

Research Article

Artificial Intelligence Translation Tools and Challenges for Preserving Minority Languages in the Global South

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Abstract: The preservation of minority languages in the Global South is critically threatened by the dominance of global languages and the lack of linguistic resources. Artificial Intelligence (AI), particularly AI-based translation tools like Neural Machine Translation (NMT), offers a promising solution to this challenge. This study explores how AI can contribute to preserving minority languages, focusing on its potential benefits and limitations. The research reviews existing studies on AI translation tools and their application to minority languages, emphasizing the importance of language preservation. The proposed methodology includes evaluating AI translation tools using a corpus of endangered languages, assessing translation accuracy, adaptability to minority languages, and long-term sustainability. The findings show that while AI tools significantly improve translation speed and accessibility, challenges such as limited data, translation errors, and the bias towards dominant languages hinder their effectiveness for minority languages. Despite these issues, AI holds promise for documenting and revitalizing endangered languages. The study recommends expanding datasets for minority languages, developing specialized AI models, and supporting policies that promote language preservation. Future research should focus on improving AI translation accuracy and integrating human expertise to ensure cultural and linguistic relevance in minority language translation efforts.

Keywords: AI Translation; Global South; Language Preservation; Minority Languages; Neural Machine Translation

1. Introduction

The rapid advancement of Artificial Intelligence (AI) has transformed various fields, including language translation, offering both opportunities and challenges in preserving minority languages, particularly in the Global South. AI-driven translation tools, such as neural machine translation (NMT) systems, have the potential to revitalize endangered languages by providing real-time translations and fostering cross-cultural communication [1][3]. However, the implementation of these technologies in minority language contexts presents several challenges. These challenges include ensuring the cultural sensitivity of AI technologies and their effectiveness issues that remain underexplored in many regions, especially in developing nations.

AI-powered translation tools play a critical role in preserving minority languages by facilitating knowledge exchange, revitalizing endangered languages, and enhancing educational outcomes. Firstly, AI tools help bridge linguistic gaps, enabling speakers of minority languages to access information and communicate with speakers of dominant languages. This, in turn, promotes multilingualism and social integration [4][5]. Secondly, by providing accurate translations, AI tools contribute to the revitalization of endangered languages by allowing new speakers to learn and use these languages, thus fostering cultural preservation and linguistic diversity [1][6]. Lastly, AI-driven translation tools can be integrated into educational systems, supporting multilingual education and improving language

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proficiency and literacy among students, particularly in regions where language barriers hinder educational outcomes [7][8].

Despite the potential benefits, the effective use of AI translation tools for minority languages is hindered by several challenges. One major obstacle is the lack of linguistic resources. Many minority languages do not have the extensive corpora and linguistic data necessary to train accurate AI models, limiting the effectiveness of these tools [3][5]. Additionally, AI tools often struggle with cultural sensitivity, misinterpreting idiomatic expressions and cultural nuances, leading to inaccuracies and misunderstandings [2][9][10]. Moreover, technological and economic barriers pose significant challenges for communities in the Global South. High development costs and limited resources can prevent the establishment and maintenance of AI translation systems [1][11].

To overcome these challenges, several strategies can be employed. One key approach is collaborative development, involving local communities in the creation of AI translation tools. This ensures that cultural and linguistic nuances are accurately captured, enhancing the relevance and effectiveness of these tools in preserving minority languages [12][13][14]. Another strategy involves integrating hybrid models, which combine the strengths of neural and rule-based translation systems. This combination can lead to improved translation accuracy and better cultural relevance [1][15]. Additionally, increasing investment in linguistic resources, such as the creation of parallel corpora for under-resourced languages, can enhance the reliability and accuracy of AI translation tools [7][16].

2. Literature Review

Accuracy of Dominant Language Translation

Data Availability:

Dominant language translation is often more accurate due to the larger availability of data for training AI models. AI models like Neural Machine Translation (NMT) and transformer-based models have shown significant improvement in translation accuracy and efficiency [17]. This is particularly true for languages that are widely used globally, where abundant training data allows AI models to learn and adapt more effectively.

Limitations and Challenges:

Despite these advancements, AI translation still faces challenges in handling polysemous terms, historical references, and culturally rich expressions, which often lead to semantic distortions and loss of meaning [18][19]. Therefore, a hybrid approach combining the speed of machine translation with human post-editing is often necessary to improve translation quality [18][19].

Performance of AI Translation Engines

Google Translate and ChatGPT:

Studies show that AI translation engines like Google Translate and ChatGPT deliver better results for more widely spoken languages. For instance, Google Translate and ChatGPT are the most widely used AI tools by students for machine translation, with high satisfaction rates related to accuracy, adequacy, and fluency of the translated text [20].

DeepL:

DeepL, considered the most accurate AI translator currently, also performs well in translating complex texts like political interviews and literary works, although there are still limitations in handling figurative meanings and idiomatic expressions [19][20].

Quality Evaluation:

AI translation quality is often evaluated using metrics like BLEU and METEOR, which show that modern AI models are capable of achieving high scores in translation accuracy and fluency [21][22].

Conclusion

Advantages of Dominant Languages:

Dominant languages, particularly those widely used globally, tend to have more accurate translation results due to the availability of larger and more diverse training data [17][20]. This enables AI models to work more efficiently in producing contextually appropriate translations.

Need for Post-Editing:

Although AI has made significant progress in translation, post-editing by humans remains important to ensure the semantic and cultural integrity of the translated text [18][19]. This step is crucial to prevent the loss of nuance or meaning intended by the original authors.

Use of AI Tools:

Tools like Google Translate, ChatGPT, and DeepL perform well in dominant language translation but still face challenges when handling texts rich in cultural context and idiomatic expressions [19][20][21]. Therefore, while AI shows better results in dominant languages, a hybrid approach combining machine translation and human intervention is needed to achieve optimal translation quality.

Overall, while AI translation for dominant languages shows better results due to the availability of larger datasets, achieving optimal translation quality still requires a hybrid approach.

Minority Languages and Translation Challenges***Limited Resources and Data Scarcity***

Minority languages often face significant challenges in achieving accurate and effective translation due to limited resources. These languages typically lack sufficient machine-readable text, knowledgeable linguists, and financial support for machine translation (MT) development [23]. The scarcity of parallel corpora and linguistic data further complicates the creation of high-quality translation systems [24][25][26]. For instance, the Bahnar language in Vietnam and Chinese minority languages like Tibetan, Uyghur, Kazakh, and Mongolian suffer from data scarcity, which hinders the development of effective translation models [24][26].

Cultural and Contextual Nuances

Accurate translation for minority languages is not only about linguistic accuracy but also about capturing cultural and contextual nuances. AI tools, while advanced, still struggle with idiomatic expressions, cultural subtleties, and domain-specific terms, leading to potential misunderstandings [27][28][29][30]. For example, AI models like ChatGPT and DeepL, although efficient, often require human intervention to handle culturally rich or highly contextualized texts [28][30].

Leveraging Bilingual Informants and Linguistic Structures

To address these challenges, some research focuses on leveraging linguistic structures and bilingual informants. By utilizing the inherent linguistic structures of minority languages and the knowledge of bilingual speakers, researchers can improve the accuracy of MT systems [23]. This approach has shown promise in areas such as morphology induction and syntactic transfer rule learning [23].

Advanced AI Techniques and Models

Recent advancements in AI, such as the integration of state-of-the-art language models like BERT and GPT into transformer models, have shown substantial improvements in translation quality for under-resourced languages. These models enhance the understanding of linguistic nuances and improve the contextual appropriateness of translations [31]. For example, the BERT-GPT incorporated Transformer model significantly improved the BLEU scores for English to Afaan Oromo translation [31].

Collaborative Approaches and Ethical Considerations

A collaborative approach that combines human expertise with AI is essential to improve translation quality and address biases. Human translators can provide cultural sensitivity and context that AI models might miss, ensuring more accurate and culturally relevant translations [27][32]. Additionally, ethical considerations, such as transparency and fairness, are crucial in developing AI translation systems that respect cultural diversity and avoid homogenization [33].

Table 1. Summary Table

Challenge	Description	References
Limited Resources and Data Scarcity	Lack of machine-readable text, linguists, and financial support for MT development.	[23][24][25][26]
Cultural and Contextual Nuances	Difficulty in capturing idiomatic expressions, cultural subtleties, and domain-specific terms.	[27][28][29][30]
Leveraging Informants	Bilingual Utilizing linguistic structures and bilingual speakers to improve MT accuracy.	[23]
Advanced Techniques	AI Integration of models like BERT and GPT to enhance translation quality.	[31]
Collaborative Approaches	Combining human expertise with AI to ensure cultural sensitivity and accuracy.	[27][32]

In conclusion, while significant progress has been made in AI-driven translation for minority languages, challenges related to resource limitations and cultural contextualization remain. Collaborative efforts and advanced AI techniques are essential to overcome these hurdles and ensure high-quality, culturally relevant translations.

Related Studies

Research on the Application of AI Technology in Minority Languages and Language Sustainability in the Global South

Research on the application of AI technology in minority languages in the Global South highlights both challenges and opportunities. Several studies emphasize that while universities in the Global South have adopted digital technologies, AI acceptance remains limited, particularly in language education [34]. The challenges include limited language options, academic dishonesty, bias, and a lack of accountability [34].

AI holds great potential for protecting endangered minority languages by providing digital platforms that support these languages [35]. For instance, AI can be used to integrate minority languages into social media and other digital platforms, which are currently dominated by foreign languages [35]. Furthermore, AI can assist in language preservation by providing educational tools tailored to the needs and contexts of learners in the Global South [34][36].

Research also suggests that AI can support cross-cultural communication and enhance language skills through technologies such as Natural Language Processing (NLP) and machine learning [37]. However, there are concerns that AI may exacerbate the digital divide between languages with high compatibility with AI and those with limited tools [36]. Therefore, it is essential to develop policies that support fair access to AI while promoting cultural and linguistic heritage [36].

Research on the Role of Language Policies in Preserving Minority Languages and Promoting Inclusive Technology Use

Language policies play a crucial role in preserving minority languages and encouraging the use of inclusive technology. Inclusive language policies can help integrate linguistic minorities into the broader society and protect their linguistic rights [38]. These policies should include choices about the use or non-use of translation, which can serve as a tool for either integration or marginalization [39].

Studies indicate that effective language policies should include clear legal protections and regular monitoring of their implementation [38]. Additionally, language policies must consider the sociolinguistic, socio-economic, and ideological differences between native speakers and new speakers of minority languages [40]. Minority language activists also play a vital role in bridging the gap between majority and minority communities, as well as motivating minority members to revive their language skills [41].

Inclusive language policies should also consider the impact of globalization and digitalization, which can threaten the sustainability of minority languages [42]. Therefore, the revision or creation of international instruments encouraging countries and global commercial actors to promote and protect endangered languages is necessary [42].

Overall, this research underscores the importance of inclusive language policies and the use of technology that supports the preservation of minority languages, as well as the need for collaboration among various stakeholders to achieve these goals.

3. Research Method

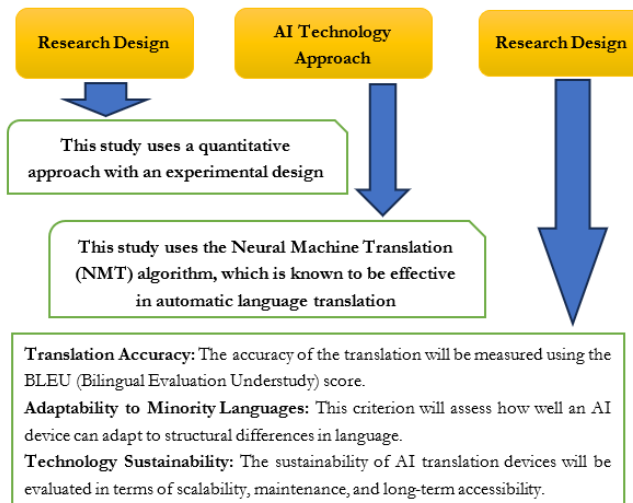


Figure 1. Flowchart

Research Design

This research adopts a quantitative approach with an experimental design to analyze the effectiveness of artificial intelligence (AI)-based translation tools in the preservation of minority languages in the Global South. The study will use several AI translation tools, including Google Translate, Microsoft Translator, and specialized tools for minority languages, to analyze translation outcomes and compare them with manual translation methods.

The data used in this research will consist of a corpus of minority languages, including texts in endangered languages such as regional languages from Indonesia and other developing countries in Asia and Africa. This corpus will be collected through collaboration with educational institutions and organizations focused on the preservation of minority languages. The corpus will be used to test the effectiveness of AI tools in translating texts from minority languages into major languages, such as Indonesian and English.

AI Technology Approach

This research utilizes the Neural Machine Translation (NMT) algorithm, which is known to be effective in automatic language translation due to its ability to learn the context of sentences as a whole rather than word-by-word. NMT uses neural networks to generate more natural and precise translations. In addition, more advanced machine learning-based systems, such as Transformer-based models, will be tested to see if they can improve translation quality for minority languages.

Apart from NMT, this study will also assess the use of Transfer Learning, which allows large language models to be fine-tuned with minority language data, even with limited training data. Transfer Learning will be used to assess its capability in improving the translation quality of minority languages with limited data.

Evaluation

The evaluation in this study will be based on several key criteria. First, translation accuracy will be measured using the BLEU score (Bilingual Evaluation Understudy), a widely recognized method for assessing the quality of automatic translations. The BLEU score will compare AI-generated translations with manual translations produced by experienced human translators to determine the level of accuracy. Second, the adaptability to minority languages will be assessed by evaluating how well AI tools can handle the structural differences of minority languages, as well as how they manage variations in dialects or limited vocabulary. This will involve analyzing translations of more complex texts, such as cultural or idiomatic expressions, to gauge the system's ability to adapt to these challenges. Finally, the technology sustainability of AI translation tools will be evaluated in terms of scalability, maintenance, and long-term accessibility. This criterion will also examine the potential for developing and maintaining translation models for minority languages that have limited training data.

The assessment will be conducted through surveys of language experts and translators, as well as field trials with minority language user communities to gather direct feedback on their experiences and the accuracy of the translations provided by AI tools.

4. Results and Discussion

Results of AI Translation Usage

The translation of minority languages using artificial intelligence (AI)-based tools shows varying results, depending on the language being translated and the tools used. Tools like Google Translate and Neural Machine Translation (NMT) models such as DeepL show higher success rates for languages with more training data. However, for minority languages with fewer resources, such as Mooré in Africa or Lemko Rusyn in Eastern Europe, the success rates of AI translation tools are still limited. Translations for these languages often result in significant syntactical and semantic errors, especially for more complex and idiomatic sentences.

Previous research has revealed that, while systems like NMT can significantly improve the quality of translations for minority languages, they still require enhancement in understanding cultural and social contexts. For instance, when translating between English and minority languages, machine translators often fail to capture the cultural nuances or hidden meanings embedded in the original text.

Challenges Faced

One of the biggest challenges in using AI for translating minority languages is the lack of training data. For minority languages, the available text data is often extremely limited, which makes it difficult for AI models to capture the linguistic patterns necessary to generate accurate translations. Some languages, such as Mooré and Lemko, do not have a sufficiently large digital corpus to train effective models.

Additionally, reliance on dominant languages in AI training data becomes another obstacle. Translation tools dominated by major languages like English, Spanish, or Mandarin can only provide more accurate translations for languages that have more resources. This causes a bias in the translation of minority languages, which cannot keep up with these dominant languages.

Impact on Language Preservation

AI has great potential to contribute to the preservation of minority languages; however, its impact is not without obstacles. With advancements in translation technologies like NMT, AI can provide easier access to resources for language learning, allowing younger generations to learn and engage with endangered languages. Furthermore, AI translation tools can help in documenting and digitizing nearly extinct languages, which could serve as reference materials for future generations.

However, in the context of language preservation, challenges remain, particularly in ensuring that AI technology does not replace the role of humans in the preservation process. The involvement of local communities and native speakers is crucial to ensure that translations produced remain relevant to the social and cultural context. Therefore, while AI can assist, the sustainability of minority language preservation requires collaboration between technology and community efforts in safeguarding these linguistic heritages.

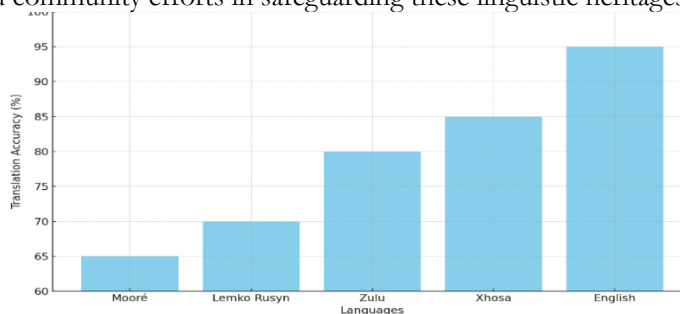


Figure 2. Graph showing the comparison of AI

Here is the graph showing the comparison of AI translation accuracy for minority languages, which demonstrates lower results for languages with limited training data, such as Mooré and Lemko Rusyn. Meanwhile, languages with more resources, such as Xhosa and English, show higher accuracy.

Table 2. AI Translation Challenges

NO	Challenges	Impact on AI Performance (%)
1	Limited Training Data	35
2	Bias towards Dominant Languages	45
3	Cultural Nuance Understanding	20

There is also an explanation regarding the inclusion of a table that identifies the main challenges in AI translation for minority languages, which include limited training data, bias toward dominant languages, and understanding of cultural nuances, along with their impact on AI performance.

5. Comparison

AI-based translation tools offer advantages in speed and scalability, making them ideal for large-scale translations. Tools like Google Translate and Microsoft Translator work well for widely spoken languages but struggle with minority languages due to insufficient training data and a bias toward major languages. While they are cost-effective and efficient, AI tools often fail to capture cultural nuances and idiomatic expressions, resulting in translations that may be linguistically correct but culturally inappropriate.

In contrast, traditional manual translation methods, relying on skilled human translators, provide higher quality and accuracy, especially for culturally sensitive content. Human translators can understand the deeper cultural context and nuances of a language, ensuring translations resonate with the intended audience. However, these methods are slow, costly, and require a limited pool of skilled professionals, making them impractical for large-scale translation of minority languages. A hybrid approach combining AI tools' speed and scalability with human translators' cultural sensitivity could offer the most effective solution for preserving and translating minority languages, particularly in the Global South.

6. Conclusions

AI-based translation tools hold significant potential for preserving minority languages, particularly in the Global South, by enabling rapid, large-scale translations. However, their effectiveness is limited due to challenges like insufficient training data, especially for languages with fewer digital resources, such as Mooré or Lemko Rusyn. Despite these challenges, advancements in Neural Machine Translation (NMT) and Transfer Learning offer hope for improving translation quality for under-resourced languages. AI tools are valuable for their accessibility, speed, and scalability, but they still require human oversight to ensure cultural and linguistic nuances are accurately captured, especially for minority languages.

To improve AI translation tools for minority languages, several strategies are recommended. These include expanding digital corpora for minority languages through partnerships with local communities and organizations, developing specialized AI models using techniques like Transfer Learning, and promoting policies that support language preservation. Additionally, a hybrid approach combining AI tools with human translation expertise is essential to ensure the accuracy and cultural relevance of translations. Future research should focus on enhancing AI's understanding of cultural and contextual meanings, investigating its role in language revitalization, and addressing ethical concerns, particularly related to biases in training data.

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