MACHINE TRANSLATION IN LANGUAGE LEARNING AND PROFESSIONAL TRANSLATION: A LITERATURE REVIEW

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Abstract

Machine translation (MT) is fundamental in translating from source to target languages. This demand has indicated exponential growth over the past years due to the rapid development of this artificial intelligence. With the increasing use of MT, where the MT itself has its benefits and downsides, researchers have actively conducted MT research for more than seven decades. This paper addresses three key research questions: the theoretical frameworks adopted in MT studies, the benefits and drawbacks of MT in both language learning and professional translation. After discussing and summarizing the three key research questions, the author concludes and ponders implications for MT users and trainers and new directions for future research.

Keywords:

Machine translation; translation in language learning; professional translation; benefits of MT; downsides of MT.

Abstrak

Terjemahan mesin (TM) merupakan hal mendasar dalam penerjemahan dari bahasa sumber ke bahasa sasaran. Tuntutan akan penerjemahan mesin ini telah berkembang pesat selama beberapa tahun terakhir ini sehubungan dengan laju perkembangan teknologi kecerdasan buatan ini. Dengan meningkatnya penggunaan TM, yang mana TM itu sendiri memiliki kelebihan dan kekurangannya, para peneliti aktif melakukan penelitian TM selama lebih dari tujuh dekade. Artikel ini membahas tiga pertanyaan utama penelitian yakni landasan teori dalam studi tentang TM, manfaat dan kekurangan TM dalam pembelajaran bahasa, serta manfaat dan kekurangan TM dalam penerjemahan profesional. Setelah mengupas dan merangkum ketiga hal pokok di atas, penulis menarik simpulan dan membahas implikasi TM bagi pengguna dan pengajaran TM serta arah baru untuk penelitian mendatang.

Kata kunci:

terjemahan mesin; terjemahan dalam pembelajaran bahasa; penerjemahan profesional; manfaat terjemahan mesin; kekurangan terjemahan mesin.

1. Introduction

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Links Between Theoretical Framework, Machine Translation (Mt) In Language Learning, And Mt in Professional Translation

The author proposes that the discussion on the theoretical framework is compatible with machine translation (MT) in language learning and MT in professional translation. Literature has frequently suggested that the theoretical perspective is of critical importance to help language educators and practitioners view the emerging phenomenon of increasing MT use in both language learning and professional translation in this globalization era. However, this topic has received little attention in previous studies as Deng and Yu's (2022) argument that theoretically informed studies represent an overlooked area in MT research. Confirming this statement, Jolley and Maimone (2022) discovered that only one out of the fifteen studies reported in their paper suggests its adoption of a theoretical perspective, namely second language acquisition (SLA) theory when discussing the use of MT to raise L2 awareness. Additionally, the author's readings on previous literature reviews (e.g., Deng & Yu, 2022; Garg & Agarwal, 2018; Jolley & Maimone, 2022; Pluymaekers, 2022) suggest that these authors exclude the theoretical perspective in their studies. Accordingly, one of the study's aims is to fill in the gap in the literature by exploring the range of theoretical perspectives scholars have utilized in their MT studies. Furthermore, Jolley and Maimone (2022) suggested that future research on the impacts of MT use on language teaching and learning should emphasize the connections between pedagogical practices and SLA theories. Accordingly, the study aims to explore the theoretical perspectives adopted in machine translation (MT) studies.

Literature has revealed that the discussions on MT in language learning are often separated from professional translation. However, Widdowson (in El-Daly, 2022) says that numerous applied linguistics researchers have been interested in studying translating as a tool in language teaching for the last four decades. With the rapidly increasing

number of MT users, including language learners, language teachers must integrate MT in their second or foreign language classrooms.

The reason for this is twofold. First, for most foreign language learners, thinking in a foreign language for writing assignments is arduous. Hence, translation occurs when transferring a writing task into a target language, in which MT frequently plays a significant role. This process is confirmed by Jolley and Maimone's (2022) report that the combined findings of the studies reported in their systematic review paper indicate that "MT tools do indeed belong in the L2 classroom as a resource for translation and writing tasks." (p. 34). Second, MT usage persists regardless of teachers' attitudes or perceptions in the language learning or translation course contexts. However, empirical studies on the effects of MT use in L2 learning are still scarce (Jolley & Maimone, 2022).

Moreover, the author's readings on the existing literature suggest that little is known concerning studies, particularly library research, on machine translation in both language learning and professional translation, the combined content of the most frequently studied areas. Therefore, the author aims to amalgamate these two areas in this study. As previously pointed out, adding a research question of the theoretical framework into these two topics is of significance to help language educators, translation practitioners, and translation researchers view the emerging phenomenon of increasing MT use in both language learning and professional translation in this globalization era (this is further discussed in the next section). The author draws predominant questions from the literature about the questions commonly asked by researchers and language practitioners, i.e., the theoretical frameworks adopted in MT studies, the benefits and downsides of MT in both language learning and professional translation.

TRANSLATION IN THE GLOBALIZATION ERA

Translation is an ultimate demand in this globalization era due to increasing human interactions across the universe. In his literature review, Austermühl (2014) mentions that even though a growing number of business transactions, research reports, scientific publications, internet pages, scientific publications, and international conferences have indicated the use of English as the default language, these phenomena will not, at least at present, necessarily create a monolingual world leading to the end of translation. Austermühl (2014) further points out that as far as the economy is concerned, translators will remain in the global market since international traders require customers to buy their products in their languages.

Historically, most translation companies introduced technology in the translation industry, such as computers, by the 1990s (Arenas & Moorkens, 2019). Until then, translators had to pedagogically learn about word processors and operating systems due to limited training. The expectations of the professional world of translation and the training provided at the university indicate that the increasing demand for translation is not equally supported by the necessary translation related-training (Arenas & Moorkens, 2019). Three years after the introduction of Trados Translator's Workbench in 1992, most translation agencies and freelancers began to use it in 1995 when dealing with technical documentation or software components (Arenas & Moorkens, 2019). This technology usage marked the development of translation tools in the translation industry, where Trados recycled translators' work due to identical or similar content matches. Although such tools could have been better, they became the most prevalent translation technology in the 2000s (Arenas & Moorkens, 2019). Trados and MemoQ are two examples of computer-assisted translation (CAT) tools.

Machine translation (MT), web-based machine translation (WBMT), online machine translation (OMT), and machine translation-assisted language learning (MTALL) are frequently used as synonyms. Likewise, translation technology, translation tools, translation environment tools (TEnTs), and computer-aided translation (CAT) are used interchangeably in translation literature to mean the same thing (O'Brien & Vázquez, 2020). Literature has indicated that MT has recently gained popularity due to the rapid development of artificial intelligence (Deng & Yu, 2022; Läubli et al., 2020). Moreover, the free access to OMT on individuals' gadgets, such as the internet through computers, tablets, and smartphones, contributes to the convenient use of the OMT by all levels of language students (Nino, 2020). Studies have shown that millions of people have used MT on a daily basis for multi-use cases (Way, 2018). In 2016, Google introduced neural machine translation (NMT) to the world (Lee et al., 2019). As of 2018, Google Translate has become the most prominent publicly available MT, and more shockingly, it is used by over 200 million users daily (Prates et al., 2020).

It is essential to note why (professional) translators, language and translation students need machine translation. Some authors argue that the untimely approach to machine translation relies heavily on manual translation rules and linguistic knowledge; however, the fundamental complexity of natural (human) languages indicates that covering all language irregularities with manual translation rules is no longer ideal (e.g., Tan et al., 2020). Tan et al. (2020, p. 5) state that "with the availability of large-scale parallel corpora, data-driven approaches that learn linguistic information from data have gained increasing attention."

The growing number of MT users indicates the utmost importance of MT and users' satisfaction with its quality though it is not a perfect tool (Way, 2018). With the growing number of MT users, companies and academic researchers have continued striving to improve the quality of

the translation. As the quality of the translation and its measurement are like the two sides of the same coin, system developers have made considerable efforts to enhance the translation levels produced by their engines and measurement tools. On the other hand, some translators are equally concerned about the poor quality of MT in their workflows. However, instead of refusing MT, the impact of the MT on their professional work has to be measurable (Way, 2018).

As previously indicated, machine translation and translation technology are prominently connected with globalization. American popular cultures, such as pop music, films, and video games, accelerate English into a global lingua franca (Dollerup in Ho, 2004).

Two decades ago, Crystal (2003) observed that internet users grew exponentially. More and more netizens use chatting tools such as Netspeak, an interactive dialect of global English used in the virtual community of the global village (Crystal, 2003). Crystal (2003) suggested that this tool help netizens communicate via electronic platforms such as e-mail, the World Wide Web (WWW), and mobile phone messages. Furthermore, the literature has repeatedly shown that this fad stays.

The remaining paper will discuss the theoretical framework, method, and literature review. It then draws conclusions, discusses implications for MT users and teaching, and suggests new directions for future research.

2. THEORETICAL FRAMEWORK

The author adopts Vygotsky's (1978) socio-cultural theory and Melby's (1982a, 1982b) translator work station framework as the bedrock for the study. The socio-cultural theory is concerned with the social and cultural factors that affect language use and translation practices. This theory relates to this paper, exploring practices integrating machine translation (MT) and computer-assisted translation

(CAT) tools with language learning and professional translations. This phenomenon reflects the language learning and professional translation contexts in the 21st century.

In their introduction chapter to Vygotsky's (1978) book '*Mind in Society*,' Michael Cole and Sylvia Scribner contend that Vygotsky elaborated on Engels' notion of "human labor and tool use as the means by which man changes nature and, in so doing, transforms himself." (p. 7). Vygotsky embodied this concept of mediation in human-environment interaction through tools historically created by societies along with the changes in society and cultural development. In other words, changes in individual development are rooted in society and culture.

Historically, language learners and professional translators accessed printed resources (dictionaries and books) in translating from source to target languages in the old times. However, with the rapidly increasing language learning and professional translation technologies (especially the improved MT quality), users of MT have now utilized MT tools such as Google Translate, Microsoft Translator, Bing Translate, and CAT tools such as Trados to enhance work productivity. This theory connects with the present study as it aims to explore the benefits and drawbacks of MT as a modern device and, thus, as a new approach to language learning and professional translation due to the rapidly changing environment.

Melby (1982b, p. 57) proposes 'a three-level design for a translator work station.' The three levels in the translator work station framework consist of processing, analyzing, and utilizing MT in translating. Melby (1982b) takes a different approach to machine translation through what he calls 'the Translation Aid System.' Melby (1982b) holds that machine translation should be viewed as a translator's assistance rather than a replacement. Melby encourages users to use MT as wisely as possible, meaning that they are not heavily dependent on MT and are critical of the linguistics corpus MT provides.

This framework resonates with the present study because the author aims to explore what MT proves and does not prove beneficial to its users and what has been uncovered by studies on professional translators' perceptions of MT.

3. METHOD

The author utilized data from the existing literature via Google, Google Scholar, and Proquest for this library research. Through the digital platforms, the researcher keyed in 'machine translation,' 'theoretical perspectives in machine translation studies,' 'theories in machine translation studies,' 'benefits and downsides of machine translation,' 'translation in language learning,' 'translation teaching,' 'translation education,' and 'professional translation.' The total number of sources compiled in this paper was sixty-four. However, the author utilized five papers to address the first research question on theoretical perspectives adopted in machine translation (MT) studies. In their book *Research Methodologies in Translation Studies,* Saldanha and O'Brien (2014) mention the inclusion and exclusion of the most relevant sources and the rationale for writing a literature review. Accordingly, the author excluded papers that are not theoretically grounded because one of this study's aims was to explore the adopted theories in MT studies. The publication date was limited to the most recent years, i.e., the last five years overall (Austermühl, 2014; Briggs, 2018; Liu et al., 2022; Nino, 2020; Popel et al., 2020).

Before discussing the five reviewed studies, the author reviewed two studies advancing theoretical frameworks (i.e., Deng & Yu, 2022; Jolley & Maimone, 2022). The author builds on this literature in her discussion on a similar topic (the first research question) to a more comprehensive description. The remaining papers were used to answer the second and third research questions on the benefits and downsides of MT both in language learning and professional translation. The publication years for the remaining two research questions range from

1994 to 2023. However, the majority of the papers are fieldwork research and literature reviews published between 2013 and 2023. Few very old publications are due to the theories adopted in the studied articles reported in this paper. Additionally, more than half of the sources used in this study are journals, and most papers are peer-reviewed.

It is essential to note that the scope of the review to address the first research question is deliberately restricted to five articles for the following reasons. First, scholars agree that there is no rule of thumb for the number of articles reviewed in a literature review though three to over thirty sources are acceptable (ResearchGate, 2019). Thus, the author qualitatively analysed the five papers. Second, the discussion of the five adopted theories studied in this paper covered theories' advocates, key concepts of a theory, research approaches in which the theories were adopted, and how the theories were connected to the aim of the studies. This format indicates a more in-depth discussion of theories than those presented by Jolley and Maimone (2022) and Deng and Yu (2022). However, a more detailed description of theoretical perspectives from a broader range of articles is beyond the scope of this article; however, a quick search on a range of articles for such a purpose can be accessed in reviewed articles or studies of Buttner et al. (2022), Kanglang and Afzal (2021), Klimova et al. (2023), Lee (2021), Pluymaekers (2022), Ragni and Vieira (2021), Saroukhil et al. (2018), Tan et al. (2020), and Zhen et al. (2021).

In addition, following Vygotsky's (1978) method, data 'analysis is essentially description and not explanation.' (p. 62). Hence, in analyzing data, the researcher describes what literature has uncovered the answers to the research questions raised in this literature review. Meanwhile, in respect of Melby's (1982a, 1982b) research approach, it is strenuous to identify his adopted translation theory in developing his translator work station framework. However, some of the existing literature indicates his adoption of functionalist theories involving

studies of translation and linguistics (e.g., Melby et al., 2005). Calvo (2018) indicates that functionalist theories involve a descriptive analysis when dealing with complex international translation projects to ensure that translation quality meets the client's expectations. Thus, this functionalist approach conforms with Vygotsky's method of data analysis, as mentioned above. The research questions are: (1) What are the theoretical perspectives underpinning machine translation studies? (2) What are the benefits and downsides of machine translation in language learning? (3) What are the benefits and downsides of machine translation in professional translation?

4. Review of The Literature

What Are the Theoretical Perspectives Underpinning Machine Translation Studies?

Previous studies have been conducted on machine translation (MT) and focused on several areas, for examples, translation technology and language learning (Nino, 2020); the development of computer-aided translation (CAT) tools (Koehn, 2009); neural machine translation (NMT) (Tan et al., 2020); issues and challenges of approaches to machine translation (Okpor, 2014); perceptions and attitudes of translation instructors and learners (Liu et al., 2022); translation and technology (O'Brien & Vázquez, 2020); and transforming machine translation (Popel et al., 2020).

Deng and Yu (2022) argue that efforts to synthesize studies on machine translation-assisted language learning (MTALL) are limited despite the increasing number of studies in this area. Concerning the theoretical perspectives, Deng and Yu (2022) assert that none of the three systematic reviews studied (Kanglang & Afzaal, 2021; Lee, 2021; Zhen et al., 2021) focused on the theoretical frameworks used in MTALL research.

Jolley and Maimone (2022) have conscientiously reviewed scholarly works (i.e., dissertations, theses, argumentative essays, and

descriptions of classroom activities) and classified them into five unified components under the following principal foci "MT and CAT systems, MT in translator training, MT in language teaching and learning, MT use and perceptions, and MT as academic dishonesty" (p. 28). However, Jolley and Maimone (2022) stress the last three components as reflecting the most frequent questions researchers and language practitioners ask. Interestingly, approximately among the twenty-two studies reported in the category of *MT in language teaching and learning*, only one study is reported as adopting a theoretical perspective (Jolley & Maimone, 2022). The reported study was conducted by Selcuk et al., indicating a psycholinguistic perspective as the bedrock for the study. This theory helps explain why learners use MT "Low learner confidence and high levels of anxiety related to L2 writing may be other motivating factors to use MT." (cited in Jolley & Maimone, 2022, p. 30). Although Jolley and Maimone (2022) emphasize that the role of learners' affective and cognitive factors in their MT use has not yet been investigated, they provide no information regarding the absence of theoretical perspectives of the majority of the reported studies in MT in language teaching and learning. Theoretical perspectives are crucial as they help language educators view MT in language teaching and learning and affect their decisions of using or not using MT and their perceptions of learners' MT use.

In their second research question of *How MT might affect language learning,* Jolley and Maimone (2022) identified Richmond as the first researcher to view the MT use from the second language acquisition (SLA) theory. Richmond (in Jolley & Maimone, 2022) proposed the blueprint of back-translation and pre-editing activities to promote cross-linguistic comparisons and augment learners' awareness of L2 grammaticality. Richmond says such activities raised users' attention to form and maximized input processing. Belam (in Jolley & Maimone, 2022) supports this view when saying that post-editing demands learners to develop analytical skills of both the source and

target texts in detail, enriching their vocabulary and syntactic repertoire.

*A systematic review of MT by Deng and Yu (2022) reveals that the three reported systematic review studies (*Kanglang & Afzaal, 2021; Lee, 2021; Zhen et al., 2021) *of MT research lacked theoretical lenses. Accordingly, these authors proposed this research question What are the frequently used theoretical frameworks adopted in MTALL research?* Deng and Yu (2022) found that less than half of the included studies (9 out of 26) adopted theoretical frameworks, which include seven theories, models, and frameworks. These included:

> The taxonomy of error types, CALF (syntactic complexity, accuracy, lexical complexity, and fluency) measures, translanguaging, the ecological theoretical framework, the technology acceptance model, the TPACK (technological, pedagogical, and content knowledge) framework, and the ADAPT (amending, discussing, assessing, practicing and training) approach. (*Deng & Yu, 2022,* p. 6)

The succinct summary of the most frequently adopted theoretical frameworks is informative and expedient for current and future language and translation researchers and practitioners. The following Table 1 presents this summary.

Table 1. The most frequently adopted theoretical frameworks in Deng and Yu's (2022) systematic review of machine translation studies.

Theoretical Frameworks		**Key Concepts/Views**	**Putting Theories to Practice**
1.	Ferris et al.'s (2013) taxonomy of error types	N/A	●To assess the linguistic accuracy of the translation: twenty main error types in this taxonomy, ranging from punctuation errors to sentence-structure errors.

			●To analyze the grammatical errors in the English text produced by Google Translate.
2.	CALF (syntactic complexity, accuracy, lexical complexity, and fluency) measures ●the most widely used methodological framework	N/A	●To measure linguistic performance: syntactic complexity, accuracy, lexical complexity, and fluency. ●To provide information about language improvement and writing quality aspects of Korean students' English writing. ●To investigate the effect of machine-translation tools on multidimensional levels. ●To investigate CALF measures across different text genres and proficiency levels.
3.	Translanguaging ●a dominant theory in multilingual education	●Linguistic practices are fluid, and languages are integrated linguistic systems used for communicative purposes.	●To encourage students to motivate all linguistic resources for learning and understanding. ●To study how pupils and teachers perceive machine translation in multilingual learning. ●To research machine translation and

			understand bilingual or multilingual students' uses of it.
4.	The ecological theoretical framework	●Views teaching and learning as ecosystems. ●Multiple ecological components may interact across multiple levels within a larger ecology. ●It is plausible for researchers to consider essential components in an educational setting, as they may influence pedagogical practices.	●To analyze foreign language instructors' beliefs about machine translation through an ecological lens. ●Following the ecological theoretical frame, they extended data-collection measures to closed-ended and open-ended surveys, as well as the areas of inquiry into students' uses and motivations and the teaching profession.
5.	Davis' (1989) technology acceptance model (TAM)	●To examine individuals' acceptance of new technology. ●To exploit the TAM's three key components, i.e., perceived usefulness, perceived ease of use, and behavioral intention.	●To examine individuals' acceptance of new technology. ●To investigate Chinese undergraduate students' responses to post-editing of machine translation based on perceived usefulness and perceived ease of use. ●To understand the relationships among perceived usefulness, perceived ease of use, students' English learning motivation, and reading

			anxiety. ●To explore students' intention to use machine translation through an extended model.
6.	Shulman's (1986) TPACK (technological, pedagogical, and content knowledge) framework	●To utilize teachers' pedagogical and content knowledge.	●To emphasize the importance of technological knowledge in teaching. ●To discuss how preservice teachers integrate translation tools into their lessons.
7.	The ADAPT (amending, discussing, assessing, practicing, and training) approach	●To integrate teachers' and instructors' pedagogical knowledge of technology into their lessons.	●To integrate machine translation into classroom teaching. ●To cover the five elements of this approach: amending assignments, discussing translation tools, assessing with translation tools, practicing integrity, and training learners to use translation tools.

Table 1 represents the most frequently adopted theoretical frameworks in Deng and Yu's (2022) systematic review of machine translation studies. The table represents a connection among theoretical frameworks, key concepts or views, and putting theories to practice. Table 1 also indicates the usefulness of the theories in informing researchers of the research conduct. Based on researchers'

views of the translation technology or MT, they decide how to conduct their research. However, as the table suggests, Deng and Yu (2022) only mention three theory proponents (Davis' (1989) technology acceptance model (TAM); Ferris et al.'s (2013) taxonomy of error types; Shulman's (1986) TPACK) out of the seven theories or frameworks. These authors also exclude the key concepts of the first two theories compared to the other three without any particular reasons. Nevertheless, they succeed in articulating the adoption of the notions of those theoretical frameworks in scholars' research, as shown in the 'Putting Theories to Practice' column. The researchers are excluded from the table because the discussion emphasizes the theoretical frameworks discussed by Deng and Yu (2022).

Among the seven theories, CALF measures are regarded as the most widely used methodological framework to measure linguistic performance, and translanguaging is seen as a dominant theory in multilingual education and a pedagogical approach. The table above indicates that Deng and Yu (2022) eliminate the research methods adopting the theories. They only presented how scholars instigated the theories. Specifying theorists to distinguish a particular theorist from another is pivotal because certain theorists are original proponents while others develop their models or frameworks from the existing ones. Similarly, providing research methods is paramount because theories inform researchers how to conduct research (Abend, 2008). The author thus proposes the following comprehensive inclusion of theories and their proponents, research methods, and researchers, as summarized in Table 2. Unlike Deng and Yu's (2022) discussion of the theoretical frameworks, the author presents this in a table to allow easy reading.

Table 2. A summary of the theoretical perspectives studied in this paper.

Theoretical Frameworks		Key Concepts/Views	Research Methods	Putting Theories to Practice	Researchers
1	Vygotsky's (1978) socio-cultural theory Bloom's revised taxonomy (Krathwohl, 2002)	●Learning is intermediated by teachers' support, peer collaborations, and various tools. ●A hierarchy of thinking order from lower to higher levels. The categories include 1) remembering, 2) understanding, 3) applying, 4) analyzing, 5) evaluating, and 6) creating, with the latter two skills representing higher-order skills.	●Quantitative: *surveys*	●To analyze how students use WBMT to support their written and oral communication skills. ●To examine how students with limited English ability use WBMT to keep pace with their more proficient peers in competitive learning circumstances.	Briggs (2018)

2.	Benson's (2011) model for the promotion of autonomous learning in the class	●The integration of OMT as a form of an autonomous ILL task. ●Learner autonomy operates on six levels: ➡a *resource-based approach*—independent use of learning resources. ➡a *curriculum-based approach*—curriculum control. ➡a *classroom-based approach*—classroom control decisions. ➡a *teacher-based approach*—teacher roles ➡a *learner-*	●Quantitative: *online surveys*	●To focus on technology-, learner- and resource-based approaches to connect well with the autonomous use of OMT for ILL. ●To support a learner-centered approach to allow learners' autonomy through exploration, experimentation, and interaction with technologies, while language teachers plays a role as a facilitator	Nino (2020)

		based approach—the development of autonomous learning skills. ➨a *technology-based approach*—independent use of learning technologies.		of learning to encourage exploration of language and promotion of digital literacy.	
3.	PACTE's (2003) translation competence model and translation competence acquisition model	●Expert knowledge that a competent professional translator needs to possess. ●Five sub-competencies: bilingual sub-competence, extra-linguistic sub-competence, instrumental sub-competence, knowledge	●A mixed-methods design: *surveys & semi-structured in-depth interviews*	●To provide an initial picture of the perceived influence of MT on translation competence acquisition and compare translation instructors' and learners' use and perceptions of MT in Hong Kong.	Liu et al. (2022)

		about translation sub-competence, and strategic sub-competence. Psycho-physiological components in each translation activity.			
4.	Melby's (1982) translator work station	Three levels of the translator's work station: •Level 1-Text Processing •Level 2-Text Analysis •Level 3-Machine Translation • Computer-assisted translation (CAT) comprises machine-aided human	•Descriptive writing *(book)*	•To improve the overall quality of professional translation by marrying humans to computers	Austermüh l (2014)

		translation (MAHT) and human-aided machine translation (HAMT).			
5.	Vaswani et al.'s (2017)(2017) transformer encoder-decoder architecture (deep-learning framework transformer)	●The encoder ➨represents subwords in the source-language sentence by a list of vectors ➨automatically extracts features describing relevant aspects and relationships in the sentence ➨creates a deep representation of the original sentence. ●The decoder converts the deep representation	Quantitative: *an automatic metric on English & French pair and English & Polish pair* Quantitative: *news article*	●A neural-based translation system CUBBITT (Charles University Block-Backtranslation-Improved Transformer Translation)—significantly outperformed professional translators on isolated sentences in a prestigious competition WMT 2018. ●CUBBITT conveys	Popel et al. (2020)

		to a new sentence in the target language.		meaning of news articles significantly better than human translators even when the cross-sentence context is taken into account.	

As shown in Table 2, the inclusion of research methods is essential to demonstrate the overall research methodology of the reported studies. Overall, the table suggests five theoretical perspectives, models, or frameworks, each consisting of key concepts or views, research methods, and how the perspectives, models, or frameworks are put into practice to inform researchers' studies. The five theoretical perspectives, models, or frameworks include Vygotsky's (1978) socio-cultural theory and Bloom's revised taxonomy (Krathwohl, 2002), Benson's (2011) model for the promotion of autonomous learning in the class, PACTE's (2003) translation competence model and translation competence acquisition model, Melby's (1982) translator work station, and Vaswani et al.'s (2017) transformer encoder-decoder architecture (deep-learning framework transformer).

Briggs' (2018) exploratory study aimed to provide language educators with information on the student's use of, evaluations of, and attitudes and beliefs concerning the web-based machine translation

(WBMT) tools for English language learning. Briggs's research is grounded in Vygotsky's (1978) socio-cultural theory, postulating that language learning is intervened through teacher support, peer collaboration, and tools. Briggs points out the importance of tools in language learning. For instance, language learners were initially introduced to printed dictionaries as sought-after tools for nurturing their self-mediated language learning (Briggs, 2018). However, with the development of society and culture in this global community, language learners have begun to be exposed to smartphones, which enables them to quickly access electronic dictionaries and WBMT tools (Briggs, 2018). Using Vygotsky's (1978) theory in his quantitative study, Briggs (2018) analyzed how learners deploy WBMT to support their written and oral communication skills.

Exploiting Bloom's revised taxonomy (Krathwohl, 2002), Briggs also looked at how learners with limited English ability use WBMT to maintain their pace with their more proficient counterparts in competitive learning environments. Bloom's revised taxonomy assists in the understanding of learners' order of thinking from lower to higher levels. Thus, lower-level students of English may use WBMT to level up their confidence in their written and spoken skills.

Nino (2020) adopts Benson's (2011) model for promoting autonomous learning in the classroom in her quantitative study. This model requires that OMT is integrated with the language classroom to foster learners' independent language learning (ILL). Understanding how learner autonomy works in different *approaches helps educators to effectively connect the most relevant approaches to learners' use of OMT for their ILL. Nino focuses on the most relevant approaches in her research context, which include approaches to technologies (independent use of learning technologies), learners (the development of autonomous learning skills), and resources (independent use of learning resources).*

Utilizing Benson's (2011) model for the promotion of autonomous learning in the classroom, Nino (2020) supports learners' autonomy in a learner-centered classroom through exploration, experimentation, and interaction with technologies while language teachers serve as facilitators of learning, encouraging exploration of language and promotion of digital literacy.

Liu et al. (2022) apply PACTE's (2003) translation competence model and translation competence acquisition model in their mixed-methods research design through surveys and semi-structured in-depth interviews for data collection. PACTE is a group of researchers conducting multi-empirical research to investigate the components and acquisition of translation competence, conducting ground-breaking work to examine what establishes and characterizes translation competence. This model emphasizes the expert knowledge that a competent professional translator should have. The competence model comprises five integrated sub-competencies: bilingual sub-competence, extra-linguistic sub-competence, instrumental sub-competence, knowledge about translation sub-competence, and strategic sub-competence. In addition, psycho-physiological components work in each translation activity. Expert knowledge encompasses declarative and procedural knowledge (Anderson in Liu et al., 2022). Individuals develop declarative knowledge or 'knowing what' through extrinsic and translational information exposure. Examples of this are extra-linguistic sub-competence and knowledge about translation sub-competence.

Meanwhile, bilingual, instrumental, and strategic sub-competences are connected with procedural knowledge (PACTE, 2003), which signifies 'knowing how' and is learned through repeated practice to build automation (PACTE, 2003). Psycho-physiological components, such as attitudinal, cognitive, and psycho-motor in translation (e.g., confidence, motivation, analysis, and reasoning), play a critical role in integrating all sub-competences. Adopting the model, Liu et al. (2022)

aimed to explore the perceived influence of MT on translation competence acquisition and compare translation instructors' and learners' perceptions and use of MT in Hong Kong.

In his discussion of a thought-provoking chapter on *translation in the information age* in his book '*Electronic Tools for Translators*,' Austermühl (2014) shadows Melby's (1982) translator work station framework. This framework proposes three levels of the translation workstation: level 1-text processing, level 2-text analysis, and level 3-machine translation. Austermühl (2014) argues that computer-assisted translation (CAT) is not merely concerned about the machine but also human translation. Hence, amalgamating these two qualifies an effective workflow and augments the overall quality of professional translation through the combined work of machine-aided human translation (MAHT) and human-aided machine translation (HAMT). In other words, rather than abusing either of the translation modes, Austermühl (2014) recommends that professional translators consider using machine translation to engender high-quality translations.

Popel et al. (2020) deploys the transformer encoder-decoder architecture (deep-learning framework transformer) of Vaswani et al. (2017) in their quantitative study operating an automatic metric on English and French and English and Polish pairs in the news translation task. This framework utilizes encoder and decoder systems. The encoder represents sub-words in the source-language sentence through a trajectories list, automatically extracting features describing relevant aspects and relationships. It also creates a profound representation of the original sentence. Therefore, the decoder converts the entrenched representation of a new sentence in the target language. Popel et al. (2020) found that Charles University Block-Backtranslation-Improved Transformer Translation (CUBBITT) substantially outperformed professional translators on isolated sentences in a prestigious WMT 2018 competition in the event of the English-Czech News Translation Task. Such performance shows that CUBBITT

conveys the meaning of new articles considerably better than human translators, even when considering the cross-sentence context.

In addition, from the table, we learn that unlike Deng and Yu's (2022) research, this review paper found that none of the studies reveals the most extensively used theory, framework, or model. Each study indicates a different adopted theory, framework, or model. Most research approaches also fall into quantitative studies; where surveys are the most popular data collection tools. The following section answers the second research question on the benefits and downsides of machine translation in language learning.

WHAT ARE THE BENEFITS AND DOWNSIDES OF MACHINE TRANSLATION IN LANGUAGE LEARNING?

This section discusses the benefits and downsides of machine translation (MT) in language learning. Despite the rapid growth of technology, individuals are cognizant of the fact that the development of machine translation or translation technology was not designed to assist language learning; consequently, it has limited abilities depending on the language pair, language direction, and genre (Nino, 2020). Nevertheless, research has found that the need for machine translation (MT) in language learning is increasingly ultimate, and efforts to ban MT have been futile (White & Henrich, 2013). Concerning teacher support and tools, Briggs (2018) mentions that in the Korean university context, smartphones have become ubiquitous, and students can easily access electronic dictionaries and web-based machine translation (WBMT) tools.

Studies have shown the usefulness of MT in language learning, especially for writing-related tasks (Briggs, 2018; Lee, 2019; 2021; Nino, 2020; Raído & Torrón, 2020). Briggs (2018) surveyed 80 upper-year Korean-speaking university students regarding their use of, and attitudes toward, WBMT tools. The results indicated that most students used them to support their language studies at home and school and

for various purposes (Briggs, 2018). Lee's (2019) analysis of students' writing found that MT aided in decreasing lexico-grammatical errors and increased writing revisions, thus positively affecting student writing strategies and helping them consider writing as a process. Investigating 87 MT studies on foreign language training published between 2000 and 2019, Lee (2021) discovered that most studies reported the positive impacts of MT use in foreign language learning, especially for writing. These results ring true with Raído and Torrón's (2020) finding that MT improves the production of second-language written texts.

Lee (2021) observed that language teachers need to consider this in their classrooms, with many students using MT for academic purposes in recent years. This situation has become a whistleblower for teachers to begin attending MT-related training. With the growing number of students using MT, studies have found that language teachers are urged to work with students and assist them in using MT effectively (White & Heinrich, 2013). Nino (2020) corroborated this finding by saying that in this globalized world where individuals are engaged in cross-cultural communication through the help of translation, and as language educators, we have a vital role to play and ensure that language students are well aware of this.

Bowker (2020) reported that a growing number of international students studying business in Canada had urged her team to conduct machine translation literacy instruction for this group of students and their language teachers at a Canadian university. A total of 24 Continuing Education staff members attended the MT literacy information session, and they expressed anxieties about the newest form of this technology, known as neural machine translation (NMT) (Bowker, 2020).

In her translation technology and language learning research, Nino (2020) concluded that the use of online machine translation (OMT) technology primarily helps international language learners with their

written comprehension and understanding of vocabulary in context and serves as a quick language assessor for short utterances in written or oral forms. This result is confirmed by Lee (2021), who maintains that MT effectively helps students to enhance their writing skills. Comparing two versions of students' English writing (i.e., the original version vs. the revised version with the assistance of machine translation), Lee (2021) discovered that students' writing increased tremendously, and MT may also improve learners' syntactic complexity and accuracy to improve their writing quality. Cancino and Panes' (2021) results align with these outcomes when saying that syntactic complexity and accuracy scores were higher in the groups with access to Google Translate (GT) than those without GT.

Apart from the positive effect of MT on foreign language writing, a study by Fredholm (2019) showed that MT positively affects learners' improved lexical diversity. Fredholm alludes that when students use GT, their lexical diversity improves; however, this effect disappears when the tool is no longer expended. This effect implies that "The results point to the need for a deeper understanding of language structure and lexicon, a reinforced focus on vocabulary in foreign language teaching, and a widened range of explicit instruction of translation tools and strategies." (Fredholm, 2019, p. 98).

Despite all the positive impacts that MT has on English students' writing and lexical skills, there have been ongoing debates on the downsides of MT. Owing to the fact that OMT is omnipresent and is part of our day-to-day lives, users are aware of its benefits and limitations as a language learning device (Mundt & Groves, 2016), and the MT popularity will continue as students remain using it as a valuable resource for their independent language learning to help with their understanding and production (Nino, 2020). Furthermore, Raído and Torrón (2020) articulate that with free online MT tools that can benefit non-economic sectors such as language learning, the

adoption of MT technology continues growing and exploiting its full potential for language acquisition and production, users are concomitantly urged to improve their existing knowledge of MT.

One of the language teachers' apprehensions is that MT tools may not adequately increase students' translation skills if they excessively rely on them. While some studies (e.g., Lewis-Kraus, 2016) reported students' positive attitudes towards the MT tools as a result of the tremendous improvement of the MT translation accuracy, studies have also shown that the quality of WBMT output was poor and easily detected by teachers (Briggs, 2018; Stapleton & Ka Kin, 2019). Bowker (2020) expresses her crucial concern that the superb service of the MT technology would allow non-native speakers of English to write their written assignments in their native language and then submit their machine-translated versions in English. This matter could thwart the need to learn and write in English (Bowker, 2020). Stapleton and Ka Kin (2019) found that although most of the teachers in their study perceive Google Translation (GT) as a tool, all teachers are concerned about the negative effect of GT on students' learning. Their critical alarm was the GT's inability to generate grammatically correct translations, and the GT's convenience would prevent the students from learning by themselves and experiencing the language learning process. Suppose accurate translations are readily and instantly available to students upon submitting texts in their first language. In that case, they will demotivate learners to learn, write, or even read in a foreign language (Stapleton & Ka Kin, 2019).

A review of the literature by Jolley and Maimone (2022) demonstrates that MT use indicates academic dishonesty or cheating in the context of translator training and formal learning. Thus, efforts have been made to focus on strategies for detecting, reacting to, and preventing the unauthorized use of MT (Jolley & Maimone, 2022). Case (2015) countered this argument by saying that her research participants agreed that despite students' MT use being considered

cheating, 'students are bound to use it anyway' (p. 2). Conversely, Ducar and Schocket (2018) claim that academic dishonesty is not always publicized, nor is there a consensus on whether MT use amounts to cheating.

Researchers, however, agreed that the use of powerful and free online MT proceeds. Regardless of teachers' and researchers' perceptions, language teachers are encouraged to provide students with training instead of banning students from using MT. Lee (2019) states that although MT can be a useful device for language learning, it is essential for teachers to be aware of its limitations and provide ample supervision to students. This statement resounds with Alhaisoni and Alhaysony's (2017) statement that most students request training and strategies for effective MT use from their teachers. The kinds of supervision and training can be seen in the following areas.

For instance, teachers have come to realize to focus on providing students with the necessary skills for using MT and 'design assignments and exams to practice and assess these skills' (Case, 2015, p. 2). As Briggs (2018, p. 18) puts it:

> Rather than pretending that this powerful tool does not exist or banning its use entirely, teachers need to consider that we can better serve our students by developing lessons geared towards helping them use these tools effectively and appropriately.

Stapleton and Ka Kin (2019) suggest that schools should provide training on the appropriate use of GT to enable students to benefit from it. Teachers in Stapleton and Ka Kin's (2019) research purported several ideas, including training students to identify the grammar rules and how to correct the GT-generated errors to assist them in being proficient English writers, thus encouraging them to do it from scratch apart from using GT for noticing and correcting errors. Other teachers implied activities involving checking translation results, changing, and editing them, discussing the GT-produced errors in class, and helping them

improve their English. In short, “teachers could explain why a translated sentence is wrong, how it is wrong, and how students can improve it.” (Stapleton & Ka Kin, 2019, p. 25). Another activity integrating GT with foreign language reading and writing strategies is using GT to check or enrich language and comprehension upon students' reading or writing a text (Lee, 2019; O’Neill, 2019).

The next section of the paper addresses the third research question on the benefits and downsides of MT in professional translation.

WHAT ARE THE BENEFITS AND DOWNSIDES OF MACHINE TRANSLATION IN PROFESSIONAL TRANSLATION?

In the previous section, the author discussed the benefits and drawbacks of machine translation (MT) in language learning. This section shows a connection between translation teaching and the benefits and downsides of MT in professional translation. It is because professional translation is expected to include translation technology in the translation industry in an era of rapidly advancing artificial intelligence. As presented in the previous section, the MT discussion deals with the foreign language students-related context. In contrast, this section concentrates on both student translators and professional translators due to the nature of translation technology in the translation industry. Student translators are early career translators who develop their translation skills as future professional translators.

Information technology has grown tremendously since the early 1980s ‘with the accompanying advantages of speed, visual impact, ease of use, convenience, and cost-effectiveness.’ (Craciunescu et al., 2004, p. 1). In his literature review, Ho (2004) listed the CAT software research and application softwares as a solution to the cross-linguistic and cross-cultural needs for the fast growth of the new global economy. In particular, the CAT tool application is crucial for the software localization industry, which requires translating the source text into the

software package, including program strings and user manuals. The CAT tool also helps translators organize their work into a wide range of foreign languages simultaneously within a limited time (Ho, 2004). Almost two decades later, researchers such as Obrien and Vazquez (2020, p. 19) concur with this statement, saying that "the translation profession has become highly technologized, necessitating the inclusion of translation technology teaching in undergraduate and postgraduate translation programmers."

Skripak et al. (2022) found that employing a CAT system with different functions is crucial for translators 'to improve, optimize, and ensure the quality of the translation process' (p. 2358). Skripak et al. (2022) concluded that integrating the CAT scheme in translation education increases overall education quality. It equips translation students with the necessary learning process and their vision of future job markets in competitive edge circumstances. Learning about MT also means improving students' general computer literacy in the modern linguistic services market with computer technologies. These authors added that "the ability to use automated translation programs and knowledge of various CAT and applied tools significantly improve the productivity and quality of work, leading to an increase in the translator's competitiveness." (Skripak et al., 2022, p. 2358). However, Austermühl (2014) warns MT users that "there is no such thing as a computer-aided cure-all" that will turn a poor translator into a good one (p. 2). However, he argued that the appropriate tools could help translators enhance their work efficiency and quality if used properly.

The recent development of NMT proves the drastically improved MT quality. Arivazhagan et al. (2019) have introduced a universal NMT system capable of translating between any language pair and a massively multilingual NMT model managing 103 languages trained on over 25 billion examples. Wu et al. (2016) and Hassan et al. (2018) reported that the NMT-driven dramatic improvement in translation

quality has even managed to narrow the gap in human-translation quality on isolated sentences ominously. Popel et al.'s (2020) study supports this outcome, showing that their developed neural-based translation system called Charles University Block-Backtranslation-Improved Transformer Translation (CUBBITT) outperforms human translators in the translations of news articles even when the cross-sentence context is taken into consideration. While some studies have shown that translation technologies are not designed to replace human translators (e.g., Austermühl, 2014), other studies (e.g., Pym, 2013) suggest that the integration of data from statistical machine translation (SMT) into translation memory suites (TM/MT technologies) 'can be expected to replace fully human translation in many spheres of activity.' This case appears to alarm human translators that their roles must be adjusted from traditional translators translating from scratch to machine translation post-editor.

The development of NMT signifies a new paradigm called the neural paradigm (Ragni & Vieira, 2021). These authors insist that this neural paradigm changes translators' work, particularly in the editing process and its specifics. Arena (2013) found that translators have mixed experiences and feelings towards the output of MT and post-editing, not merely owing to their reluctance to accept its existence in the localization process but because of their past experiences with different output qualities and the translation projects' features. Although translators were satisfied with their translation work, they were dissatisfied with the payment as machine-translation post-editors. Nevertheless, it depends highly on the types of clients and tasks (Arena, 2013).

Little is known about empirical studies detailing the economic effects of using artificial intelligence (AI) such as MT (Hui et al., 2018). Almost two decades ago, Craciunescu et al. (2004) mentioned that MT only represented a tiny percentage of the market. Further, Oren (cited in Craciunescu et al., 2004) reported market analysts' prediction that

machine translation would remain at most 1% of an over U.S. $10 billion translation marketplace by 2007. However, this figure counteracts the data demonstrated by Hui et al. (2018), who conducted their studies on the effect of the introduction of eBay Machine Translation (eMT) on eBay's international trade, showing the increased international trade, especially in the export area by 17.5%. Furthermore, Brynjolfsson et al. (2018) found that eMT boosts U.S. exports to Spanish-speaking Latin American countries by 17.5%-20.9% on eBay. EBay facilitated over U.S $14 billion of world trade among more than 200 countries as a trading platform in 2014. As a central AI technology, eMT statistically learns to translate from different source languages to target languages. Hui et al. (2018, p. 1) further state that "eMT is optimized to work in real-time, yielding high-quality translations within milliseconds." and concluded that "Machine translation has made the world significantly more connected and effectively smaller." (Hui et al., 2018, p. 1).

It is also reported that MT is beneficial in the currently fast-changing globalized economy concerning fast, affordable, and responsive services. As an automatic translation system, MT can operate large text volumes, from simple letters to technical manuals, and rapidly translate them (Brynjolfsson et al., 2018; n.a., 2022). Moreover, compared to a professional translator, the MT offers a much more affordable price (Craciunescu et al., 2004; n.a., 2022). This finding is consistent with research by Crystal (2003), who argued that translation services had increased prices to such an extent that half the budget of an international company can quickly be drained away in translation costs.

Despite the benefits of MT in professional translation-related works, studies have suggested some drawbacks of this evolving technology. Austermühl (2014) contends that MT systems are simply one of many translation tools. He questions the translation that MT

produces because of the MT's weaknesses in areas such as communicative, cultural, and encyclopedic dimensions of translation. Nino (2020) maintains that despite MT's capability of translating basic questions such as 'Where is the bathroom?' (p. 22), the MT system, e.g., Google Pixel Buds and Google-assistant-enabled headphones, often gets lost in translation when dealing with complex sentences, background noise, or strong accents. Briggs (2018) underlines the imperfect system of MT by saying that a pragmatic challenge for computers will endure. Keszthelyi (2017, p. 23) quoted a statement by the general director of an influential Hungarian translation company, Peter Lepahin, that "The more underlying meaning and connotation is present in the text, the more elaborate and sophisticated it is, the clumsier *MT* becomes." Briggs (2018) summarized the shortcomings of the MT system by pointing out rare or unknown vocabulary, an area that MT still struggles with, coupled with a tendency to over-or under-translate some sentences. Briggs (2018) also cites another MT's imperfection concerning conversational language, which 'is characteristically quite context-dependent, as is the Korean language in general' (p.5). Thus, language learners need to be aware of the limitations of MT accuracy.

Despite the increased productivity caused by the MT systems, as previously discussed, Rossi (2017) reported student translators' perceived MT use that although MT did enhance their productivity level, it did not significantly influence their perceptions because "very few reported that they enjoyed working with a raw MT output." (p. 53). In other words, this finding suggests that the reported teachers in Rossi's (2017) study were unhappy with the MT quality. Rossi (2017) also stated that participants felt the loss of control and authorship, which is in line with current uncertainties about "what might or might not be the ultimate success of automated systems in dealing with problems or questions of translatability" (p. 54). These results echo earlier studies reporting the limitations of MT (e.g., Briggs, 2018; Craciunescu et al., 2004; Nino, 2020).

Another MT's flaw is concerned with the aesthetic aspect of translation, involving creativity and the power of imagination (Craciunescu et al., 2004). Literary texts, for instance, possess polysemy, connotation, and style, which play a fundamental role that MT cannot maneuver (Craciunescu et al., 2004). These authors further argue that "computers could not even begin to replace human translators with such texts." (Craciunescu et al., 2004, p. 9). Even with other types of texts, Craciunescu et al.'s (2004) analysis of the roles and abilities of both MT and CAT indicates that they need to be more efficient and accurate to eradicate human translators' existence. Wang et al. (2022, p. 150) advance the idea that "There is still a long way to go to achieve high-quality MT. It is necessary to develop new methods combining symbolic rules, knowledge, and neural networks to further improve translation quality." Thus, both machine translation and human translators should complement each other, and human translators are required to explore and exploit the potential of the sophisticated technology without feeling intimidated (Craciunescu et al., 2004).

The discussions on the first, second, and third research questions demonstrate findings suggesting a connection with Vygotsky's (1978) social-cultural theory and Melby's (1982a, 1982b) translator work station framework. All the research reported in this paper confirms Vygotsky's notion of the changing world leading to changing human behaviors and the tools or technology utilized in their daily lives, including how languages are learned and translation technology is adopted in this rapidly changing artificial intelligence era. Vygotsky's concept of society and culture echoes Melby's translator work station framework because this framework assists users, including language learners, language teachers, translation trainers, and translation researchers, in understanding the approach to language learning and translations in the modern digital age as a productive and effective, instead of destructive or interruptive, device.

5. CONCLUSIONS

This review paper addressed three primary research questions: the theoretical perspectives adopted in machine translation (MT) studies, the benefits and downsides of MT in both language learning and professional translation. This review found that MT studies lacking theoretical perspectives, as shown in two systematic literature reviews by Jolley and Maimone (2022) and Deng and Yu (2022), respectively, are perplexing. Meanwhile, the five reviewed articles by the author suggest varied theoretical perspectives, frameworks, or models. In other words, none of these was the most widely used in the studies reviewed in the papers. Thus, this result contrasts with the finding of Deng and Yu (2022), which shows the two most dominant frameworks or models. In addition, different held views or assumptions affect MT users' attitudes towards MT use in language teaching and learning and in professional translation.

This study also found that MT is most commonly exploited in developing students' writing tasks or assignments compared to developing other skills. Although the study suggests ongoing debates on MT's benefits and downsides in language learning and professional translation, the literature points out that human translators should not view MT as a rival. Instead, they need to shift their standpoints from feeling threatened by the inclusion of MT in this rapidly advancing artificial intelligence era to maximizing the MT potential for increased productivity and high-quality translations. It is because studies have continually shown an increasing number of MT users, both language learners and professional translators. The latter is partly connected to the MT education conducted in most higher education contexts.

These findings have significant implications for language educators, translation trainers, and researchers. First, more theoretically grounded MT studies are encouraged to help teachers view MT roles and understand the existing phenomena. Second, embracing

MT use in language classrooms or translation education is vital as learners continue using it regardless of teachers' attitudes and perceptions. This suggestion resonates with Alhaisoni and Alhaysony (2017), who insist that MT training and effective strategies for MT use are students' most desired areas. Third, effective teaching of how to utilize MT enhances responsible MT usage. Fourth, it is suggested that language educators collaborate with academic librarians and other experts to support learners' effective use of MT.

Future research should concentrate on the following areas. Firstly, more studies need to be theoretically grounded as theories, frameworks, or models aid researchers in conducting their studies, especially in formulating research aims, approaches to research design, and data collection and analysis techniques. Secondly, the current trend in MT research methods is quantitative design. Thus mixed-method and qualitative designs could be further developed. Thirdly, more research is required to explore how users exploit Google Translate or other tools to help with their comprehension of digital reading material instead of writing development, which most contemporary studies have conducted. Additionally, as this review was limited to only five studies to address the first research question on theoretical perspectives, it might be possible to use a broader range of studies focusing specifically on this topic in future investigations.

6. REFERENCES

Abend, G. (2008). The Meaning of Theory. *Sociological Theory* 26. In R.A. Swanson (Ed.), *Theory Building in Applied Disciplines (*173–199), Berrett-Koehler Publishers.

Alhaisoni, E., & Alhaysony, M. (2017). An investigation of Saudi EFL university students' attitudes towards the use of Google Translate. *International Journal of English Language Education, 5, 72-82.*

Arenas, A. G., & Moorkens, J. (2019). Machine translation and post-

editing training as part of a master's programme. *The Journal of Specialized Translation*, *31, 217-238.*

Arivazhagan, N. Bapna, A., Firat, O., Lepikhin, D., Johnson, M., Krikun, M., Chen, M. X., Cao, Y., Foster, G., Cherry, C., Macherey, W., Chen, Z., & Wu, Y. (2019). Massively multilingual neural machine translation in the wild: Findings and challenges https://dblp.org/rec/journals/corr/abs-1907-05019.html

Austermühl, F. (2014). *Electronic tools for translators.* Routledge. https://doi.org/10.4324/9781315760353

Benson P. (2011). Language learning and teaching beyond the classroom: An introduction to the field. In P. Benson & H. Reinders (Eds.), *Beyond the Language Classroom (7-16)*, Palgrave Macmillan. doi: 10.1057/9780230306790_2

Brynjolfsson, E., Hui, X., & Liu, M. (2018, August). Does machine translation affect international trade? Evidence from a large digital platform, *NBER Working Paper,* 24917, 1-40.

Bowker, L. (2020). Chinese speakers' use of machine translation as an aid for scholarly writing in English: A review of the literature and a report on a pilot workshop on machine translation literacy. *Asia Pacific Translation and Intercultural Studies 7*(3), 288–298.

Briggs, N. (2018). Neural machine translation tools in the language learning classroom: Students' use, perceptions, and analyses. The JALT CALL Journal, *14*(1), 3–24.

Büttner, B., Firat, M., & Raiteri, E. (2022). Patents and knowledge diffusion: The impact of machine translation. *Research Policy*, *51,* 1-18. https://doi.org/10.1016/j.respol.2022.104584

Calvo, E. (2018). From translation briefs to quality standards: Functionalist theories in today's translation processes. *Translation & Interpreting, 10(1),* 18-32. doi:10.12807/ti.110201. 2018.a02

Cancino, M., & Panes, J. (2021). The impact of Google Translate on L2 writing quality measures: Evidence from Chilean EFL high school

learners. *System, 98*, 102464.

Case, M. (2015). Machine translation and the disruption of foreign language learning activities. *eLearning Papers*, *45*, 4-16. http://urn.kb.se/resolve?urn=urn:nbn:se:du-20314

Chen, W. (2020). Using Google Translate in an authentic translation task: The process, refinement efforts, and student perceptions. *Current Trends in Translation Teaching and Learning E, 7*, 213-238. 10.51287/cttl_ e_ 2020 _7_cheryl_chen_wei-yu.pdf

Crystal, D. (2003). *English as a Global Language.* Cambridge University Press.

Deng, X.; Yu, Z. A. (2022). A systematic review of machine-translation assisted language learning for sustainable education. *Sustainability, 14*, 7598. https://doi.org/10.3390/ su14137598.

El-Daly, H. M. (2022). Linguistic and socio-cultural approaches to translation: Theoretical and pedagogical reflections, International Journal of English Language, Literature and Translation Studies (IJELR), *9*(4), 50-72.

Fredholm, K. (2019). Effects of Google Translate on lexical diversity: Vocabulary development among learners of Spanish as a foreign Language. *Revista Nebrija de Lingüística Aplicada a la Enseñanza de las Lenguas*, *13*(26), 98-117.

Garg, A., & Agarwal, M. (2018). Machine translation: A literature review. *Computer Science*, 1-17.

Hassan, H. et al. (2018). Achieving human parity on automatic Chinese to English news translation. *Computer Science,* 1-25. http://arxiv.org/abs/1803.05567.

Ho, G. (2004). Globalization and translation: Towards a paradigm shift in translation studies. [Ph.D. Thesis, The University of Auckland].

Hui, X., Liu, M., & Brynjolfsson, E. (2018, September). The effect of machine translation on international trade: Evidence from a large

digital platform. https://cepr.org/voxeu/columns/effect-machine-translation-*international-trade-evidence-large-digital-platform*

Jolley, J. R., & Maimone, L. (2022). Thirty years of machine translation in language teaching and learning: A review of the literature. *L2 Journal*, *14*(1), 26-44. Doi 10.5070/L214151760.

Kanglang, L., & Afzaal, M. (2021). Artificial intelligence (AI) and translation teaching: A critical perspective on the transformation of education. *International Journal of Educational Science, 33*, 64–73.

Keszthelyi, C. (2017). Human factor remains vital in translation and speech recognition. *Budapest Business Journal*. https://bbj.hu/ special-report/human-factor-remains-vital-in-translation-speech-recognition_129858

Klimova, B., Pikhart, M., Benites, A.D., Lehr, C., & Sanchez-Stockhammer, C. (2023). Neural machine translation in foreign language teaching and learning: A systematic review. *Education and Information Technologies, 28*, 663–682.

Koehn, P. (2009). A process study of computed aided translation. *Machine Translation, 23*(4), 241-263. doi: 10.1007/s10590-010-9076-3

Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory into Practice, 41*(4), 212–218. doi: 10.1207/s15430421tip4104_2

Läubli, S., Castilho, S., Neubig, G., Sennrich, R., Shen, Q., & Toral, A. (2020). A set of recommendations for assessing human-machine parity in language translation. *Journal of Artificial Intelligence Research*, *67*, 653-672.

Lee, H. G., Lee, J., Kim, J. S., & Lee, C. K. (2015). Naver machine translation system for WAT 2015. In *Proceedings of the 2nd Workshop on Asian Translation* (69–73). http://anthology.aclweb.org/attachments/W/W15/W15-5008.Presentation.pdf

Lee, S.M. (2019). The impact of using machine translation on EFL students' writing. *Computer Assisted Language Learning, 33*, 157–175.

Lee, S.M. (2021). The effectiveness of machine translation in foreign language education: A systematic review and meta-analysis. *Computer Assisted Language Learning*, *36*(1-2), 103–125. doi: 10.1080/09588221.2021.1901745

Lewis-Kraus, G. (2016, December 14). The great A.I. awakening. *The New York Times.* https://www.nytimes.com/2016/12/14/ the-great-aiawakening.html

Liu, K., Kwok, H.L., Liu, J., & Cheung, A.K. (2022). Sustainability and influence of machine translation: Perceptions and attitudes of translation instructors and learners in Hong Kong. *Sustainability 14*, 1-29. https://doi.org/10.3390/ su14116399

Melby, A. K. (1982a). Multi-level translation aids in a distributed system. In J. Horecký (Ed.), *Proceedings of COLING 82 (*215-220). North Holland Publishing Company.

Melby, A. K. (1982b). The translation profession and the computer. *CALICO Journal*, *1*(1), 55-57.

Melby, A. K.*, Manning, A. D., & Klemetz, L. (2005).* Quality in translation: Lesson for the study of meaning. *Linguistics and the Human Sciences, 1*(3), 403–446. doi: 10.1558/lhs.2005.1.3.403

Mundt, K. & Groves, M. (2016). A double-edged sword: The merits and the policy implications of Google Translate in higher education. *European Journal of Higher Education*, 1–15. doi: 10.1080/21568235.2016.1172248

Niño, A. (2020). Exploring the use of online machine translation for independent language learning. *Research in Learning Technology*, *28, 1-32.*

N.A. (2022, January). The benefits of Machine Translation and its growing

importance within the business world. Deta85 https://www.cedat85.com/the-benefits-of-machine-translation-and-its-growing-importance-within-the-business-world/

O'Brien, S., & Vázquez, S. R. (2020). Translation and technology. In S. Laviosa & M. González-Davies (Eds.), *The Routledge Handbook of Translation and Education* (264-277), Routledge.

Okpor, M.D. (2014). Machine translation approaches: Issues and challenges. *International Journal of Computer Science Issues*, *11*(5), 2, 159-165.

O'Neill, E. M. (2019). Online translator, dictionary, and search engine use among L2 students. CALL-EJ, *20*(1), 154-177. http://callej.org/ journal/20-1/O'Neill2019.pdf.

PACTE. (2003). Building a translation competence model. In F. Alves (Ed.), *Triangulating Translation: Perspectives in Process Oriented Research* (43–66), John Benjamins.

Pluymaekers, M. (2022). How well do real-time machine translation apps perform in practice? Insights from a literature review. In *Proceedings of the 23rd Annual Conference of the European Association for Machine Translation* (51-60). https://aclanthology.org/2022.eamt-1.8

Popel, M., Tomkova, M., Tomek, J., Kaiser, L., Uszkoreit, J., Bojar, O., & Žabokrtský, Z. (2020). Transforming machine translation: A deep learning system reaches news translation quality comparable to human professionals. *Nature Communications*, 1-15. https://doi.org/10.1038/s41467-020-18073-9

Prates, M.O.R., Avelar, P.H., & Lamb, L.C. (2020). Assessing gender bias in machine Translation-A case study with google translate. *Neural Computing and Applications*, *32*, 363–6381. https://doi.org/10.1007/s00521-019-04144-6

Pym, A. (2013). Translation skill-sets in a machine-translation age. *Meta*, *58*(3), 487–503. https://doi.org/10.7202/1025047ar

Ragni, V., & Vieira, L. N. (2022). What has changed with neural machine translation? A critical review of human factors. *Perspectives*, *30*(1), 137-158. DOI : 10.1080/0907676X.2021.1889005

Raído, V. E., & Torrón, M. S. (2020). Machine translation, language learning, and the 'knowledge economy. In M. Filimowicz & V. Tzankova (Eds.), *Reimagining Communication: Action* (155-171), Taylor and Francis/Routledge.

Rossi, C. (2017). Introducing statistical machine translation in translator training: From uses and perceptions to course design and back again. *Revista Tradumàtica. Tecnologies de la Traducció*, *15*, 48-62. https://doi.org/10.5565/rev/tradumatica.195

Saldanha, G., & O'Brien, S. (2014). *Research Methodologies in Translation Studies*. Routledge.

Saroukhil, M.A., Omid Ghalkhani, O., & Hashemi, A. (2018). A critical review of translation: A look forward. *International Journal of Education & Literacy Studies*, *6*(2), 101-110.

Skripak, I. A., Shatskaya, A. V., Ukhanova, E. V., Tkachenko, A. E., & Simonova, N. A. (2022). Information technologies and language: The impact of CAT systems on improving the efficiency of translators' training. *Theory and Practice in Language Studies*, *12*(11), 2358-2364. Doi : https://doi.org/10.17507/tpls.1211.16

Stapleton, P., & Ka Kin, B. L. (2019). Assessing the accuracy and teachers' impressions of Google Translate: A study of primary L2 writers in Hong Kong, *English for Specific Purposes*, *56,* 18–34.

Tan, Z., Wang, S., Yang, Z., Chen, G., Huang, X., Sun, M., & Liu, Y. (2020). Neural machine translation: A review of methods, resources, and tools. *AI Open*, *1*, 5–21. https://doi.org/10.1016/j.aiopen.2020.11.001

Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Aidan N. Gomez, A. N., Łukasz Kaiser, L., & Polosukhin, I. (2017). Attention is all you need. In *Advances in Neural Information Processing*

Systems (Curran Associates, Inc.). https://doi.org/10.48550/arXiv.1706.03762

Vygotsky, L. (1978). *Mind in Society: Development of Higher Psychological Processes*. Harvard University Press.

Wang, H., Wu, H., He, Z., Huang, L., & Church, K. W. (2022). Progress in Machine Translation. *Engineering*, *18,* 143–153. https://doi.org/10.1016/j.eng.2021.03.023

Way, A. (2018). Machine translation: Where are we at today?1-8. doi:10.5040/9781350024960.0018

White, K. D., & Heidrich, E. (2013). Our policies, their text: German language students' strategies with and beliefs about web-based machine translation. *Teaching German*, 46(2), 230–250. doi: 10.1111/tger.10143

Wu, Y. et al. (2016). Google's neural machine translation system: Bridging the gap between human and machine translation. http://arxiv.org/abs/1609.08144.

Zhen, Y.; Wu, Y.; Yu, G.; Zheng, C. (2021). A review study of the application of machine translation in education from 2011 to 2020. In *Proceedings of the 29th International Conference on Computers in Education (ICCE)* (17–24).