

(Research/Review) Article

Cognitive Processes in Translation: A Systematic Review of Novice Translators' Strategies and Research Trends

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Abstract. This study examines cognitive processes in translation with a particular focus on novice translators through a systematic literature review. The objectives are to identify the main cognitive stages in translation, examine cognitive and metacognitive strategies used by novice translators, analyze research methods in translation process studies, and identify research gaps for future investigation. Following the PRISMA 2020 guidelines, this review analyzes 27 peer-reviewed studies published between 2015 and 2025, sourced from Scopus, Web of Science, and Google Scholar. A thematic analysis approach was employed to classify the studies into five key themes: cognitive stages, cognitive and metacognitive strategies, novice–expert differences, research methodologies, and technology-mediated translation. The findings indicate that translation is a recursive cognitive process involving comprehension, transfer, production, and revision. Novice translators tend to rely on surface-level strategies and demonstrate limited metacognitive regulation compared to experts. Methodologically, translation process research is dominated by think-aloud protocols, supplemented by eye-tracking and keystroke logging, each with inherent limitations. In addition, the role of technology in shaping translation cognition remains relatively underexplored. This study highlights the need for integrated approaches that combine cognitive, metacognitive, and technological perspectives, and emphasizes the importance of process-oriented pedagogy in developing translation competence.

Keywords: Cognitive Processes; Metacognition; Novice Translators; Systematic Literature Review; Translation Research.

Received: April 2, 2026

Revised: July 20, 2026

Accepted: August 1, 2026

Online available: Sept 02, 2026

Curr. Ver.: Sept 02, 2026



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1. Introduction

Translation has evolved from being viewed as a purely linguistic activity to a complex cognitive process involving multiple layers of mental operations. Contemporary research in translation studies emphasizes that translation is not merely about transferring meaning between languages, but rather about how translators process, interpret, and reconstruct meaning through cognitive mechanisms. This paradigm shift has led to the emergence of cognitive translation studies, a field that focuses on understanding the mental processes underlying translation activities (Muñoz Martín, 2020; O'Brien, 2019).

Understanding cognitive processes in translation is particularly important in the context of translator training. Novice translators, especially students in higher education, often struggle with complex translation tasks due to limited experience and underdeveloped cognitive and metacognitive skills. They tend to rely on surface-level strategies, such as literal translation and direct equivalence, which may hinder the production of accurate and contextually appropriate translations. In contrast, expert translators demonstrate more efficient processing, deeper inferencing, and stronger self-regulation (Alves & Gonçalves, 2018; Muñoz Martín, 2020; Siregar et. al., 2023).

Despite the growing body of research, studies on cognitive processes in translation remain fragmented. Existing research varies in theoretical frameworks, research designs, and methodological approaches. While some studies focus on specific aspects such as cognitive load or decision-making, others examine broader processes without integrating findings across contexts. Moreover, much of the literature is concentrated in Western contexts, with limited attention to learners in non-Western or English as a foreign language (EFL) environments.

Another important issue concerns methodological limitations. Think-aloud protocols, which have been widely used in translation process research, provide valuable insights into cognitive processes but may interfere with natural thinking processes. Although newer methods such as eye-tracking and keystroke logging offer more objective data, their application remains relatively limited due to technical and practical constraints (O'Brien, 2019).

In addition, the rapid development of digital technologies and artificial intelligence (AI) has significantly transformed translation practices. Tools such as computer-assisted translation (CAT) and machine translation (MT) are increasingly integrated into translation workflows. However, their impact on cognitive processes, particularly among novice translators, has not been sufficiently explored.

Given these gaps, there is a need for a comprehensive synthesis of existing studies on cognitive processes in translation. A systematic literature review offers a structured approach to identifying patterns, comparing findings, and highlighting areas that require further investigation.

Therefore, this study aims to conduct a systematic literature review on cognitive processes in translation with a focus on novice translators. The objectives of this study are fourfold: (1) to identify the main cognitive stages involved in translation processes; (2) to examine the cognitive and metacognitive strategies employed by novice translators; (3) to analyze the research methods used in investigating translation processes; and (4) to identify research gaps and propose directions for future studies.

2. Literature Review

Cognitive Process in Translation

Cognitive processes in translation refer to the mental operations that enable translators to comprehend, interpret, and reformulate meaning across languages. Within the framework of Translation Process Research (TPR), translation is commonly conceptualized as a multi-stage process involving comprehension of the source text, transfer of meaning, production of the target text, and revision (Carl & Schaeffer, 2017). These stages are not linear but recursive, reflecting the dynamic and iterative nature of translation as a complex problem-solving activity.

Empirical studies have demonstrated that translators continuously shift between these stages while managing competing cognitive demands such as lexical retrieval, syntactic restructuring, and semantic interpretation (Muñoz Martín, 2020). This recursive processing highlights the importance of cognitive flexibility and working memory in translation performance. Furthermore, translation is often characterized by moments of uncertainty or problem triggers, during which translators engage in intensive cognitive effort to resolve linguistic or contextual challenges (O'Brien, 2018). Such findings support the view that translation is not merely a linguistic transfer but a cognitively demanding activity requiring constant decision-making and adaptation.

Cognitive and Metacognitive Frameworks

The study of translation cognition is grounded in cognitive psychology, particularly in information-processing theory, which conceptualizes translation as a complex sequence of mental operations involving comprehension, storage, and production (Shreve & Angelone, 2017; Muñoz Martín, 2020). Within this framework, translation is not a linear process but a dynamic and recursive activity in which multiple cognitive operations interact continuously. A central component of this system is working memory, which enables translators to temporarily store and actively manipulate linguistic information while coordinating source text comprehension and target text production. This function becomes especially critical when dealing with syntactic complexity, lexical ambiguity, and culturally embedded meanings (Baddeley, 2012).

Beyond core cognitive processes, metacognition plays a pivotal role in regulating translation performance. Defined as the awareness and control of one's cognitive processes (Flavell, 1979), metacognition allows translators to plan, monitor, and evaluate their decisions throughout the translation process (Alves & Gonçalves, 2018). Empirical studies consistently show that expert translators demonstrate higher levels of metacognitive control, enabling more efficient allocation of cognitive resources and more strategic problem-solving (Alves, Szpak, & Gonçalves, 2020; Muñoz Martín, 2020). In contrast, novice translators tend to exhibit limited metacognitive regulation, which often results in surface-level processing and less effective translation outcomes.

Recent developments in translation studies further suggest that translation cognition should be understood as an integrated system in which cognitive processing and metacognitive regulation operate simultaneously and interdependently. Moreover, metacognition is increasingly viewed as a trainable competence that can be developed through pedagogical intervention rather than a fixed individual trait (Koskinen, 2020). However, despite advances in Translation Process Research, metacognition remains underoperationalized in many studies, and the interaction between cognitive processes, expertise development, and contextual factors is still insufficiently explored (Risku, 2017; O'Brien, 2019). This indicates the need for more integrative and context-sensitive frameworks to better capture the complexity of translation processes.

Translation Process Research and Methodological Approaches

Translation Process Research (TPR) has significantly advanced the empirical investigation of translation cognition by employing innovative methods to capture real-time cognitive activity. Among the most widely used methods is the think-aloud protocol (TAP), which requires participants to verbalize their thoughts during translation tasks. TAP has been instrumental in revealing translators' decision-making processes and problem-solving strategies (Jääskeläinen, 2017). However, it has been criticized for its potential reactivity, as the act of verbalization may alter natural cognitive processes.

To address these limitations, researchers have increasingly adopted more objective methods such as eye-tracking and keystroke logging. Eye-tracking technology provides insights into visual attention and cognitive effort by measuring gaze patterns, fixation duration, and regressions (Hvelplund, 2019). Keystroke logging, on the other hand, captures temporal aspects of translation behavior, including pauses, revisions, and typing patterns, which are indicative of cognitive effort (Carl et al., 2016).

Despite their strengths, these methods also have limitations. Eye-tracking data may be difficult to interpret without contextual information, while keystroke logging does not capture the underlying reasoning behind translation decisions. Consequently, recent research emphasizes the importance of methodological triangulation, combining multiple data sources to achieve a more comprehensive understanding of translation cognition (Mellinger & Hanson, 2017).

Novice and Expert Translators

The distinction between novice and expert translators is a central concern in translation studies. Novice translators, typically students or individuals with limited experience, tend to rely on surface-level processing strategies such as literal translation and direct lexical equivalence. They also experience higher cognitive load, which can negatively affect translation quality (Bouziane, 2015).

In contrast, expert translators demonstrate more efficient cognitive processing, characterized by deeper semantic analysis, better integration of contextual information, and more effective problem-solving strategies (Alves & Gonçalves, 2018). Experts are also more adept at managing cognitive load through strategic planning and monitoring, reflecting higher levels of metacognitive competence.

However, recent studies suggest that the novice–expert distinction should not be viewed as a fixed dichotomy. Translation expertise develops gradually and is influenced by factors such as domain knowledge, task complexity, and familiarity with translation tools (Muñoz Martín, 2020). This perspective highlights the importance of viewing expertise as a dynamic and context-dependent construct.

Technology-Mediated Translation Cognition

The increasing integration of digital technologies has significantly reshaped translation practices and, consequently, translation cognition. Tools such as computer-assisted translation (CAT) systems, machine translation (MT), and artificial intelligence (AI) are now integral to professional translation workflows. These technologies alter how translators process information by redistributing cognitive effort between human and machine components (O'Brien, 2019; O'Hagan, 2021).

Research on post-editing of machine translation suggests that while MT can reduce certain types of cognitive effort, it may also introduce new challenges, such as error detection and quality evaluation (Vieira, 2016). This indicates that technology does not eliminate cognitive effort but rather transforms its nature.

Moreover, emerging studies on human-machine interaction highlight that translation cognition is becoming increasingly distributed across systems, requiring translators to develop new competencies in managing technological tools (Specia et al., 2020; Gaspari, 2022; Siregar et al., 2023). Despite its growing importance, this area remains underexplored, particularly in relation to novice translators. As a result, further research is needed to understand how technology influences cognitive processes, learning outcomes, and the development of translation expertise.

3. Method

This study employs a Systematic Literature Review (SLR) to synthesize existing research on cognitive processes in translation, with a particular focus on novice translators. The SLR approach was selected because it provides a structured, transparent, and replicable method for identifying, evaluating, and integrating findings from multiple studies (Kitchenham & Charters, 2007; Tranfield et al., 2003). The review follows the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which ensure methodological rigor through a systematic process of identification, screening, eligibility, and inclusion of relevant studies (Page et al., 2021).

To ensure comprehensive coverage, relevant literature was collected from three major academic databases: Scopus, Web of Science (WoS), and Google Scholar as a supplementary source. The search strategy was guided by a combination of keywords and Boolean operators, including "cognitive processes," "translation process research," and "novice translators," as well as methodological terms such as "think-aloud protocol," "eye-tracking," and "keystroke logging." This approach is consistent with established practices in translation process research, which emphasize triangulation of data sources to enhance coverage and reliability (Jakobsen, 2017; Carl & Schaeffer, 2017).

Clear inclusion and exclusion criteria were applied to ensure the relevance and quality of the selected studies. Articles were included if they were peer-reviewed, written in English, published between 2015 and 2025, and focused on cognitive processes in translation involving novice translators, such as students or non-professional translators. Both empirical studies and systematic reviews were considered. Studies were excluded if they focused solely on translation products, lacked clear methodological descriptions, or were non-scholarly publications.

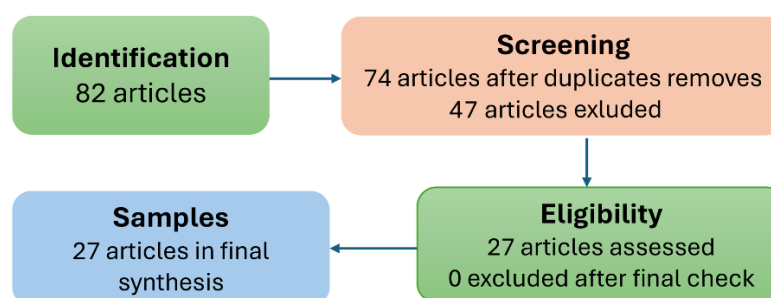


Figure 1. Study Selection Process based on PRISMA 2020 Guidelines

The study selection process followed the PRISMA framework. Initially, a total of 82 records were identified across the selected databases. After removing duplicates, the remaining records were screened based on titles and abstracts, resulting in the exclusion of irrelevant studies. Full-text eligibility assessment was then conducted based on predefined

criteria. After this screening and eligibility process, 27 studies were included in the final analysis. This final corpus is considered sufficient for thematic synthesis in systematic literature reviews, particularly in translation studies where data saturation is achieved through conceptual recurrence rather than statistical representation (Page et al., 2021; Braun & Clarke, 2021).

Data from the selected studies were systematically extracted using a structured coding framework to ensure consistency and transparency. The extracted information included authorship, year of publication, research objectives, participant characteristics, research methods, and key findings related to cognitive processes and strategies in translation. The collected data were then analyzed using thematic analysis, following the procedures proposed by Braun and Clarke (2006, 2021). This approach is widely used in qualitative synthesis because it allows for the identification, organization, and interpretation of recurring patterns across studies (Braun & Clarke, 2021).

To enhance the reliability and validity of the findings, a quality appraisal was conducted on all included studies. Each article was evaluated based on the clarity of research objectives, methodological rigor, transparency of data collection and analysis procedures, and relevance to the research focus. This step aligns with best practices in systematic review methodology, which emphasize critical appraisal as an essential component of evidence synthesis (Booth et al., 2016).

To ensure consistency between data extraction and thematic synthesis, a predefined coding framework was developed prior to analysis. All 27 included studies were categorized into five main thematic domains: (1) cognitive stages in translation processes, (2) cognitive and metacognitive strategies employed by novice translators, (3) novice–expert differences in translation performance, (4) research methodologies used in translation process research, and (5) technology-mediated translation processes. This coding structure was iteratively refined during analysis to reflect recurring patterns across the dataset and ensure alignment between methodological design and thematic interpretation.

4. Results and Discussion

Results

The final dataset consisted of 27 studies selected through the PRISMA 2020 screening process. These studies were published between 2015 and 2025 and focused on cognitive processes in translation, particularly involving novice translators such as students and non-professional translators. The thematic analysis identified five main categories of research focus: cognitive stages, cognitive and metacognitive strategies, novice–expert differences, research methodologies, and technology-mediated translation.

To further clarify these thematic categories, the selected studies were organized according to their primary research focus, as presented in Table 1. Classification of Selected Studies Based on Research Topics, highlighting the distribution and dominant trends in research on cognitive processes in translation.

Table 1. Classification of Selected Studies Based on Research Topics

No	Research Topic	Description	Number of Studies	Authors
1	Cognitive Stages in Translation	Studies focusing on stages such as comprehension, transfer, production, and revision	7	Michael Carl & Moritz Schaeffer (2017); Ricardo Muñoz Martín (2020); Qian Yu (2021); Abdelhamid Bouziane (2015); Luciana Nogueira Vieira (2016); Fabio Alves & José Luiz Gonçalves (2018); Sharon O'Brien (2018)
2	Cognitive and Metacognitive Strategies	Studies examining problem-solving, decision-making, and self-regulation processes	6	Yuhong Dong & Shun Chen (2025); Dewi Indarti (2024); Mona Baker & Giulia Lorenzi (2020); Özgür Emirkadı (2023); Gert Togato et al. (2022); Qian Yu (2021)

No	Research Topic	Description	Number of Studies	Authors
3	Novice vs. Expert Translators	Studies comparing cognitive behaviors between novice and professional translators	5	Abdelhamid Bouziane (2015); Engliana (2019); Kristian Hvelplund (2019); Ricardo Muñoz Martín (2020); Michael Carl & Moritz Schaeffer (2017)
4	Research Methodologies (TPR)	Studies focusing on methods such as think-aloud protocols, eye-tracking, and keystroke logging	5	Riitta Jääskeläinen (2017); Christopher D. Mellinger (2019); Arnt Lykke Jakobsen (2017); Michael Carl, Barbara Dragsted & Arnt Lykke Jakobsen (2016); Christopher D. Mellinger & Thomas A. Hanson (2017)
5	Technology and Cognitive Processes	Studies exploring machine translation, CAT tools, and artificial intelligence in translation	4	Sharon O'Brien (2018); Luciana Nogueira Vieira (2016); Mohammed Shormani (2024); Fabio Alves (2015)
Total number of studies			27	

The thematic analysis revealed five main categories of research focus in translation process studies. The largest group of studies (7 studies) focused on cognitive stages of translation, including comprehension, transfer, production, and revision. A second group (6 studies) examined cognitive and metacognitive strategies, particularly among novice translators. Five studies investigated differences between novice and expert translators, highlighting developmental aspects of translation expertise. Another five studies focused on research methodologies, including think-aloud protocols, eye-tracking, and keystroke logging. The remaining four studies addressed technology-mediated translation, particularly machine translation, post-editing, and AI-assisted translation processes.

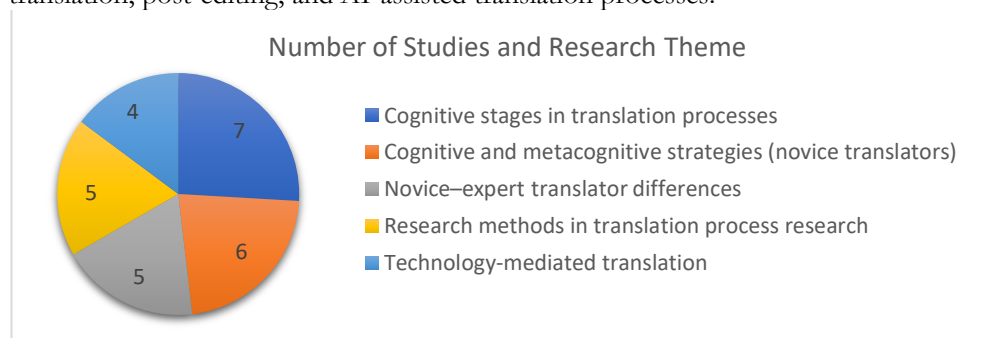


Figure 2. Number of studies and research theme

This distribution indicates that the majority of studies focus on internal cognitive mechanisms, particularly stages and strategies, while fewer studies address the role of technology. The thematic structure reflects both the maturity of foundational research and the emergence of new directions in the field.

Cognitive Stages in Translation (7 Studies)

The largest group of studies (7 out of 27) examines translation as a multi-stage cognitive process involving comprehension, transfer, production, and revision. These stages are consistently described as recursive and interactive rather than linear.

Evidence from multiple studies (e.g., Carl & Schaeffer, 2017; Muñoz Martín, 2020; Yu, 2021) indicates that the comprehension stage is a major source of difficulty, particularly for novice translators, who often struggle with implicit meanings and contextual interpretation. Supporting this, Bouziane (2015) and Vieira (2016) highlight that misinterpretation at this stage leads to cascading errors in later stages.

The transfer stage is identified in several studies (e.g., Alves & Gonçalves, 2018) as cognitively demanding due to the need for semantic restructuring. Meanwhile, the production stage often reflects the translator's level of expertise, with novice translators tending toward

literal rendering. Finally, revision processes, as discussed in studies such as O'Brien (2018), demonstrate that expert translators engage in more systematic monitoring and refinement. Overall, strong convergence across all seven studies confirms that translation is a dynamic and iterative cognitive activity, requiring constant interaction among stages.

Cognitive and Metacognitive Strategies (6 Studies)

A substantial portion of the reviewed studies (6 out of 27) focuses on cognitive and metacognitive strategies. These studies consistently emphasize that translation is not only a linguistic activity but also a strategic and self-regulated process.

Across the six studies (e.g., Dong & Chen, 2025; Indarti, 2024; Baker & Lorenzi, 2020; Emirkadi, 2023), translators are shown to employ cognitive strategies such as inferencing, problem-solving, and decision-making. These strategies are essential for handling ambiguity and linguistic challenges.

More importantly, metacognitive strategies including planning, monitoring, and evaluation, are identified as critical for successful translation. Evidence from multiple studies indicates that translators with higher metacognitive awareness produce more accurate and coherent outputs.

However, the findings also reveal that novice translators lack consistent use of metacognitive strategies, as reflected in several studies within this category. This limitation contributes to inefficient processing and increased cognitive load. Thus, the six studies collectively highlight that metacognition is a key component of translation competence, with direct implications for translator training.

Novice vs. Expert Translators (5 Studies)

The comparison between novice and expert translators emerges as a significant theme, addressed in 5 out of the 27 selected studies, highlighting its central role in understanding translation competence. The majority of these studies (e.g., Bouziane, 2015; Engliana, 2019) indicate that novice translators tend to rely on surface-level processing strategies, primarily focusing on lexical equivalence and direct, word-for-word translation. Such approaches often lead to outputs that lack naturalness and contextual appropriateness, reflecting limited engagement with deeper semantic and pragmatic aspects of the source text.

In contrast, expert translators demonstrate a markedly different cognitive profile. Findings from several studies (e.g., Muñoz Martín, 2020; Carl & Schaeffer, 2017) show that experts engage in deeper processing by integrating contextual, pragmatic, and cultural knowledge into their translation decisions. This allows them to produce more coherent and communicatively effective translations. Empirical evidence further supports this distinction. For instance, Hvelplund (2019), using eye-tracking data, reveals that expert translators exhibit shorter fixation durations, process information more efficiently, and manage cognitive load more effectively than novices.

Taken together, the convergence of findings across these studies suggests that translation expertise is closely associated with cognitive efficiency and strategic flexibility. Rather than merely possessing greater linguistic knowledge, expert translators demonstrate superior control over cognitive resources and employ more adaptive strategies when facing translation challenges.

Research Methodologies in Translation Process Research (5 Studies)

Another group of five studies focuses on the methodological approaches used to investigate cognitive processes in translation, reflecting the growing sophistication of Translation Process Research (TPR). Among these approaches, the think-aloud protocol (TAP) remains the most widely employed method. Studies such as Jääskeläinen (2017) and Jakobsen (2017) highlight the effectiveness of TAP in providing direct access to translators' internal cognitive processes, particularly in uncovering decision-making and problem-solving strategies during translation tasks. Through verbalization, researchers are able to trace how translators interpret source texts, evaluate alternatives, and resolve translation difficulties in real time.

However, despite its strengths, TAP is not without limitations. Several studies (e.g., Mellinger, 2019; Carl et al., 2016) point out that the requirement for participants to verbalize their thoughts may interfere with natural cognitive processing, potentially altering the very phenomena being observed. This concern has led researchers to question the ecological

validity of TAP and to seek complementary methods that can capture cognitive activity more objectively.

In response to these limitations, there has been a noticeable shift toward the use of quantitative and process-oriented tools, such as keystroke logging and corpus-based analysis. These methods allow researchers to capture temporal patterns, pauses, revisions, and other indicators of cognitive effort without interrupting the translation process. Studies by Mellinger and Hanson (2017) further demonstrate the increasing importance of quantitative approaches in enhancing the reliability, replicability, and analytical rigor of translation research.

Overall, the convergence of findings across these five studies indicates a clear trend toward methodological diversification and triangulation. By combining qualitative and quantitative approaches, researchers are better equipped to capture the complexity of translation cognition, thereby strengthening the validity and depth of insights in translation process research.

Technology and Cognitive Processes (4 Studies)

The smallest category, comprising 4 out of the 27 selected studies, focuses on the relationship between technology and cognitive processes in translation, indicating that this is still an emerging area of research within Translation Process Research (TPR). Despite its limited representation, this category provides important insights into how technological tools are reshaping the cognitive demands of translation activities.

Studies such as O'Brien (2018) and Vieira (2016) demonstrate that machine translation (MT) and post-editing practices significantly influence cognitive effort. While these technologies can enhance efficiency by reducing the need for full text production, they simultaneously introduce new cognitive challenges, particularly in evaluating, monitoring, and correcting machine-generated output. Rather than simplifying the translation process, MT shifts the nature of cognitive effort from text production to quality assessment and decision-making (Siregar et al., 2025).

Alves (2015) further emphasizes that post-editing requires a distinct type of cognitive engagement compared to traditional translation. Translators must engage in rapid decision-making, error detection, and continuous evaluation, often under time pressure. This suggests that technological mediation does not reduce cognitive complexity but transforms it, requiring different cognitive and metacognitive skills.

More recent studies (e.g., O'Hagan, 2021; Specia et al., 2020; Gaspari, 2022) have begun to explore the role of artificial intelligence (AI) in translation processes, particularly in relation to human-machine interaction and cognitive effort. Overall, this imbalance reveals a clear research gap and underscores the need for further investigation into technology-mediated cognitive processes, particularly in relation to novice translators who are still developing both linguistic competence and technological literacy.

Discussion

The present study aimed to (1) identify the main cognitive stages involved in translation processes, (2) examine the cognitive and metacognitive strategies employed by novice translators, (3) analyze the research methods used in investigating translation processes, and (4) identify research gaps and propose directions for future studies. The findings of this review demonstrate that these objectives have been addressed.

The findings of this review provide a comprehensive understanding of how cognitive processes in translation have been conceptualized and investigated over the past decade. The thematic distribution reveals a strong dominance of studies focusing on cognitive stages (7 studies) and cognitive and metacognitive strategies (6 studies), indicating that translation research remains largely grounded in a process-oriented paradigm. This orientation reflects the influence of cognitive theories such as information processing and problem-solving models, which effectively explain how translation occurs at the mental level (Shreve & Angelone, 2017; Muñoz Martín, 2020). Across the studies analyzed, translation is consistently conceptualized as a multi-stage cognitive activity involving comprehension, transfer, production, and revision, where these stages are recursive and dynamically interconnected (Carl & Schaeffer, 2017; Muñoz Martín, 2020). However, despite their explanatory power, these approaches tend to underrepresent socio-cultural and contextual dimensions of translation (Risku, 2017), suggesting that current research may be cognitively robust but

contextually limited. This shows that while the first objective is fulfilled, it also reveals a theoretical imbalance in how translation cognition is framed.

In relation to the second objective, which examines the cognitive and metacognitive strategies employed by novice translators, the synthesis of six studies confirms that novice translators predominantly rely on surface-level cognitive strategies such as literal translation, direct equivalence, and limited inferencing (Bouziane, 2015; Engliana, 2019; Alves & Gonçalves, 2018). These strategies reflect restricted engagement with deeper semantic and pragmatic processing. More importantly, novice translators demonstrate limited use of metacognitive strategies, particularly in planning, monitoring, and evaluating their translation processes. Across multiple studies, metacognition emerges not merely as a supportive mechanism but as a central determinant of translation expertise (Alves, Szpak, & Gonçalves, 2020; Muñoz Martín, 2020). This finding aligns with broader cognitive psychology theories that associate metacognitive regulation with high performance in complex tasks (Flavell, 1979). Nevertheless, most studies conceptualize metacognition as an individual cognitive trait rather than a competence that can be systematically developed through instructional design. This creates a critical gap between identifying expert behavior and translating it into pedagogical practice (Koskinen, 2020; Risku, 2017), indicating that the second objective is achieved but remains pedagogically underdeveloped.

Regarding the third objective, which focuses on research methods used in translation process research, the findings show that methodological approaches are both diverse and evolving. Think-aloud protocols (TAP) remain the dominant method for accessing translators' cognitive processes, providing rich qualitative insights into decision-making and problem-solving behaviors (Jääskeläinen, 2017; Jakobsen, 2017). However, concerns about reactivity—where verbalization may alter natural cognitive processes—limit its ecological validity (Mellinger, 2019; Carl et al., 2016). In response, several studies increasingly adopt eye-tracking and keystroke logging techniques, which provide more objective and fine-grained measures of cognitive effort and attention (Hvelplund, 2019; Mellinger & Hanson, 2017). Despite these advancements, a fundamental methodological tension persists between depth and ecological validity: qualitative methods capture reasoning processes but may distort natural cognition, whereas quantitative methods enhance precision but fail to fully explain underlying cognitive mechanisms. The growing use of mixed-method approaches reflects an emerging effort toward methodological triangulation (Mellinger & Hanson, 2017; Carl, 2021), indicating that the third objective is well addressed, although methodological integration remains incomplete.

Finally, in addressing the fourth objective concerning research gaps and future directions, the findings reveal several critical limitations in the current literature. Although only a small proportion of studies (4 out of 27) focus on technology, their implications are highly significant. The integration of machine translation, computer-assisted translation tools, and artificial intelligence is transforming translation practices, shifting cognition from an internal mental process to a distributed system involving human-machine interaction (O'Brien, 2019; O'Hagan, 2021). This transformation challenges traditional cognitive models by suggesting that translation cognition is no longer purely individual but technologically mediated. Studies on post-editing further demonstrate that while machine translation can enhance efficiency, it also introduces new cognitive demands related to evaluation, monitoring, and decision-making (Vieira, 2016; Alves, 2015; O'Brien, 2022). However, the limited number of studies in this area indicates that the field has not yet fully addressed the cognitive implications of technological advancement, representing a major gap in the literature. In addition, most studies adopt cross-sectional designs, with very few longitudinal investigations examining how cognitive processes develop over time. There is also limited contextual diversity, as many studies are conducted in controlled or Western academic environments, which restricts the generalizability of findings (Tranfield et al., 2003; Page et al., 2021).

Taken together, these findings indicate that while all four research objectives have been met, research on translation cognition remains fragmented across thematic domains, including cognitive stages, strategies, expertise, methodology, and technology. This fragmentation reflects a broader limitation in the field, where cognitive processes are often studied in isolation rather than as an integrated system (Muñoz Martín, 2020; Shreve & Angelone, 2017). In reality, translation involves the simultaneous interaction of all these dimensions. Therefore, there is a clear need for a more integrated model of translation cognition that combines cognitive processing, metacognitive regulation, expertise development, and technological mediation (Risku, 2017; O'Brien, 2019). From a pedagogical

perspective, this implies a shift from product-oriented instruction to process-oriented and strategy-based learning that explicitly fosters metacognitive awareness and prepares students for technology-enhanced translation environments (Koskinen, 2020; Alves & Gonçalves, 2018). From a research perspective, future studies should adopt longitudinal designs, employ multi-method approaches, and explore technology-mediated cognition in diverse socio-cultural contexts in order to capture the full complexity of translation processes (Braun & Clarke, 2021; Page et al., 2021).

6. Conclusions

This systematic review examined cognitive processes in translation by synthesizing 27 selected studies published over the past decade. The findings confirm that the four research objectives have been successfully addressed, while also revealing broader theoretical, methodological, and pedagogical implications. Overall, translation is consistently conceptualized as a multi-stage cognitive activity involving comprehension, transfer, production, and revision, with these stages operating in a recursive and dynamic manner. However, the dominance of cognitively oriented approaches indicates a tendency to prioritize internal mental processes, often at the expense of socio-cultural and contextual dimensions of translation.

Furthermore, the review highlights clear differences between novice and expert translators. Novice translators tend to rely on surface-level strategies and demonstrate limited metacognitive regulation, whereas expert translators exhibit greater cognitive efficiency and strategic flexibility, particularly in planning, monitoring, and evaluating their work. These findings underscore the central role of metacognition in the development of translation competence. From a methodological perspective, the field demonstrates increasing diversity through the use of think-aloud protocols, eye-tracking, and keystroke logging. Although each method offers unique insights, their limitations point to the necessity of mixed-method approaches to achieve a more comprehensive understanding of translation processes.

Finally, this review identifies several critical gaps in the literature, including the limited exploration of technology-mediated translation processes, the scarcity of longitudinal studies, and the lack of contextual diversity across research settings. These gaps suggest that translation cognition remains an evolving field that requires more integrative and context-sensitive approaches. Therefore, this study contributes by proposing the need for a more holistic model of translation cognition that integrates cognitive processes, metacognitive regulation, expertise development, and technological mediation. Future research should adopt longitudinal, multi-method, and cross-cultural designs to better capture the complexity of translation in real-world and technology-enhanced environments.

Acknowledgments: The author sincerely thanks all the scholars whose research informed this study, providing valuable insights into the applications of artificial intelligence in language learning. Special appreciation goes to the academic community for making research articles and digital resources accessible, and together with AI-assisted tools to collect the literature.

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