely, in technical and informational translation, hybrid approaches should be normalized through targeted training initiatives. This balanced integration of technology and pedagogy will ensure that translators evolve not as passive users but as informed stewards of translation technologies [31-34].

10.1. Final Reflections

In conclusion, the findings reaffirm that the advancement of MT

does not signal the decline of the human translator but rather a transformation of professional identity. Translators of the future will serve as mediators between algorithmic output and human communication, ensuring that meaning, emotion, and cultural integrity remain intact. By embedding critical engagement, ethical awareness, and technological fluency into translator education, the profession can fully harness MT's potential while preserving the irreplaceable value of human creativity and interpretive judgment.

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