

# Development of AI-driven Language Translation Technology: From Technological Breakthroughs to Cultural Adaptation

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**Abstract.** The use of artificial intelligence in linguistics is changing language learning, research, human communication, and translation in a big way. Through the promotion of numerous artificial intelligence language models such as ChatGPT, the natural language processing (NLP) models they employ have greatly assisted users in extracting the necessary information, promoting theoretical research and practical exploration in many fields. Meanwhile, by enhancing the accuracy of language and the ability to recognize multiple languages, the efficiency and accuracy of real-time translation and simultaneous interpretation have been effectively improved. Some article reports highly praise the advanced nature of artificial intelligence. However, the cultural differences and ethical considerations involved still require active communication and close cooperation among workers, scholars, linguists, computer scientists and relevant departments in this field. This study explores the impact of artificial intelligence on cross-cultural language communication, language teaching research, and translation for different needs. It is precisely because the future interdisciplinary research and application fields of artificial intelligence and linguistics have broad prospects that issues such as rational use, risk reduction, efficiency optimization, and privacy protection need to be put on the agenda as early as possible.

## 1 Introduction

In this field, from a practical application perspective, it clearly demonstrates the transformative assistance of artificial intelligence in language teaching, research, translation and other fields, such as the improvement of real-time translation accuracy, providing more efficient tools for language practitioners (such as translators and teachers), helping learners more conveniently acquire language knowledge and practice skills, and changing the mode of language learning and application.

For the development of the industry, it is necessary to point out that the application of artificial intelligence is accompanied by challenges such as cultural differences and ethics, promote cross-domain collaboration among linguists, computer experts and policymakers, make early plans to avoid risks such as data privacy and misinformation, and ensure the

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healthy development of artificial intelligence in the field of language, so that the technological dividends can be fully released.

From the view of academic research, it is important to explain ideas like explainable artificial intelligence and its ethical issues, so that scholars can study AI in a more careful way. This helps AI support language innovation in a responsible and effective way, and also makes progress in global language communication more sustainable. At the same time, it can build a more inclusive and efficient environment for international communication, giving a strong base for multilingual exchange and new development in language technology.

For wider groups like cross-border communicators and people who love languages, learning how to use AI language tools more effectively and safely, based on research, can help them overcome language barriers. At the same time, it can improve their ability to see the risks of AI, such as misinformation. This will make multilingual communication a better experience, and it will also help language technology play a real role in public communication and intercultural exchange.

This study aims to look at how cultural adaptation works when making an AI translation tool. The goals have three main parts, which are specifically:

- Research needs to look at how modern AI systems actually work in language change, translation, and interpretation processes. For instance, explore the presentation and expression of proverbs and unique cultures from different regions, cultures, and ethnic groups.
- Identify the root causes of errors in translation and expression within artificial intelligence translation programs.
- Determine which aspects of evaluation and quality inspection require manual review and assessment to optimize cultural matching and translation accuracy.

## **2 The development stages of AI translation technology**

### **2.1 Statistical machine translation**

In the 1990s, SMT emerged unexpectedly. It used large bilingual corpora to build probability models and employed statistical data to analyze and translate the source and target languages, generating translation texts. Mohamed proposed in 2024 that SMT could convert articles into computational mathematical model probabilities. Through data collection, it aimed to achieve translation and language conversion. However, due to insufficient processing and analysis capabilities in handling rare words and complex grammar, the translation texts were found to be unsmooth and incoherent. Although it laid a solid foundation for the development and evolution of later technologies and was supported by data, it was still constrained by mechanical matching.

### **2.2 Neural machine translation**

Since 2010, due to the development of deep learning technology, neural machine translation (NMT) has become the mainstream approach. Compared to SMT, NMT uses neural networks to achieve feedback from the source language to the target language. Alaqlobi mentioned in his research on artificial intelligence and applied linguistics in 2024 that NMT can enhance the naturalness and accuracy of translations by modeling the semantics and grammar of the language as a whole, especially for the transitions between paragraphs. However, there are still some shortcomings. For example, during the training process, a large amount of computational data is required, and for longer texts, its translation may result in information omission [1].

## **2.3 Generative AI translation**

Shahid state's that generative artificial intelligence translation has successfully achieved technological improvement based on large language models (such as Transformer) [1]. These models, through extensive training with multimodal data, are able to generate translation texts that are more in line with people's daily expression habits and can handle translation tasks such as speech and images simultaneously. Research conducted by Abdulkeem ZUBAIR Ph.D, reveals that generative artificial intelligence demonstrates advantages over past technologies in terms of translation efficiency and suitability for various scenarios, but still requires improvement in translation accuracy, especially in rare languages and specialized terms [2].

## **3 Technological breakthroughs in AI translation**

### **3.1 The imperative of cultural meaning transfer**

From the perspective of cross-cultural communication, AI translation has made engagement much easier and faster. But real intercultural dialogue is more than just changing words from one language to another; it also needs to send the cultural meaning correctly. As pointed out by Charles-Kenechi and Cheng et al., AI still has problems like a weak understanding of cultural context, wrong choice of words with many meanings, and a lack of clear logic [3,4]. Because of this, in sensitive cases like business negotiations or diplomacy, using AI too much may cause important cultural details to be lost or misunderstood, which can harm communication. The future may be a mixed model, where AI helps with efficiency, and human input makes sure the cultural meaning is accurate.

### **3.2 Developing the hybrid human-AI model**

Based on this idea, the hybrid model should develop AI to work like a "cultural assistant" for interpreters. This means giving AI more cultural data and building human-AI workflows where checking cultural meaning is the most important step. For teachers and communicators, the training should move from only "what to translate" to "how to communicate across cultures in a meaningful way," with AI helping to make cultural differences clearer instead of more confusing. To make this work in real situations, there should be clear steps for both AI and humans. For example, in a company meeting, AI can first give a quick translation of what was said, and then a human interpreter will check carefully for cultural details or words that may mean different things. This shared process helps prevent losing or changing important messages. It also gives people from different cultures more confidence, because they know someone who understands their culture has reviewed the translation.

### **3.3 Transformative opportunities for pedagogy**

This trend has a big influence on language teaching research. Artificial intelligence gives new chances, because it can offer students real and updated bilingual texts, as well as practice and feedback that change with their level. These tools can change curriculum design by moving away from old-style language drills and making learning more learner-centered and in real contexts. Future research should look at how to use these tools in the best way to support learning, especially for improving speaking and writing through real-time interaction with AI support.

### **3.4 Addressing the challenge of over-reliance**

However, there are also challenges. Language learning is not only about building linguistic skills but also about intercultural understanding and critical thinking. If students depend too much on artificial intelligence, these important human skills may become weaker. Because of this, future learning methods need to include AI literacy as a key skill. Learners should be trained to check AI outputs critically, understand its limits in cultural use, and use it for a deeper study of the language and culture. Teachers can also use AI in class to give students automatic feedback on their writing or speaking. But students should also learn how to find and fix mistakes that AI makes. For instance, a teacher might ask students to compare an AI translation with a human translation of the same sentence. By doing this, students can see where AI has trouble, especially with idioms or cultural references. This not only teaches them about the limits of AI, but also makes them better at using the language themselves. In the future, tests of language ability might not only check how well students can use a language, but also how well they can work with AI to communicate effectively.

### **3.5 Model architecture innovation**

The architecture of Transformer is regarded as a milestone in artificial intelligence translation technology. According to Mohamed et al., the attention mechanism of Transformer can notice long-distance dependencies in language, which helps to improve the shortcomings of traditional models in context understanding [5]. Alaqlobi et al. pointed out in their research that the models of Transformer (such as BERT, GPT) can enhance the logic and coherence of the translated language by using bidirectional semantic encoding [6].

### **3.6 Upgrade of data and training methods**

The scope, scale and diversity of the training data can significantly affect the quality of translation. Shrivastava et al. proposed in 2023 that current artificial intelligence translation technology systems can achieve coverage of more language environments by collecting multi-source data, demonstrating their advantages in cross-cultural dialogue translation [7]. At the same time Abdulkeem ZUBAIR Ph.D shows, using various training learning methods including transfer learning and domain adaptation, the model can adapt to the translation needs of specific domains such as medicine and law more quickly [2].

## **4 The cultural adaptation issues of AI translation**

### **4.1 The translation challenges of cultural loanwords**

Words such as idioms, religious terms and slang are difficult for artificial intelligence translation technology to overcome because of their specific cultural connotations. In Chinese, the character "dragon" symbolizes auspiciousness and authority, but in Western culture, it represents evil. If artificial intelligence merely translates, it may lead to misunderstandings. Al-Muslimawi pointed out that cultural allusions in literary works, such as the ancient Chinese story of "Yu Gong Moving the Mountain", are difficult to convey their metaphorical meanings [8]. If artificial intelligence lacks data resources with relevant cultural background knowledge to support it. One way to help AI with these culturally specific words is to build better dictionaries that include not just the word, but also its meaning and how it is used in different cultures. For example, the Chinese word "dragon" could have a note explaining that it is a symbol of good luck in Chinese culture, but often represents something

evil in Western stories. Programmers can feed this information into AI systems so that the AI can choose the best way to translate based on the situation. This kind of cultural database could be very helpful, especially for translating books, movies, and other creative works where cultural meaning is very important.

## **4.2 Limitations of cultural context understanding**

The intersection and integration of language and culture require that translation outcomes not only achieve the transformation of words but also accurately convey the connotations of the context. The research indicates that although artificial intelligence translation systems can handle the surface structure of language, they are limited by cultural contexts such as understanding historical background and social customs. For example, in the translation of literary works, they may lose the original flavor, just like when translating Arabic proverbs, artificial intelligence may cause deviations in the translation due to its unfamiliarity with tribal culture. Another example is the translation of jokes or humor. What is funny in one culture can be confusing or even offensive in another. AI might translate the words of a joke correctly, but miss the cultural context that makes it funny. This is why human translators who understand both cultures are still very important. They can change the way a joke is told so that people from a different culture can understand and enjoy it. In the future, perhaps AI can learn to recognize when something might be a joke or a cultural reference and then ask a human for help. This teamwork could lead to translations that are both accurate and enjoyable to read.

## **5 Synthesis**

### **5.1 Cross-cultural language communication perspective**

From the perspective of cross-cultural language communication, AI translation has greatly lowered the barrier to entry. However, truly effective intercultural exchange is more than just converting linguistic symbols; it requires the precise transfer of cultural meaning. As Charles-Kenechi and Cheng et al. note, AI still struggles with "insufficient understanding of cultural contexts, incorrect judgment of polysemous words, and a lack of logical coherence. [3,4]" This means that in sensitive settings like business negotiations or diplomacy, over-reliance on AI can cause subtle cultural information to be lost or misunderstood, undermining communication. The future lies in a hybrid model where AI handles efficiency and humans ensure cultural accuracy.

### **5.2 Language teaching research perspective**

From the perspective of language teaching research, this trend also profoundly impacts language teaching research. AI offers unprecedented opportunities: providing authentic, up-to-date bilingual corpora for students and offering personalized practice and feedback. However, it also presents challenges. Language education aims to foster not just linguistic competence, but also intercultural awareness and critical thinking. Over-reliance on AI can weaken these essential human abilities. Thus, future language pedagogy should integrate AI as a cognitive tool, not a crutch, focusing on fostering AI literacy, deepening cultural understanding, and strengthening higher-order thinking. By teaching students to use AI wisely, we are preparing them for the future workplace. Many jobs will require people to work with AI in some way. In the field of translation, knowing how to use AI tools effectively can make a translator's work faster and more accurate. But it is also important for students to

remember that AI is a tool, not a replacement for human creativity and understanding. The best translators of the future will be those who can combine the speed and efficiency of AI with the deep cultural knowledge and emotional understanding that only humans can provide. This balance will be the key to success in the global marketplace.

### **5.3 Real-world case evidence**

A recent study conducted by Taher in Libyan higher education provides real-world evidence for these challenges [9]. found that while AI tools like Google Translate help students understand vocabulary and feel less anxious about speaking English, they often fail to convey the cultural aspects of language. The findings show that AI translations sometimes make the meaning too simple or even change the cultural meaning, especially with idioms, humor, and formal language. This can lead students to just "copy-paste" the AI translation without thinking critically. But the results also show that if teachers ask students to compare AI translations with human ones, it can give good learning chances. Such practice helps students build critical thinking and understand cultural differences more deeply. The research suggests that AI itself does not directly help or block cultural understanding in language education; its value depends on how teachers use it in their teaching.

The application of artificial intelligence in the field of translation is becoming increasingly widespread, bringing many advantages, significantly improving efficiency and reducing costs [3, 4]. However, problems such as insufficient comprehensive understanding of cultural backgrounds, incorrect judgment of polysemous words, and insufficient logical coherence still exist [4, 10].

The future of the translation industry requires continuous optimization of artificial intelligence system translation technology and strengthening of human-machine collaboration, allowing professional translators to focus on creative and culturally rich translation work [3, 11]. In the context of global development, the translation industry is complemented by the collaboration of artificial intelligence system translation and human translation, enabling the industry to continuously advance and achieve new heights.

## **6 Conclusion**

Artificial intelligence translation has greatly reduced communication barriers and enhanced efficiency. However, its greatest value lies in collaboration with humans, as humans can provide the cultural insights that artificial intelligence often overlooks.

When translating elements with cultural specificity such as idioms and humor, key challenges still exist. In the field of education, artificial intelligence provides powerful learning tools, but there is also a risk of over-reliance, so artificial intelligence literacy and critical thinking are of utmost importance.

The future depends on advancing technological development while integrating richer cultural knowledge, ultimately building a balanced human-machine partnership to achieve both accurate and culturally resonant translations.

## **References**

1. K. Shahid, The Convergence of Artificial Intelligence and Linguistics: Implications for Future Communication and Translation. *J. Future Build.* **2**, 31–41 (2025).
2. A. Zubair, Bridging Linguistics Divides: Integrating Artificial Intelligence Technologies into the Practice of Comparative Literary Criticism. *Fountain Univ. J. Arts Humanit.* **1**, 2 (2024).

3. S. Charles-Kenechi, Artificial Intelligence in Translation Studies: Benefits and Challenges. *Cascades, J. Dept. Fr. Int. Stud.* **2**, 5–15 (2024).
4. Y. Cheng, R. Wang, J. Chen, Y. Chao, A. Maimaitili, H. Zhang, Context-based AI Translation from a Globalization Perspective: A Case Study of ChatGPT. *Sino-US Engl. Teach.* **20**, 370–380 (2023).
5. Y.A. Mohamed, A. Khanan, M. Bashir, A.H.H.M. Mohamed, M.A.E. Adiel, M.A. Elsadig, The Impact of Artificial Intelligence on Language Translation: A Review. *IEEE Access* **12**, 25553–25579 (2024).
6. O. Alaqlobi, A. Alduais, F. Qasem, M. Alasmari, Artificial Intelligence in Applied Linguistics: A Content Analysis and Future Prospects. *Cogent Arts Humanit.* **11**, 2382422 (2024).
7. R. Shrivastava, M. Jain, S.K. Vishwakarma, L. Bhagyalakshmi, R. Tiwari, Cross-Cultural Translation Studies in the Context of Artificial Intelligence: Challenges and Strategies. In A. Kumar, S. Mozar, and J. Haase (Eds.), *Advances in Cognitive Science and Communications* 1–20 (Springer Singapore, 2023).
8. R.M.A.A. Al-Muslimawi, Contemporary Linguistic Methodologies in Analyzing Literature: Exploring New Dimensions of Language, Culture and the Impact of AI. *Tasnim Int. J. Hum. Soc. Leg. Sci.* **4**, 12 (2025).
9. R.S.H. Taher, The Effectiveness of AI-Driven Translation Technologies in Mediating Cultural Understanding: A Case Study of English Language Teaching Practices in Libyan Higher Education. *Libyan J. Educ. Res. E-Learning* **1**, 1–16 (2025).
10. X. Dai, Comparative Analysis of Artificial Intelligence Translation and Human Translation from the Perspective of International Communication—Taking the Chinese Translation of "Dream of Autumn" as an Example. *Lect. Notes Lang. Lit.* **7**, 36–42 (2024).
11. R. Lu, English Translation Studies: Chinese Literary Works. *Arts Cult. Lang.* **1**, 3 (2025).