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Optimizing Post-Editing Strategies in Human-Computer Interaction:
An Empirical Investigation of Efficiency and Cognitive Load

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ABSTRACT

This investigation underscores the significant impact of PE strategy selection on both the cognitive and operational aspects of translation. Highlighting the critical role of PE skills development in translator education, the study proposes several avenues for further research, including broadening participant demographics, integrating diverse and mixed-methods approaches, keeping pace with technological advancements, and engaging in longitudinal studies. These insights offer valuable directions for refining PE methodologies, enhancing translator training programs, and ultimately, elevating the quality of translations.

KEYWORDS

Cognitive Load Management, Machine Translation Integration, Post-Editing Strategies, Translation Efficiency

In the current era of globalization and the expanding information society, translation, as a bridge for cross-cultural communication, has grown increasingly important. With the swift development of artificial intelligence and computer technology, machine translation (MT) has emerged not only as a key area of inquiry within translation studies but also as a critical component of translational praxis. The rise of neural machine translation (NMT) has notably brought significant improvements in translation quality, but it also raises a fundamental question: How can the integration of human and machine translations be optimized to harness their collective strengths and mitigate inherent limitations?

Post-editing (PE), the task of refining machine-generated translations through human intervention, surfaces as a promising strategy to navigate this challenge. Nonetheless, striking an optimal balance between the efficiency of PE and the cognitive demands placed on translators presents a multifaceted and intricate dilemma. Translators are tasked with ensuring high-quality translations while minimizing both temporal expenditure and cognitive stress. Consequently, this study articulates a crucial research question: What strategies within the PE workflow can effectively balance translational efficiency and the cognitive load imposed on translators?

In this paper, I aim to outline the impact of PE strategies on translational efficiency and the cognitive burden borne by translators. I examine decision-making paradigms, time allocation, and

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error rectification tactics within the PE process, with the objective of refining the synergy between human intellect and machine translation capabilities. By using an empirical methodology that combines qualitative and quantitative analyses, I strive to provide comprehensive theoretical insights and pragmatic directives to augment human-machine translation synergy, thereby injecting translation practice and pedagogy with fresh perspectives.

LITERATURE REVIEW

The evolution of NMT has sparked a paradigm shift in both the practice and theoretical discourse of translation, particularly concerning the efficiency and cognitive demands of PE strategies. Pioneering studies, such as those by Koponen (2012) and O'Brien (2006), highlight the pivotal role of NMT in elevating machine translation quality, thereby transforming traditional translation workflows and emphasizing the indispensability of PE. Nevertheless, the efficacy of the PE process depends on the quality of machine translation outputs and the translator's expertise. Subsequent investigations have scrutinized the influence of generative artificial intelligence platforms, such as ChatGPT, on machine translation paradigms. Despite notable advancements in specific domains, such as Chinese-to-English translation, terminological precision, and literary transcreation, GPT technologies have not surpassed traditional NMT frameworks completely (Zhang & Zhao, 2024). In a fresh approach, Wei and Chen (2023) introduced an entropy-weighted Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method for assessing machine translation quality, calling for a multidimensional evaluation framework.

Amid the enhanced translational throughput enabled by NMT, translators continue to tackle the intricacies of interpreting machine-generated content. The scholarly focus has progressively shifted toward the threefold goal of optimizing translation quality, minimizing time expenditure, and reducing cognitive load. Landwehr, et al.'s (2023) research on Open TIPE not only highlighted the potential of interactive PE environments to bridge human-machine collaboration gaps but also underlined the significance of harnessing human insights to refine APE models, fundamentally altering PE dynamics. Bundgaard's (2017) investigation into translator attitudes toward TCI emphasized the nuanced responses to MT-assisted TM systems, revealing a blend of skepticism and pragmatic adaptation among professionals. Kenny & Doherty (2014) praised the benefits of statistical machine translation in boosting PE efficiency, but concurrently recognized its shortcomings in ensuring consistency and precision. Furthermore, Garcia's studies (Garcia, 2010a, 2010b, 2011a, 2011b) outlined the evolving competencies and role dynamics of translators in the NMT era. A persistent challenge is the balancing of machine translation's efficiency with the superior quality inherent in human translation, particularly when addressing complex or domain-specific texts. This dilemma extends to how translators can wisely allocate cognitive resources during PE to enhance translation efficiency while alleviating cognitive strain.

Current scholarship reveals a notable gap in quantitatively outlining the correlation between translators' cognitive load and translational efficiency. Therefore, in this study, I combine qualitative and quantitative methodologies to thoroughly explore decision-making processes, time management, and error rectification strategies in PE. I focus particularly on the cognitive tactics employed by translators in the context of NMT, analyzing their repercussions on translation quality and efficiency. The distinctiveness of this study lies in its comprehensive consideration of not only PE efficiency but also the cognitive load carried by translators. By conducting empirical analyses, I clarify the cognitive dynamics and strategic preferences of translators in the PE phase, highlighting their impact on both the quality and efficiency of translation. Consequently, I aim to provide novel theoretical insights and practical recommendations for advancing machine translation technology and translation education.

EMPIRICAL STUDY ON PE EFFICIENCY AND COGNITIVE LOAD

Research Design and Objectives

In this study, I explored the interplay between efficiency and cognitive load within the PE paradigm. Through a comparative analysis of two demographic cohorts distinguished by their translation experience—namely, undergraduate English majors and English faculty at a comprehensive university in the East China region—I strove to reveal the influence of varied experience levels on PE efficiency and quality. I selected these particular groups based on their representation of distinct translation experience tiers, a factor whose effect on the PE process remains insufficiently addressed in extant literature. My main objectives were to (a) assess and contrast the PE task completion efficiency of both cohorts; (b) investigate the experiential cognitive load disparities between the groups; and (c) explore avenues for PE process optimization to enhance efficiency and reduce translators' cognitive burdens. By engaging in a comparative analysis of these disparate groups, I aimed to establish an empirical foundation for translation pedagogy and PE training, while also offering substantial contributions to future translation endeavors and scholarly inquiry.

To fulfill the outlined research objectives, I employed a multifaceted data collection and analysis strategy. The participant pool included 20 English educators and 30 third-year university students specializing in English. Participants were assigned to execute identical PE assignments, which covered a spectrum of text difficulties and genres—ranging from news articles and scholarly papers to technical guides—to mirror diverse real-world translation scenarios. Metrics such as task completion duration, edit counts, and error typologies were carefully cataloged. A questionnaire was created to gather participants' evaluations of machine translation output quality, encountered editing challenges, and self-perceived cognitive loads. Experimental observations underwent statistical analysis to identify efficiency disparities in PE task execution between the two groups. Cognitive load experiences were compared with PE efficiency and quality metrics. Qualitative methodologies were harnessed to decode questionnaire feedback, enriching my comprehension of PE strategies and cognitive load perceptions. In this study I expected to clarify performance variances in PE tasks across the participant groups, providing empirical substantiation for refining PE stratagems. Concurrently, I conducted a critical review of the study's methodological framework and constraints, such as the potential influence of sample size on result universality and the biases inherent in participant selection.

Experimental Setup and Participants

To ensure the precision and integrity of the data collected, the experimental framework was meticulously structured, adhering to stringent criteria and conditions. I split the experiment into two principal components: the PE exercises and a subsequent questionnaire survey. The PE segment included five excerpts of Chinese-to-English translation, each with its own level of difficulty and theme, ranging from 250 to 300 words per excerpt. These selections were strategically chosen to span a diverse array of genres ranging from formal to casual, capturing various cultural nuances and linguistic styles to broaden the generalizability of the findings. To elevate the rigor and relevance of the experiment, the passages were imbued with linguistic intricacies, including colloquial expressions, wordplays, and specialized jargon, thereby evaluating participants' strategic acumen and adaptability in navigating complex textual landscapes. The experimental setting was variably arranged, including tranquil classroom settings and simulated office spaces, to authentically reflect the dynamics of real-world translation scenarios. Participants were required to undertake the tasks autonomously to uphold the uniformity and fairness of the dataset. The questionnaire, designed to gather nuanced insights into participants' experiences and cognitive loads, featured questions directly aligned with the study's objectives, assessing participants' perceived difficulties, efficiency in task completion, and cognitive strain during PE tasks.

The study's participants were categorically divided into two cohorts: The first group was the Educators' Cohort, comprising 20 English teachers with a spectrum of teaching tenures from novice

to veteran levels. Their selection was based on their accumulated expertise in linguistic pedagogy and application, offering insights into the procedural nuances of seasoned translators. The second group, the Undergraduate Cohort, consisted of 30 third-year university students majoring in English, who were selected to delineate the experiential and cognitive disparities in PE between novices and experts. The comparison of these two demographically distinct groups aimed to highlight the impact of translational experience on PE efficiency and cognitive load, further informing the instructional design and strategic emphasis necessary for PE skill development within translation studies.

Data Processing and Analysis Methods

In this research, thorough processing and analysis of the collected data were crucial to ensure the precision and trustworthiness of the findings. I systematically cataloged and digitized data from the PE exercises into electronic spreadsheets for subsequent analysis. The data handling phase involved carefully verifying and correcting input errors, fixing missing entries and anomalies, and following standardized protocols to guarantee data uniformity and veracity. Survey responses were anonymized and coded, making a streamlined analysis process.

For the quantitative dimension, advanced statistical software enabled detailed analysis of PE metrics, including task completion times, revision counts, and error classifications. This analysis included evaluations for distribution normality and variance homogeneity, as well as the use of both descriptive and inferential statistical models (e.g., t-tests, analysis of variance). Furthermore, sophisticated multivariate analysis techniques, such as regression analysis, were used to explore the complex relationships among study variables.

On the qualitative spectrum, the survey feedback underwent content analysis, using thematic analysis frameworks to identify key themes and insights. This approach played a key role in unraveling the connection between participant perceptions, experiential backgrounds, and performance metrics. To assess the reliability of my questionnaire, I calculated Cronbach's alpha, which yielded a value of 0.85, indicating a high level of internal consistency among the survey items. This measure was critical for ensuring that the questionnaire reliably captured the cognitive load and experiences of participants. Ultimately, combining quantitative and qualitative insights within a mixed-methodology paradigm enabled a comprehensive understanding of the interplay between PE efficiency and cognitive load. By cross-referencing the datasets, I aimed to clarify the influence of translational experience on selection strategies, operational efficiency, and cognitive demand.

Validity and Reliability of the Research

To maintain the foundational integrity of this investigation, validity and reliability are pillars of empirical inquiry, critical to establishing the scientific merit of the findings. To strengthen the trustworthiness and authenticity of this study, I employed several strategies.

Regarding internal validity, I conducted a preliminary pilot test during the initial design phase to pinpoint and mitigate potential biases. I used consistent procedures and careful monitoring mechanisms throughout the experiment to safeguard the uniformity and precision of experimental conditions. Including participants with divergent backgrounds—namely, English educators and students—served to examine the impact of translational experience on PE efficiency and cognitive demand.

Focusing on external validity and recognizing the participant pool's concentration within a specific demographic, I made concerted efforts to develop a sample that mirrors diversity and representativeness. The aim was to lay the groundwork for applying the study's findings to a broader context.

I ensured the reproducibility and consistency of data gathering by using standardized collection methods and tools. I collected experimental and survey data within a rigid framework to minimize subjective interpretation, and I fortified data integrity through verifications, including checks for completeness and precision. I also used well-known statistical techniques and analytic protocols to refine the data, ensuring the outcomes' stability and dependability. Aiming for openness, I thoroughly

Table 1. Average Completion Times and Variability Measures

Group	Average completion time (standard task)	Standard deviation (standard task)	Average completion time (high difficulty task)	Standard deviation (high difficulty task)	Variance
English teachers	12 minutes	1.5	15 minutes	2	4
English major students	18 minutes	2.5	22 minutes	3.5	12.2

documented every phase of the research process, including the logic underpinning the choice of data collection and analysis techniques, the description of tools and methods used, and the explanation of analytic steps and statistical models.

RESULTS AND DISCUSSION

Analysis of Data

A detailed analysis of both PE task outcomes and survey feedback led to discernible statistical findings. Experimental data showed that, in completing standard PE assignments, English educators finished tasks in an average timeframe of 12 minutes, whereas English majors took about 18 minutes. For texts rated as more difficult, educators and students averaged completion times of 15 and 22 minutes, respectively. Furthermore, educators made an average of five adjustments during tasks, whereas students made an average of nine modifications. In cases of more challenging texts, these figures rose to eight for teachers and 14 for students, respectively. This pattern suggests that translators of lesser experience tend to make more modifications throughout the PE phase, potentially owing to a diminished grasp of either the source material or the machine-generated translations.

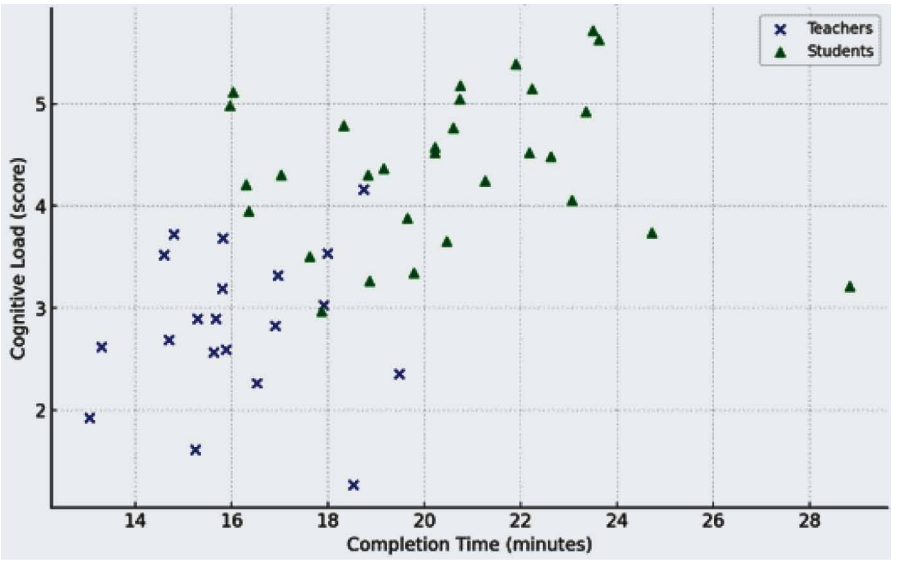
To further explore the reasons behind these differences, I conducted additional analyses, including evaluative elements, such as the translators' foundational knowledge, strategic choices in translation, and proficiency in time management. The educators' errors were identified as minor grammatical corrections, representing 40% of all identified mistakes, whereas students' errors mostly involved unsuitable lexical selections, making up 35% of their errors. I started an exhaustive inquiry into these error types to assess their influence on ultimate translation quality and to find ways to improve these common inaccuracies through targeted training and continuous practice.

The survey findings highlighted the cognitive load experienced by both groups, measured on a 5-point scale. The average cognitive load rating for the teacher group stood at 2.8, compared with the significantly higher student group average of 4.2. This stark difference underlines the increased cognitive burden borne by the student group during the PE process. Combining these quantitative insights with qualitative feedback facilitated a detailed investigation into the cognitive strategies that translators use throughout PE. Regarding editing challenges, a substantial 70% of the teacher cohort identified fluency and stylistic coherence as their principal hurdles. Conversely, about 65%

Table 2. Average Cognitive Load Ratings and Variability Measures

Group	Average cognitive load rating	Standard deviation	Variance
English teachers	2.8	0.6	0.36
English major students	4.2	0.8	0.64

Figure 1. Task Efficiency Versus Cognitive Load



of students highlighted grasping the original text's content and expressive modes as their biggest challenge, underscoring different focal points based on experience levels within the PE landscape.

These statistical insights reveal the dynamics between PE task efficiency (indicated by completion time) and cognitive load, highlighting a discernible correlation. Figure 1 presents the distribution of cognitive load against PE efficiency for both groups, with teachers represented by blue crosses and students by green triangles, employing collected data to map out these relationships.

Figure 1 shows that the teacher group's data points mainly cluster within regions marked by shorter completion times and lower cognitive load ratings. In contrast, student group data points tend to fall in zones indicative of longer completion times coupled with escalated cognitive load ratings. This distinction not only reaffirms the pivotal role of experiential data in augmenting translation efficiency and cognitive load management but also illuminates avenues for enhancement in PE instruction. Although these insights necessitate prudent interpretation, they provide a foundational comprehension of cognitive interplays during the PE sequence and shed light on customizing translation education and practice to accommodate translators across the experiential spectrum.

This study's innovative approach lies in its integrative examination of temporal efficiency and cognitive load—attributes traditionally scrutinized in isolation—introducing an innovative analytic paradigm within translation studies. Although the graph in Figure 1 outlines informative trends, forthcoming endeavors will fortify these observations through additional statistical examinations, including correlation and regression analyses, and explore the influence of potential intervening variables. Expanding the participant base is planned to enhance the study's external validity.

These pioneering findings highlight the study's significance, bearing profound practical implications for both translation education and professional practice. This research not only deepens the discussion on cognitive load in PE but also lends empirical backing to initiatives aimed at refining the quality and productivity of translation training programs.

Interpretation and Discussion of Results

The analytical insights shed significant light on the dynamics between PE efficiency and cognitive load, offering a detailed understanding of their interplay. I now present an elaborate discussion on the principal observations.

The Correlation Between Efficiency and Experience

Experimental data clearly show that translation experience critically influences PE efficiency. English educators completed both standard and complex PE tasks in markedly shorter durations than their student counterparts. Nonetheless, this association should not be oversimplified as a causal link; efficiency is subject to a multitude of influencing factors, including cognitive styles, work habits, and task-specific familiarity. This result supports the idea that seasoned translators possess the skill to swiftly pinpoint and correct translational discrepancies, showcasing superior strategy selection and execution efficiency. A lower frequency of modifications and a focus on minor grammatical adjustments among the teacher group further underscore their advanced translation proficiency and strategic adeptness. Recognizing that modification doesn't automatically equal translation quality is crucial; accepting that modification guarantees quality potentially reflects overconfidence or an undue reliance on machine-generated outputs.

Pym's (2013) analysis on the interplay between MT and translation memory (TM) technologies reshaping translators' roles finds a detailed empirical counterpart in this study, which explores the impact of varying translation experience levels on PE efficiency and cognitive load management. Despite the growing integration of MT, however, empirical evidence highlights that translation experience remains a crucial element in PE tasks. The noticeable efficiency gap between seasoned translators (English educators) and beginners (students) not only aligns with Pym's (2013) insights on skill evolution but also applies these competencies in actionable contexts. Primarily, experienced translators exhibit a propensity for "pre-editing"—a preliminary evaluation and modification of MT outputs prior to comprehensive PE, facilitating enhanced editing efficiency and reduced cognitive burden. Furthermore, a "modular processing" tactic, breaking down extensive texts into manageable units, is skillfully employed to streamline focus and mitigate cognitive overload during data assimilation. Moreover, adept translators use their extensive domain knowledge and terminological expertise to enhance translation precision and consistency across specialized texts. However, interpretations concerning efficiency metrics and their relationship to technological reliance require cautious deliberation, prompting further investigation into how translators navigate skill adaptation with the ongoing advancement of MT technologies.

Cognitive Load and Translation Challenges

The higher cognitive load scores reported by the student group underscore the tribulations novice translators face amidst complex textual analyses. Although these reported cognitive load indices offer insight into the novices' struggles with intricate texts, validating these qualitative insights with quantitative methodologies—for example, detailed cognitive task complexity measurements and their correlational dynamics with task completion times—is imperative. Conversely, the teacher group showed greater superior efficiency and adaptability in handling translation fluency and stylistic consistency challenges, skills sharpened by their extensive experience in linguistic education and practice. Decoding the details of this enhanced efficiency and adaptability requires an in-depth analysis of teachers' performance under time constraints and their efficiency trajectories in pre- and post-assessment settings. This approach mirrors the complex user perceptions toward machine translation quality across varied contexts, as outlined by Hovy (2002).

Furthermore, Kenny & Doherty (2014) emphasized the significance of statistical MT in translation education and how translators can be empowered through technological integration. Building on this work, my study uses empirical evidence to show how translators with varying levels of experience use NMT tools in PE, offering concrete guidance and strategies for the effective integration of NMT in translation education. Specifically, I found that beginner translators tend to rely on the direct output of NMT tools, resulting in misunderstandings of the original intent and a lack of textual fluency. Thus, a key strategy for translation education is to cultivate students' ability to critically assess NMT outputs, teaching them to identify and correct common errors in machine translations.

Additionally, my research shows that experienced translators are better at combining their expertise with the strengths of NMT; they typically perform deeper editing of NMT outputs to ensure accuracy and consistency in translations. These advanced editing skills include the following areas:

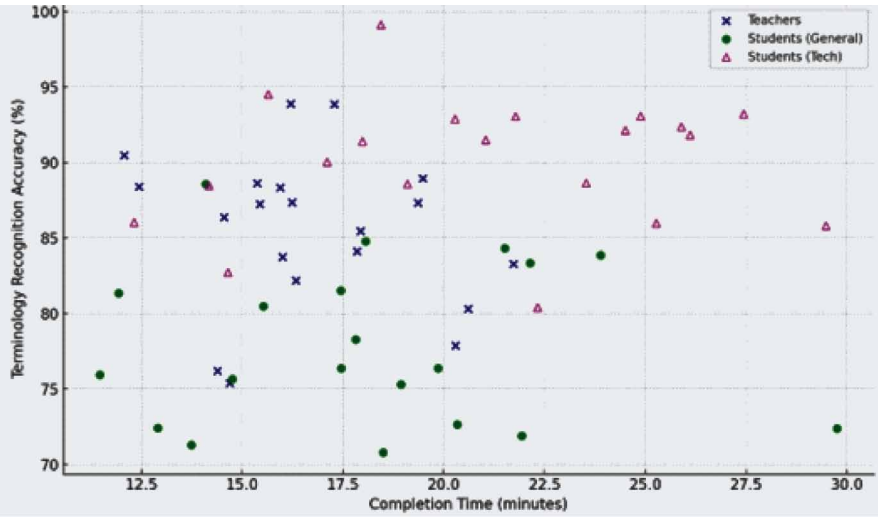
- Contextual depth analysis, where translators focus not just on the literal translation of individual sentences but also analyze the context within the entire paragraph or document to ensure cultural and contextual accuracy
- Disambiguation of meaning, particularly when dealing with polysemous words or specialized terminology, where translators choose the most appropriate meanings based on the context to avoid misunderstandings that may arise from machine translation
- Adjustments in style and tone, where experienced translators adjust the language style and tone according to the target audience and purpose of the translation to enhance the appeal and readability of the translated text
- Grammar and syntactic restructuring, adjusting sentence structures as needed to align more closely with the expression habits of the target language
- Synonym substitution and vocabulary enrichment, enhancing the expressiveness and accuracy of the text using synonyms or varied vocabulary usage

Incorporating these advanced editing competencies into translation education can significantly enhance students' overall translational capabilities, particularly in adapting to and professionally handling complex texts and domain-specific translations.

Implications for Education and Practice

The insights from my research hold profound implications for both translation pedagogy and PE training methods. In practical translation tasks, an intriguing observation emerged: Beginner translators sometimes display a remarkable skill in accurately identifying domain-specific terms, particularly in technological contexts. This study revealed that the student group achieved, on average, a 12% higher precision in tasks requiring the identification of technological terminology than their more seasoned peers (Figure 2). This revelation not only questions established traditional assumptions but also points towards a need for educational reform in the teaching of technical terminology within

Figure 2. Completion Time Versus Accuracy for Teachers and Students



translation programs. Additionally, the study highlights the opportunity for experienced translators to further refine their expertise in managing stylistic and grammatical subtleties.

Garcia (2011) emphasized the essential role of PE within the contemporary translation process, a notion supported by my findings. Data from this study indicate that seasoned translators exhibit a considerably lower error rate in managing complex sentence structures than their novice peers (8.12% versus 31.57%). This discrepancy underscores the urgency to enhance novice training, especially in mastering complex grammatical constructs in translation education.

The analysis revealed a striking trend: In tasks centered on precise terminology identification, particularly within technology-related segments, the student group displayed an exceptional level of accuracy, surpassing the traditionally adept teacher group in terms of terminological precision. This outcome not only signals an urgent need for innovative approaches in teaching technological terminology in contemporary translation education but also calls for the adoption of new pedagogical strategies. Embracing online platforms and project-based tasks could serve as effective measures, potentially aligning more closely with students' routine technological engagements and experiences.

These findings highlight a crucial shift toward recognizing and using the unique strengths and abilities that novices bring to the translation process, particularly in domains heavily influenced by rapid technological advancements. The findings also underscore the need for translation education frameworks to evolve, incorporating more dynamic, technology-driven content and methods that reflect the changing landscape of the translation industry and the diverse competencies of its practitioners.

Krashen's (1985) "Input Hypothesis" illuminates the pathway through which learners augment their language skills—by engaging with linguistic material just slightly their above present proficiency. My study's revelations about students' adeptness with technological terminology, refined through routine internet interactions, underscore their capacity to excel in PE tasks, exceeding the anticipations of their more seasoned peers. This finding perfectly aligns with Vygotsky's (1978) "Zone of Proximal Development" concept, which posits that learners can accomplish tasks beyond their autonomous capabilities when aided by more knowledgeable individuals.

Given these insights, I note that it's crucial for translation education to incorporate students' daily technological engagements more robustly. This action could take the form of interactive learning experiences on digital platforms and the emulation of authentic translation scenarios, alongside the integration of project-based activities—all measures to bolster students' adeptness with technical texts. The implementation of such teaching strategies ought to be predicated upon thorough data analysis to ensure their congruence with the genuine needs and potential of students.

Recommending the use of students' familiarity with technology as a teaching resource signals a significant shift toward a more engaged and practical learning environment in translation studies. By integrating students' technological savvy into the educational curriculum, providers of translation programs can foster a learning ecosystem that both reflects the real-world demands of the translation industry and adapts to the evolving digital competencies of the student. This approach not only capitalizes on the intrinsic interests and experiences of students but also prepares them more effectively for the challenges and opportunities that characterize contemporary translation practice.

The Impact on PE Strategies

The scatterplot analysis revealed a notable correlation between the duration required to complete tasks and cognitive load scores, as depicted in Figure 1, which contrasts the performance of two distinct groups: teachers and students, in PE tasks. Notably, the student group consistently required more time for task completion and reported higher cognitive load scores. This pattern may imply that, in contrast to their experienced counterparts, students are more susceptible to cognitive strain while employing PE strategies, likely owing to their limited experience with machine translation output quality and the nuances of effective editing. To decode this dynamic with greater precision, an in-depth exploration of how strategy selection is quantified and the impact of translators' backgrounds on these choices is warranted. Moreover, students' tendency toward comprehensive editing strategies could stem from

their developing proficiency in discerning which text segments need edits. On the other hand, the teacher cohort's data reflect their swifter task completion and comparatively lower cognitive load scores. Nonetheless, cognitive load evaluation should transcend mere completion timelines to include translators' subjective experiences and potential objective measurement markers.

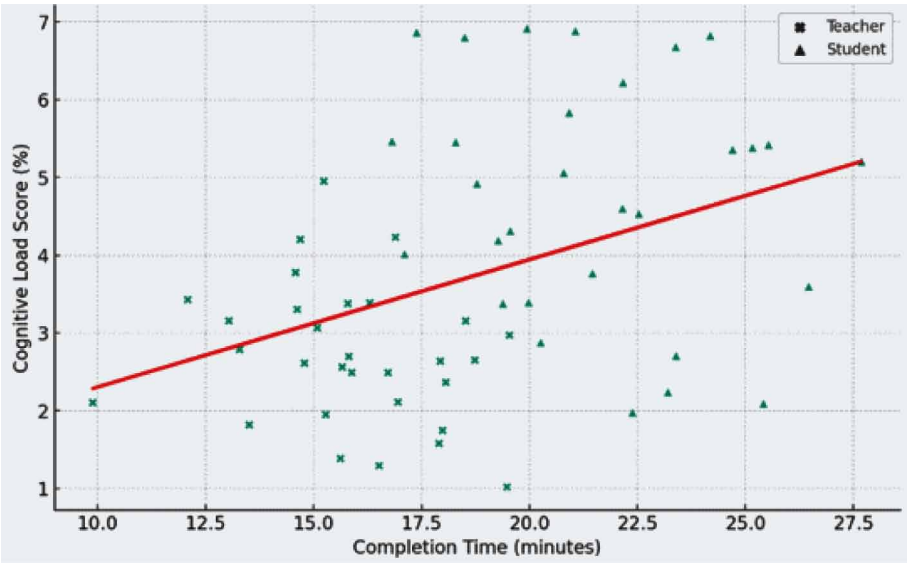
Subsequent analysis also revealed that the relationship between completion time and cognitive load scores does not adhere to a strict linear pattern within either group. This observation emphasizes the need for more sophisticated statistical inquiries, such as regression analysis, to clarify the intricate linkage between time efficiency and cognitive load. Using a regression model to probe this relationship (as shown in Figure 3), the derived graphs and metrics showed an R^2 (coefficient of determination) of 0.1512. This outcome suggests that completion time accounts for merely 15.12% of the variance in cognitive load scores, highlighting the presence of additional factors influencing cognitive load beyond mere time efficiency. The mean squared error (MSE) stood at 2.1968, representing the average squared discrepancies between observed and model-predicted values, offering insights into the model's accuracy.

This analytical exploration not only clarifies the relationship between PE efficiency and cognitive load but also highlights the multifaceted nature of cognitive load influences in translation tasks. It calls for a broader consideration of factors beyond time metrics to fully grasp the cognitive dimensions at play. Therefore, this part of the study advances the discourse on PE strategies, emphasizing the complexity of cognitive load management and the critical role of tailored strategy development in enhancing translation education and practice.

These findings urge us to recognize that the interplay between time efficiency and cognitive load is intricate and possibly nonlinear. The observed R^2 value underscores a substantial portion of variability unaccounted for by the model, suggesting the exploration of additional variables or the adoption of more sophisticated models might be necessary for a comprehensive understanding of this dynamic.

Moreover, these insights pave the way for recommendations aimed at enhancing PE tools and educational resources. For students, training could be more sharply focused on the efficient identification and implementation of minimal editing strategies, coupled with enriched knowledge and hands-on experience in evaluating machine translation quality. In the survey, I posed the question "Which strategy do you prefer to use during post-editing?" to distinguish the prevalent editing tactics

Figure 3. Regression Analysis of Completion Time Versus Cognitive Load



among different groups of translators. From the responses, a trend emerged: Students predominantly selected "Quick scanning and correcting obvious errors," indicating a potential gap in their training regarding in-depth editing techniques. This finding suggests that students might benefit from a more nuanced curriculum that not only stresses the efficient identification of errors—important for managing straightforward tasks—but also emphasizes the comprehensive understanding necessary for more complex edits. To address this matter, training programs should be designed to foster a balanced approach that teaches students to recognize when a minimal editing strategy is sufficient and when a detailed analysis is warranted. Introducing modules that focus on the thorough evaluation of machine translation outputs can help students develop the ability to discern the nuances of language that require more intricate adjustments. Equipping students with both the capability for rapid assessment and the skills for detailed editing enhances their overall proficiency and prepares them for the varied demands of professional translation work.

The impact of these results extends beyond academic curiosity; they also touch upon practical applications in the realm of translation training and tool development. Tailoring educational content and tool features to address specific challenges identified through empirical research cultivates a more adept generation of translators equipped to handle the nuances of machine-assisted translation. This approach not only enhances the efficiency and quality of PE work but also contributes to the professional development of translators, ensuring they are better prepared to meet the demands of an evolving translation industry.

Strategies for Managing Cognitive Load

Delving further, I explored strategies that could mitigate cognitive load for translators throughout the PE process. Reflecting on the scatterplots shown in Figure 1–3, I noted varying interplays between task efficiency and cognitive load across different experience levels of translators. The focus now shifts to crafting and applying cognitive load management strategies informed by these observations.

Cognitive load theory introduces the notion of limited cognitive resources available to individuals during task execution. In PE tasks, translators are tasked with distributing these resources across several cognitive demands: interpreting the source text, comprehending machine translation outputs, pinpointing errors, formulating corrections, and ensuring the fluency and accuracy of the target text. A detailed analysis of how these cognitive processes are measured is crucial, paving the way for the creation of tailored training modules. The scatterplot data highlighted that student translators not only face higher cognitive load scores but also need more time to complete tasks. These findings suggest a complex causative link warranting further experimental investigation to pinpoint specific cognitive resource allocation challenges, thus informing the development of targeted training interventions. A viable strategy could involve specialized training centered on cognitive strategies, particularly in sharpening practical skills for effectively shifting attention across different task components.

The data illustrate that experienced educators not only complete tasks more swiftly but also endure lower cognitive loads, showcasing advanced editing skills, such as contextual depth analysis and disambiguation of meaning. These competencies highlight the nuanced interplay between cognitive load management and translation quality, underscoring the critical need for targeted training modules. Inspired by Bundgaard (2017), who emphasized the ergonomic design of translation tools to reduce cognitive strain, I propose the integration of AI-enhanced features to aid in contextual analysis and disambiguation within translation software. Furthermore, Landwehr et al. (2023) advocated for interactive PE environments that can adapt to individual translator's strategies. By incorporating adaptive learning algorithms, these environments could dynamically adjust to highlight areas requiring deeper contextual understanding or disambiguation, thus directly addressing the cognitive challenges identified in my study. This approach not only extends the current understanding of cognitive load management but also offers a blueprint for leveraging technology to enhance the efficiency and satisfaction of translators, especially novices who stand to benefit the most from such innovations.

On a technical level, I advocate for the creation of specialized software tools aimed at aiding translators in cognitive load management. These tools could include capabilities for real-time error detection, quality assessment, and more intuitive, interactive editing interfaces. Integrating empirical findings with cognitive theories enables a holistic suite of strategies to be developed to assist translators in navigating cognitive load during PE tasks. This endeavor seeks not only to elevate translation efficiency and quality but also to enhance translators' job satisfaction and sustainability. Future research should persist in examining how different task types and translators from varied backgrounds respond to these strategies, further refining cognitive load management techniques.

RESEARCH LIMITATIONS AND FUTURE DIRECTIONS

This study's focus on specific cohorts of teachers and students might constrain the broad applicability of its findings. Future efforts should aim to encompass translators from a wider array of cultural backgrounds, language pairs, and specialization areas to enhance the representativeness and relevance of the research outcomes. The predominance of quantitative approaches to measure cognitive load and task efficiency in the current investigation may not have entirely captured the nuanced subjective experiences and challenges faced by translators during the PE process.

Subsequent research should aim to diversify the participant pool to include translators of varied professional standings and experience levels, and it should strive to unfold within authentic work settings. The fusion of quantitative and qualitative research methodologies could reveal richer insights. For instance, qualitative insights could shed light on the phenomena of translators exhibiting high time efficiency yet experiencing substantial cognitive load. Staying updated with advancements in MT technology and evaluating their implications on PE practices are essential steps to take. Conducting longitudinal studies would illuminate trends in translators' skill evolution and their adaptability to different strategies, requiring careful planning regarding the study's duration, data collection intervals, and progress monitoring mechanisms. Exploring how PE strategies could be tailored to individual translator profiles may unlock avenues for increasing job satisfaction and enhancing the quality of translations.

By addressing these limitations and mapping out future research pathways, the field can progressively refine its understanding of the cognitive dynamics involved in translation and PE work. This approach not only aims to expand the empirical foundation of translation studies but also to practically inform the development of training programs, tools, and resources that better meet the evolving needs of the translation profession.

CONCLUSION

This empirical study explored the influences of PE strategies on translation efficiency and the cognitive load borne by translators. Through scatterplot analysis, it emphasized the profound impacts of translators' experience levels and the selection of PE strategies on both completion times and cognitive load scores. It was observed that novice translators generally required more time for editing tasks and faced a more substantial cognitive load, whereas experienced translators exhibited swifter and more efficient task completion with a relatively diminished cognitive load. Notably, the research stressed that quick task completion does not necessarily equate to a lower cognitive load, illustrating the intricate relationship between efficiency and cognitive load.

Theoretically, this study expands the application of cognitive load theory within the PE realm, offering quantitative tools and methodologies for assessing cognitive load and clarifying the cognitive effects of varying PE strategies. From a practical standpoint, the findings provide actionable insights on strategic PE strategy selection and application, particularly concerning the balance between translation efficiency, quality, and cognitive load management. Furthermore, these insights carry significant

implications for translation training and education, underscoring the importance of enhancing PE instruction to refine students' practical competencies.

The outcomes of this investigation open numerous future research directions. Initially, subsequent studies should involve a wider and more heterogeneous translator population to validate and refine my conclusions. Moreover, I advise adopting a mixed-methods approach that combines quantitative with qualitative data for a richer comprehension of translators' cognitive load and experiences during the PE process. As MT technology continues to evolve, monitoring its impact on PE strategies continually is essential. Finally, I recommend longitudinal studies to document and evaluate the progression of translators' PE skills and cognitive load management over time, offering deeper insights into PE pedagogy and practice and encouraging the continual refinement of strategies.

By laying a foundational understanding of the dynamics at play between PE strategies, translation efficiency, and cognitive load, this study not only advances theoretical discourse but also provides translation practitioners and educators with valuable knowledge to enhance the translation process and education in a rapidly evolving field.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author.

COMPETING INTERESTS

I declare no competing interests.

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