

**Machine Translation Technology: The Advantages and Limitations of Machine Translators  
in the Academic Community**

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On my honor as a University Student, I have neither given nor received  
unauthorized aid on this assignment as defined by the Honor Guidelines  
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## **Introduction**

Eighty-five percent. According to a survey conducted in 2017, eighty-five percent is the accuracy rate of the most popular Machine Translation (MT) technology in the modern world: Google Translate (“How Accurate Is Google Translate | Updated Review 2021,” 2021) The accuracy rate is similar to the minimum standard necessary for university admission at many institutions (Groves & Mundt, 2015). Although convenient for translating something quickly and for increasing access to educational material for students in various countries, the technology brings into question academic integrity and the need for language development (Kordoni et al., 2016, Yang & Wang, 2019, Groves & Mundt, 2021). However, MT technology has the potential to improve the quality and quantity of education around the world as academic material is mass translated and used more widely. With the benefits in mind, current limitations of MT must be further explored as the technology develops and integrates into modern society. These include limitations of the technology itself, such as the lack of understanding of the semantics of words, and limitations of the technology in society, such as how MT will be adopted into the academic community. The evolution of MT will be discussed in the context of technological determinism and how MT will drive the academic community, as well as technological momentum which observes MT in a timeframe. With all the advantages and limitations of MT in society, what impact does Machine Translation technology have on education?

## **Methods**

The benefits, disadvantages, and limitations of MT technology are explored in the following sections, followed by MT’s effects on education using historical case studies. With all the advantages and limitations of MT in society, what impact does Machine Translation (MT)

technology have on education? Various cases are collected and analyzed to understand how MT has affected institutions that require students to learn languages, and how MT is used to help students learn different languages. The studies bring to light the ethical concerns regarding the incorporation of MT into the educational community, as well as its current limitations and what the technology still needs before being widely used in the academic world. In addition, the paper touches on how MT is impacting large societies to change the structure of their educational system, whether that is removing the requirement to learn foreign languages or creating policies surrounding the implementation of MT technology.

The sources gathered are published accounts of how MT has affected different academic communities. Keywords used were variations of “machine translation,” “education,” “higher education,” “translation technology policies,” “machine translation limitations,” “developing countries,” and “societies and machine translation.” These keywords are important because they look for the connection between MT and education in the context of different societies, as well as the ethical concerns and limitations of the technology. Information is pulled from published papers and international journals and conferences, as well as other reputable sources. Interpreting and analyzing the sources help shed light on the current societal effects of MT and how it can affect society in the future if its limitations are overcome.

## **Background**

MT is defined as the “translation process from input of the source text to output of the target text without human assistance” according to Yang and Wang (2019). In other words, MT is an automatic system that can translate input from one language to another without human interference. MT was first proposed in 1933 by a French scientist George Artsrouni and Russian

scientist Petr Smirnov-Troyanskii independently (S et al., 2016). The technology has grown tremendously in the past century due to increasing demand for successful translation and internet technology in the 21st century.

The current state of the art revolves around Statistical MT (SMT), or translation based on statistical models. Although the models are statistically advanced, they often do not include any input nor feedback from linguists and translators because translators find the basic model of SMT difficult to understand, even though translators are the ones who create the inputs for the model to be trained and tested on (Way & Hearne, 2011). Efforts are being made in the engineering community to improve MT, but a true understanding of MT requires knowledge of its implementation and use in society. In some places around the globe, academic courses are adapting to incorporate MT into translation courses and teach basic language learners to become proficient in certain professional fields thanks to clear translations of key-words (Lin & Chien, 2009). Public opinions surrounding MT differ. Some people are skeptical, since “current machine translation systems lack sufficient accuracy for clinical deployment” (Dew et al., 2018). Others are optimistic, such as Popel et al., who argued that a current deep learning system can generate translations that are comparable to human professionals, as long as conservation of meaning is the primary goal (Popel et al., 2020).

Researching how MT technology affects education is important because MT is rapidly evolving to become more accurate. If discussions are not held about how to incorporate MT into the academic community, problems of academic integrity will continue and students will not be able to effectively utilize MT in their education. It is also important to explore how MT affects education in societies of various developed states, with its ability to bring equity but also be

owned and monetized. Will MT affect an advanced society more than those that are small and underdeveloped? How does MT's role differ in various contexts?

### **STS Framework**

MT will be explored in terms of technological determinism and technological momentum in the context of societal education. Together, the frameworks will explore how MT can affect societies, and how it may affect different societies differently.

MT could soon become a technologically deterministic technology. The concept of technological determinism originated from Thorstein Veblen and argues that society is shaped and driven by technology (Smith, n.d.). This concept is used often as an antonym for social constructivism, which argues that technology is driven by societal expectations. Once MT has evolved to be more accurate and pick up on the semantics of words, it will drive the academic community to create rules surrounding the usage of MT. The technology will also have a large economic impact due to the mass translation of academic material. The potential benefits of MT will change how students and professors approach courses and assignments, which is why some may argue that MT will become a technologically deterministic technology. However, one of the shortcomings of the concept of technological determinism is that it does not have a timeframe; it simply states that technology drives society from the start until it is replaced by a better technology, but does not take into account how the relationship between technology and society may change as the society evolves through time.

Technological momentum, a concept made popular by Hughes, introduces a time aspect to the duality of technological determinism and social constructivism (Marx & Smith, 1994). Hughes argues that developed societies tend to lean towards technological determinism, whereas

less-advanced societies tend to adopt social constructivism. Technological momentum is useful for putting MT in education into perspective: in less advanced societies, society drives MT because the community is typically smaller, so social norms revolving around MT and access to the technology matter more than the technology itself. In advanced societies, MT are more technologically deterministic because they are able to drive society and can easily be accepted into society's daily routines. Technological momentum is also used to understand how MT technology's impact on societies differ even at the same point in time, depending on the society's maturity and access to resources.

Since there is no current work relating MT and technological momentum, the analysis will be performed using the relationship between MT and technological determinism as the basis. A time aspect will be introduced to understand the history of MT and how it changes as societies develop and mature.

## **Results and Discussion**

MT overall has a beneficial effect on education in our current society. There are concerns within the academic community regarding academic integrity in relation to the usage of MT, but MT's advancement is too great for instructors to just ignore. Instructors must inform students of the advantages and disadvantages of MT, as well as their limitations to encourage healthy usage of MT for helpful language learning. MT is shown to help students better articulate their thoughts, especially when the language mastery is low. There are so many benefits of MT, from increasing language understanding for international students to translating educational resources for improving underdeveloped academic communities to speeding up the process of human

translation. It is likely that MT will become a technologically deterministic technology in the near future, within academic communities and beyond.

### Benefits

MT is often used to help international students learn the country's native language through self studying (Bahri & Mahadi, 2016). The technology also plays a large role in translating educational resources and online educational content into other languages for global educational use (Kordoni et al., 2016, van Rensburg et al., 2012). If policies can be created to govern the misuse of MT in academic learning, then MT technology will surely prove to be an invaluable resource for all students learning different languages, connecting to their heritage, or understanding knowledge provided in foreign text. Translating educational material is especially valuable, as knowledge can be shared with everyone, ignoring language barriers completely. Free translation services such as Google Translate would drastically improve the quality of education in less-advanced nations who may lack the resources needed for traditional schooling, books or professional translators (van Rensburg et al., 2012).

For students learning to be professional translators, MT is seen as an uncertain but useful technology. It can make their job much easier by providing a base translation to work with (Esqueda, 2021). Translators can then perform the post-editing process to fix grammatical, syntactical, and linguistic errors. Performing post-editing on a base translation typically makes a translator's job much easier. However, current translation education programs must revise their curriculum to incorporate information about MT technology. Students must learn about what MT is, the limitations and disadvantages of using the technology, in addition to how to actually use MT effectively.

A current project backed by the Knowledge 4 All Foundation is currently using MT to “facilitate multilingual online communication in developing countries specifically in the domain of education” (*Neural Machine Translation 4 Education | Knowledge 4 All Foundation Ltd.*, n.d.). MT technology is used to translate materials into the language spoken and written in the developing countries, taking down existing language barriers and allowing cross-border education, social communication, and exchange of cultural content. National educational systems could have less disparity if MT grew to be more accurate, accessible, and able to translate into more languages, allowing for more quality education across the globe. This example highlights how MT follows technological momentum across different development stages of societies. Sometimes, MT is constrained by the social construction of technology more than technological determinism in developing countries, since the people have to actively agree to use the technology to improve their education systems. The improvement and usage of the technology itself lies with the people, whereas in other societies, MT may be the one driving force forcing education systems to improve through the increased accessibility to translated educational material.

Tangentially related to education, MT can be used to preserve the world’s endangered languages. 90% of languages will be extinct or on the way out in 100 years (Bird & Chiang, 2012). If MT can successfully document a language, then others can study and learn it later on and the languages’ intricacies can be preserved. An example of an intricacy is, “before Hixkaryana was discovered to have object-verb-subject word order, it was assumed that this word order was not possible in a human language” (Bird & Chiang, 2012). Each language is different, and being able to preserve and study dead or dying languages can help linguists learn more about a society’s history, culture, and relation to the world. The preservation of languages



and translation of material will drive innovation and discovery as more information is found, and will change the way society improves as outlined by technological determinism.

### Disadvantages

In addition to its benefits, it is important to explore the disadvantages of MT in the context of its necessity. If MT is so accessible and accurate, is it necessary for students to learn foreign languages at all? This question is explored in the context of how MT affected Japanese lifestyle, specifically surrounding their universal English education (Gally, n.d.). As MT technology develops, it can also transform attitudes towards the necessity and utility of studying other languages. There are many benefits to learning foreign languages, but the need to do so may diminish with the improvement of MT.

Gally specifically explored why Japan required English to be taught to all children in the first place. Although most children would hardly ever utilize English, there were two main reasons why Japan still enforced it as a law: the first being *kyōyō*, where English should be learned for general knowledge and character development, and the second, *jitsuyō*, where the language is taught for practical purposes. However, with the impressive evolution of MT, both reasons become less apparent for the Japanese academic community; if MT can translate all English texts into Japanese, then there is no reason to study English as its practical purpose is gone. As MT technology becomes more accurate, the translated outputs become similar in quality to human translations, which removes the argument for *jitsuyō*. The *kyōyō* argument insists on learning English for general knowledge because it is an international lingua franca, but if MT is used to break language barriers across the globe, then English's role as a lingua franca diminishes and the reasoning for teaching English to all Japanese children becomes unnecessary.

With the widespread use of MT, the academic focus on foreign languages across societies is diminishing. It is another example of how technological momentum is at play - as nations become more mature and widely adopt the use of MT, the technology changes the society's values and academic direction.

### Limitations

One of the ultimate goals of MT technology is to replace human translators, but that is unrealistic at the moment given the current limitations. The technology requires a lot of human intervention to fix semantic and grammatical mistakes since the immediate results of translation are unreliable. However, MT can be effectively utilized as a standalone tool for minimal understanding of other languages or for the purposes of pre-translation, with additional post-editing of the output from human translators (Esqueda, 2021). The downside, however, is that MT is not cognizant of moral values; it does not know if text *should* be translated. While human translators can actively decide to translate information or not, machines can translate input regardless of its nature, whether it is top-secret information, contains copyright issues, or other sensitive information.

MT is relatively new and still evolving, so it is not a technologically deterministic technology yet. There are few policies in place regarding MT use for educational purposes. Some instructors ban the use of MT on language-learning assignments due to plagiarism and academic disintegrity. However, as MT develops, its accuracy will continue to increase. Bans are difficult to enforce and regulate, so instructors should embrace the use of MT instead and teach their students to use it appropriately. Once MT has evolved to be more accurate, it will force the academic community to create rules surrounding its usage. These changes will affect how

students and professors approach courses and assignments, which is why some argue that MT will become a technologically deterministic technology. It has the potential to reform language learning in the near future. Olohan explores how perceptions of MT are “perpetuated through the discourses of hegemonic actors,” how the design and use of MT is affected by relevant social group’s interpretation of the technology, and how an analytical focus on how the technology is used can limit hegemonic control in the area of translation (Olohan, 2017).

Although the advantages and disadvantages of MT are great, there are limitations such as the availability of free MT. If MT becomes monetized, then it will be really difficult for developing countries to advance using this technology. Businesses such as eBay use MT for international trade, increasing US exports to Spanish-speaking Latin America countries by 17.5% (Brynjolfsson et al., 2018). Since MT easily improves profit for companies, the technology may become monetized. This monetization situation can be analyzed with technological momentum: if MT is monetized, developed countries can further improve their societies since they have the funds to use the technology for business purposes and increased innovation. However, less-developed countries cannot reap the benefits of monetized MT if they cannot afford the technology. It is difficult to analyze if technological momentum applies for those societies - if the technology is not available, is it possible to determine how MT shapes society? If developing countries can utilize MT, the benefits are immense; sharing a common language boosts trade among different countries by nearly 50% (*Machine Learning Is Tearing down Language Barriers. What Does This Mean for Trade?*, n.d.). Breaking the language barrier can be an opportunity for developing countries to increase their presence in the world market and absorb additional technology to grow. MT could drive society in this case here, where society depends on the accuracy of MT to advance their economy.

### Historical Case Study: Machine Translation in Foreign Language Writing

In an experiment conducted by Hellmich, researchers found that students typically use MT to check vocabulary, assist with writing, or double check their work (Hellmich, 2021). Alternatively, other pressures such as a lack of confidence in the foreign language or a time crunch may cause students to turn towards MT. Although typically discouraged from using MT by instructors, student use is still high even though its accuracy is low. At the moment, instructors have limited integration of MT in the classroom due to concerns over cheating and MT's potential detrimental impacts on learning. The paper encourages instructors to instead discuss the strengths and weaknesses of MT tools with their students. With the rate MT is improving, it is no longer possible to just ban MT for academic purposes.

The study used computer tracking technology such as screen recordings, eye trackers, keystroke information and data logs to observe how students engage with technological tools. The experiment asked students to translate an input text. Results found that students who had the aid of MT paused less while writing than students who did not pause, but more writing did not necessarily always mean more successful writing or edits. The most strongly correlated actions and cognitive processes include how much students put as an input into the MT technology (Hellmich, 2021), whether students analyzed and edited the MT output, how comfortable students were with MT capabilities, and how much time they had left to complete the assignment. Students who put in a sufficient amount of input and analyzed or cross-referenced the result typically performed better than those who put in too much or too little input and just used the raw translation. However, the study noted that a perceived lack of time drove students to use MT when they might not normally. This case study highlights that MT can be

technologically deterministic in the way students learn, since the existence of the technology changes the morals and actions of students when completing assignments.

#### Historical Case Study: MT Use for Language Learning Beginners

Garcia and Pena found that MT is not designed to help beginners learn new languages, although it gave insight for how people think when translating to or from another language (Garcia & Pena, 2011). The paper uses classroom evidence such as tests and screen recordings to understand the effect of MT on Spanish or English. In the experiment, the student would respond to a prompt either in English, or in the foreign language with the help of a MT, where they could see the real-time translation and edit their input. The results indicated that MT helps beginners communicate more ideas and better articulate their thoughts, especially for those with lesser mastery. The lesser the mastery, the greater the difference between the two translation tasks. In addition, screen recordings showed that not using MT required more effort and engagement. That is measured by the number of pauses the student made during the experiment, as well as editing interventions. In the end, MT can trigger error awareness but it gives rise to plagiarism issues when students claim the work as their own. Because of the convenience MT offers, some teachers have found students presenting raw MT as their own work. In this case study, the usage of MT can be governed by people and policies as outlined in the social constructivism part of technological momentum. People can control how MT is used, but only if societal policies are put in place.

#### Historical Case Study: Independent Language Learning

Another study focused on how MT could be used for independent language learning outside of the classroom (Niño, 2020). Through polling students, the researchers found that MT technology is a quick, easily accessible aid that could help them in multiple areas, including vocabulary development (75.7%), drafting a text (73%), helping with unfamiliar grammatical structures (35.1%), and other realms (Niño, 2020). Although convenient with many applications, the study found that students were also aware of the weaknesses of MT when being used for independent language learning. Big problems included how accurate the outputs were because they still needed correction, the potential unhealthy reliance on MT for language learning and usage, and confusion from MT output due to its lack of understanding in some areas. Students were able to identify problems with MT in language learning, including the inability to:

“translate puns, double meaning, and homophones (76.7%), not being able to translate colloquialisms, idioms, and fixed expressions (70%), not being able to detect sarcasm and irony (66.7%), not distinguishing between formal and informal register (60%), not recognising cultural items (46.7%), lack of text structure, that is cohesion, coherence and co-reference (36.7%), not recognising proper names (33.3%), grammar equivalence (30%), terminology and phraseology management (23.3%) and language varieties (23.3%)” (Niño, 2020).

Despite having many flaws, MT technology is here to stay and should be incorporated into student language learning. Though it should not be the only resource one uses to learn a language, it can definitely help expand vocabulary and articulate better in a foreign language.

Thus, opportunities should be made to integrate MT into language classes in a meaningful way and educate those who are interested, instead of ignoring MT as a whole.

## **Conclusion**

With the advancement of MT technology, the quality of education will improve drastically worldwide as language barriers are diminished and knowledge is spread throughout the globe. Despite the disadvantages and limitations of the technology, there is much potential for MT to make changes in the academic community. As MT keeps evolving, it may eventually become technologically deterministic, since nations will have to rely on it for global communication, especially if the need for an international lingua franca diminishes over the years. It is important to keep up with the progress of this technology, as it could solve one of the greatest separating factors of people throughout the world: the language barrier. The amount of knowledge that could traverse between nations is immense, and the ability to translate material accurately will bring about new waves of technological innovation and scientific advancement. Countries need to accept the fact that MT is advancing, and that it will become a part of their society and their academic communities regardless. Policies must be made and continuously revised to address the evolving technology and the new information it brings to every corner of the globe.

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