

Exploring the Effectiveness of Machine Translation for Improving English Proficiency: A Case Study of A Japanese University's Large-scale Implementation

Chiho Toyoshima¹, Tsukasa Yamanaka², Kazuhiro Odagiri³ & Kohei Sugiyama⁴

¹ Research Organization of Science and Technology, Ritsumeikan University, Kusatsu, Japan

² College of Life Sciences, Ritsumeikan University, Kusatsu, Japan

³ Benesse i-Career, Tokyo, Japan

⁴ Graduate School of Science and Engineering, Ritsumeikan University, Kusatsu, Japan

Correspondence: Tsukasa Yamanaka, College of Life Sciences, Ritsumeikan University, Kusatsu, Shiga, 525-8577, Japan. Tel: 81-561-5833. E-mail: yaman@fc.ritsumei.ac.jp

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Abstract

The potential of machine translation to enhance English language proficiency in university-level education has been the subject of much discussion. This paper presents empirical evidence that supports the notion that learners' English proficiency can improve or remain steady when machine translation is used. The study spanned a one-year period and involved administering objective tests to measure changes in English proficiency. Despite its potential, there is a dearth of empirical evidence on the effectiveness of machine translation in foreign language education. This paper fills this gap by presenting a positive case study of a specific class size. However, the paper acknowledges the need for further research to better understand the mechanisms through which machine translation contributes to improvements or stabilizations in English proficiency.

Keywords: machine translation, English proficiency, Japanese university, Global Test of English Communication (GTEC), Test of English for International Communication (TOEIC), Project-based English Program (PEP)

1. Introduction

In the 2020s, machine translation has become increasingly popular in the foreign language teaching environment at universities and other institutions of higher learning, thanks to the dramatic improvement in the performance of machine translation through the implementation of neural machine translation as an application of deep learning in the 2010s, and the availability of some machine translation services at low cost. Numerous machine translation functions, including but not limited to Google Translate (<https://translate.google.co.jp/>) and DeepL (<https://www.deepl.com/translator>), are freely available to users. However, despite the popularity of these technologies among students, some teachers have outrightly rejected them, as demonstrated by the Google Irreverent Classroom (Urlaub and Dessen, 2022; Ducar and Schocket, 2018; Henshaw, 2020), and there are ongoing concerns about the negative impact on language learning (Clifford et al., 2013; Correa, 2011; Faber & Turrero-Garcia, 2020; Jolley & Maimone, 2015; Tian, 2018; Xu, 2022). Nevertheless, foreign language learners continue to use machine translation, regardless of how teachers respond (Clifford et al., 2013; Correa, 2011; Faber & Turrero-Garcia, 2020; Jolley & Maimone, 2015; Tian, 2018; Xu, 2022). While we may be able to regulate the use of machine translation in some classes, we cannot socially stop this trend as long as our society values freedom. Therefore, foreign language education should not simply eliminate the use of machine translation, but rather, it would be a meaningful and urgent issue to consider how such technology and foreign language education can coexist and be utilized in a way that brings out the best in learning. Recently, many language teachers have been paying attention to this trend and have been interested in incorporating it into their own teaching in some way (cf. Yamada et al., 2021).

When it comes to the application of machine translation in foreign language education, there remains a significant dearth of practical knowledge on the subject, in part due to the relatively new nature of the technology.

Although there are numerous studies that suggest the potential benefits of incorporating machine translation into foreign language instruction, including works by Xu (2002), Lee (2020), Mundt and Groves (2016), and van Lieshout and Cardoso (2022), there are few empirical studies grounded in objective data to support the claim that such an approach actually improves language proficiency. While subjective surveys may suggest that learners respond positively to machine translation, this does not necessarily translate to actual improvements in language proficiency. Thus, the fundamental question remains: can machine translation effectively enhance foreign language competence? This paper seeks to provide a resounding affirmation to this inquiry by presenting one practical case in support of its effectiveness.

English language education in Japanese universities has long been a topic of debate, with questions arising over the most effective teaching methods (Kikuchi, 2013). In response to these challenges, the PEP group at A University has introduced the Mirai Translator neural machine translation service in September 2022 as part of its Project-based English Program (PEP) (see 2.2). The university has contracted the service for a fee, enabling eligible students to have unlimited access to the machine translation service and encouraging them to use it actively (Mirai Translator, 2022). This pioneering initiative is the first instance of a university in Japan utilizing machine translation technology for language education purposes. As members of the PEP group, the authors of this paper are actively involved in this program, and aim to examine the effectiveness of machine translation in improving English language proficiency among Japanese university students.

In accordance with the Japanese university academic calendar, the introduction of the Mirai Translator neural machine translation service at University A occurred in September, which marked the beginning of the second semester of the academic year. In preparation for the introduction, the author's group conducted an orientation for the students on the importance of pre-editing and post-editing in machine translation, as well as the potential for mistranslations and how to avoid them. This information was also made publicly available through a video (see Project-based English Program, 2022). With these guidelines in mind, the students were encouraged to utilize the machine translation service in their English classes to enhance the quality of their English language output.

PEP's educational philosophy is geared towards utilizing machine translation in a positive and proactive manner, with the aim of improving the learning experience. Machine translation technology surpasses the English proficiency levels of most learners, facilitating greater freedom of expression, and enabling learners to articulate their ideas in ways that were previously unattainable with their current English proficiency levels. By creating an environment in which a personal language trainer is readily available at all times, PEP aims to enhance the effectiveness and efficiency of foreign language education. With machine translation continuously being tailored and updated to meet individual learner needs, it may serve as a forerunner of the future of education. Upon comprehending and internalizing the high-quality English generated by the machine translation, the learners' English proficiency is expected to improve, ultimately resulting in a virtuous learning cycle.

Objective English tests, including the Test of English for International Communication (TOEIC, see 2.4), are regularly used by PEP to verify the effectiveness of learning. Additionally, a pre- and post-test was administered using the Global Test of English Communication (GTEC, see 2.3), which measures the four English skills. Both tests were administered prior to the introduction of machine translation and after its implementation. Through analysis of the test results, the study aimed to investigate changes in overall English proficiency and skill-specific English proficiency, and to determine the quantitative impact of machine translation on students' language skills.

2. Method

2.1 Participants

The participants were freshmen (32 male, 22 female) and sophomores (32 male, 24 female) from a large Japanese private university, all of whom were enrolled in the PEP as part of their university's required curriculum. The majority of the freshmen were 18 years old, and the majority of the sophomores were 19 years old. These students were regularly required to take the TOEIC, and for the purpose of this study, they completed the GTEC assessment twice. The specific timing of the GTEC and TOEIC examinations for the freshmen and sophomores can be found in Table 1, with additional details provided in Section 2.5.

Table 1. A synopsis of the GTEC and TOEIC examination regimen undertaken by the participants

Grade	GTEC-Academic, First	GTEC-Academic, Second	TOEIC-IP, First	TOEIC-IP, Second
Freshmen	April, 2022	January, 2023	April, 2022	December, 2022
Sophomores	April, 2022	January, 2023	June, 2022	December, 2022

2.2 PEP (Project-based English Program)

PEP, an English education program developed at Keio University and implemented at several faculties of Ritsumeikan University, empowers students to independently select research themes based on their own interests or concerns. Through presentations and various forms of communication, students explore and exchange their ideas (Suzuki, 2003; Yamanaka et al., 2021). In the university setting, PEP's curriculum consists of several components: During the first and second years, students engage in presentations, debates, panel discussions, and other activities related to daily life and classes. During the second term of their second year, students work on term papers of approximately 1,500 words in length. In their third year, students focus on themes related to their specialist fields and conduct poster presentations. Fourth-year students, if they choose to do so, write an English summary of their graduation thesis and deliver an oral presentation. Freshmen and sophomores attend one project class and one skills workshop class per week, totaling 30 weeks per semester. Juniors attend one project class per week during the spring semester and have the option of taking one elective class per week during the fall semester. Fourth-year students have no elective classes available.

PEP diverges from traditional pedagogical methods that rely on textbooks for knowledge transmission. Alternative approaches such as CLIL (Content and Language Integrated Learning), a linguistic methodology that blends instructional content and foreign language instruction, have emerged and gained recognition. Prior to CLIL, content-based language learning had been implemented in foreign language education, prioritizing the learner's interests and concerns. While these approaches have achieved relative success, CLIL has limitations in that the learning content is prescribed by the teacher or selected from a predetermined list, potentially disregarding individualized student interests. PEP, on the other hand, offers learners autonomy in selecting their own content, catering to their fundamental communicative motivations. PEP also emphasizes the integration of faculty research expertise in the conception and execution of student projects. Widely implemented at various institutions of higher education, including Osaka University, Kinki University, Chiba University of Commerce, and Hokuriku University, PEP is considered a model for English education reform in Japan (Kambara & Yamanaka, 2022).

In September 2022, Mirai Translator, a subscription-based machine translation service, was introduced in PEP classes. The instructors actively promoted the utilization of this service in project classes, primarily for freshman and sophomore students. Within these classes, students leveraged the service to aid in the composition of their English texts for presentations and term papers. Furthermore, the students utilized machine translation to convert English articles and statistical materials, which were composed in the target language for the learners (English), into their native language, Japanese, in order to improve their comprehension of the material. Although the frequency of machine translation usage varied among the students, it is believed that positive use of the tool was made given its public approval.

2.3 GTEC (Global Test of English Communication)

The Global Test of English Communication (GTEC) is an English assessment tool developed by Benesse Corporation that can measure the English communication skills of a wide range of learners. Unlike traditional pass/fail tests, GTEC uses an absolute score based on Item Response Theory (IRT) to measure the four skills of reading, writing, speaking, and listening. The test comprises several versions, including GTEC-Junior for elementary to junior high school students, GTEC for junior high and high school students, GTEC-Academic for university students and adults, and GTEC-Business. Since this study focuses on university students, we selected GTEC-Academic.

GTEC-Academic is an English communication test that utilizes Computer-Adaptive Testing (CAT) and IRT to accurately measure English proficiency in four skills in a relatively short time of about 50 minutes. The test includes both short-text and long-text comprehension questions in a clickable format for listening and reading skills. However, writing and speaking skills are evaluated by English speakers to assess the practicality of English skills. (Please refer to Table 2 for further details of the measurement items).

In addition to the total score (out of 1,000 points) and skill score (out of 250 points each), the test results provide

examinees with CAN-DO statements for each skill and skill profiles for each part of the test. This enables examinees to identify their strengths and weaknesses and set their learning goals accordingly. The skill profiles for listening and reading are specific scores for each part of the test, while those for writing and speaking are based on the student's answers and scored on a 10-point scale by the evaluator. The ability statements are presented on the form (refer to Table 3 for the measurement items of the skill profiles).

Table 2. GTEC-Academic measurement ability and question structure

	GTEC-Academic Listening 21 questions approx. 11 min.	GTEC-Academic Reading 16 questions approx. 17 min.	GTEC-Academic Writing 2 questions approx. 12 min.	GTEC-Academic Speaking 3 questions approx. 9 min.
Aim of ability measurement	Measures listening ability from multiple perspectives, including immediacy, information selection, and comprehension of key points	Measures English reading comprehension skills from multiple perspectives, focusing on the lower skills of reading	Measures writing ability practically with content directly related to daily life	Measures speaking ability from pronunciation through realistic situations and tasks
Answer format	Select by clicking	Select by clicking	Answers by keyboard input	Answers in audio recording format
Question composition	Photo description questions / Illustration description questions [5 questions] Conversation response questions [8 questions] Comprehension questions [8 questions]	Vocabulary and word usage questions [8 questions] Rapid reading and comprehension questions [8 questions] Long passage comprehension questions [8 questions]	Short and memo writing question [1 question] Middle passage and e-mail composition question [1 question].	Pronunciation, rhythm, intonation [1 question]. Conversation simulation questions [1 question (sub-question 3)] Short presentation question [1 question].

Table 3. GTEC-Academic Skills Profile Assessment Items (each item rated on a scale of 1 to 10)

GTEC-Academic Listening	GTEC-Academic Reading	GTEC-Academic Writing	GTEC-Academic Speaking
[Part A] Photo description questions / Illustration description questions	[Part A] Vocabulary and word usage questions	GA (Goal Achievement)	GA (Goal Achievement)
[Part B] Conversation response questions	[Part B] Rapid reading and comprehension questions	GR (Grammar)	GR (Grammar)
[Part C] Comprehension questions	[Part C] Long passage comprehension questions	VO (Vocabulary)	VO (Vocabulary) PR (Pronunciation)

2.4 TOEIC (*Test of English for International Communication*)

The Test of English for International Communication (TOEIC) is a standardized assessment tool that evaluates a broad range of English communication skills, with a particular focus on those commonly used in business contexts. While there are various TOEIC programs available, such as the TOEIC Listening & Reading Test, TOEIC Writing & Speaking Test, and TOEIC Institutional Program, the TOEIC Listening & Reading Test (hereafter referred to as L&R) and the TOEIC Institutional Program (hereafter referred to as IP) are scored on a 990-point scale (Educational Testing Service [2016: 7]), with each of the Listening and Reading sections being allotted a maximum score of 495 points. In addition, the TOEIC L&R is designed to simulate realistic scenarios and environments, enabling the assessment of communicative proficiency in English (ibid.: 7). Thus, proficiency in answering test questions not only reflects test-taking skills but also communicative competence (Tanaka, 2017). However, it is important to note that the TOEIC primarily tests receptive skills rather than productive skills (Wilson, 1989; Daller and Phelan, 2013).

This study employs the TOEIC-IP assessment tool to evaluate the English language proficiency of participants, who are required to take the test on a regular basis as a measure of their language learning achievement.

2.5 Study Design

This study hypothesized that students would begin actively utilizing machine translation after its official introduction at the university in September 2022. To assess the impact of machine translation on students' English language proficiency, their scores were compared over time using the primary assessment tool, GTEC-Academic. Numerical data for each of the four language skills and overall scores were obtained through pre- and post-tests conducted in April 2022 and January 2023, respectively. Additionally, as part of their academic requirements, PEP students were regularly administered the TOEIC-IP, and these scores were utilized to validate results from multiple assessments. The pre-test for freshmen was conducted in April 2022, while that for sophomores was conducted in June 2022. The post-test for both groups was conducted in December 2022. Despite the slightly varied implementation dates, all assessments were conducted successfully prior to and following the introduction of machine translation. The obtained data were statistically analyzed to detect any significant differences and objectively evaluate any changes in the English language proficiency of the participants.

To operationalize this procedure, paired-sample T-tests were carried out utilizing Microsoft Excel.

3. Results

3.1 *An Analysis of English Proficiency: Comparing Results from GTEC-Academic, TOEIC-IP, and their Combination*

Table 4 provides an overview of the average results of the English language proficiency test, comprising both pre- and post-test scores, for the participants in the current study. For the purposes of the analysis, those participants who lacked both pre- and post-test results, as well as those who had scores that deviated from normalcy, such as 0 points due to machine errors or other issues, were excluded from statistical analysis. Therefore, a total of 53 freshmen were deemed eligible for the GTEC-Academic Listening analysis, 52 for GTEC-Academic Reading, 50 for GTEC-Academic Speaking, and 52 for GTEC-Academic Writing. In the case of sophomores, 49 were deemed eligible for the GTEC-Academic Listening analysis, 49 for GTEC-Academic Reading, 48 for GTEC-Academic Speaking, and 49 for GTEC-Academic Writing.

Table 4. Pre- and post-test results of the participants as assessed by GTEC-Academic and TOEIC-IP

Grade	GTEC-Academic Listening	GTEC-Academic Reading	GTEC-Academic Speaking	GTEC-Academic Writing	TOEIC-IP Listening	TOEIC-IP Reading
Freshmen (First)	109.7	107.1	111.9	112.2	251.7	212.0
Freshmen (Second)	104.1	103.7	120.4	121.3	255.8	241.4
Freshmen difference	-5.6*	-3.4	8.5*	9.1*	4.1	29.4*
Sophomores (First)	116.0	104.1	115.5	121.6	272.1	215.6
Sophomores (Second)	108.3	104.8	117.8	121.4	264.2	233.8
Sophomores difference	-7.7*	0.7	2.3	-0.2	-8.0	18.2

In this study, the GTEC-Academic test results for Listening, Reading, Speaking, and Writing were obtained twice, the first time in April 2022 and the second time in January 2023, to measure the difference in scores before and after the implementation of machine translation. Areas marked with asterisks indicate statistically significant differences at the 5% level, while other areas denote margins of error. The statistically significant differences between the two sets of scores in Table 4 show that both freshmen and sophomores experienced a decline in their Listening test scores over the course of the academic year, suggesting the possibility of an issue in PEP's English teaching methodology, which requires improvement for better English listening ability.

On the other hand, in relation to the freshmen cohort, some improvements were observed in their English proficiency, particularly in GTEC Speaking and GTEC Writing. As for similar skills among sophomore students, there were both slight increases and decreases, with no statistically significant differences found. Therefore, these results should be interpreted within the margin of error, indicating no substantial change in English proficiency.

The findings suggest that the University of A entered into a contractual agreement for the provision of machine translation services and recommended their use in classes as of September 2022, coinciding with the start of the second semester of the academic year. Moreover, it was officially sanctioned to use machine translation tools midway through the academic year, between the pre and post semesters. Consequently, it is plausible to assume that the participants, who were officially authorized to use machine translation, employed it extensively without inhibition from September onwards. Nonetheless, the analysis of test scores revealed a noticeable improvement in Speaking and Writing proficiency among the freshmen cohort, whereas the sophomores exhibited no change or decline in performance.

Also, the PEP at A University mandates that students take the TOEIC-IP. In combining the results of the TOEIC-IP, further insights may be gleaned (Table 4). This analysis excludes those who have not yet completed both the pre- and post-tests, as well as the GTEC-Academic pre- and post-tests. As a result, 53 freshmen were considered for both TOEIC-IP Listening and Reading, and 49 sophomores were analyzed for both TOEIC-IP Listening and Reading.

The TOEIC-IP at A University is administered online, with freshmen taking the first test as a placement exam before formal classes commence in April 2022, and the second exam included in the grading process in December 2022. The intervening period between these tests was around 8 months. On the other hand, sophomores were required to take the test collectively in June and December, with the first score being obtained in June 2022 and the second score in December 2022. The intervening period was about six months shorter.

The findings of this study reveal that while there was a marginal fluctuation in the Listening scores of TOEIC-IP, the change fell within the margin of error. Furthermore, it is important to note that the downward trend observed in the GTEC-Academic throughout the year may not necessarily suggest a decline in the Listening skills of the participants, as this could be attributed to certain features of the test. On the other hand, the results indicate a significant increase in Reading scores for both freshmen and sophomores as evidenced by the TOEIC-IP scores. This contradicts the marginal increase observed in Reading skills on the GTEC-Academic, which falls within the margin of error. Consequently, the shift in Reading abilities, which were within the margin of error on the GTEC-Academic, may be regarded as an increase. In other words, the results from the TOEIC-IP suggest an overall rise in Reading, offsetting the decline in Listening as indicated by the GTEC-Academic scores.

It is important to note that the TOEIC-IP only evaluates two skills, namely Listening and Reading, and thus, it is not sufficient to assess growth in speaking and writing abilities. Nonetheless, by overlapping the TOEIC-IP outcomes with those of the GTEC-Academic, it is apparent that the English proficiency of the students across all four skills and overall did not decline throughout the year.

3.2 Analysis by GTEC-Academic Skill Profiles

In order to further explore the GTEC-Academic items that displayed significant differences as presented in Table 4, our study delved into the Skill Profiles, which are a set of detailed items separately evaluated within the GTEC-Academic. Specifically, we aimed to scrutinize the changes in each corresponding item by comparing the significant differences between the first and second administrations. The outcomes of our analysis are collated in Table 5.

Table 5. Analysis of Skill Profile differences for significant skills in GTEC-Academic

Grade	GTEC-Academic Listening			GTEC-Academic Speaking				GTEC-Academic Writing		
	PART A	PART B	PART C	GA	GR	VO	PR	GA	GR	VO
Freshmen (First)	4.8	4.2	4.1	5.0	2.2	2.5	3.5	5.5	3.7	3.7
Freshmen (Second)	4.1	4.0	3.8	5.4	2.8	3.3	4.4	5.7	4.2	4.1
Freshmen difference	-0.7*	-0.2	-0.4*	0.4*	0.5*	0.9*	0.9*	0.2*	0.5*	0.4*
Sophomores (First)	5.0	4.3	4.5							
Sophomores (Second)	4.2	4.1	4.1							
Sophomores difference	-0.8*	-0.3*	-0.3*							

As in same with Table 4, areas marked with asterisks indicate statistically significant differences at the 5% level. This suggests that, from the perspective of Skill Profiles, the decrease in GTEC-Academic Listening scores is prevalent, while the increase in GTEC-Academic Speaking and GTEC-Academic Writing scores for freshmen is notable, with all relevant items displaying positive and significant differences. Consequently, identifying a discernible trend when examining Skill Profiles proves challenging. Nonetheless, speculation suggests that Vocabulary (VO) and Pronunciation (PR) exhibited relatively substantial improvements in GTEC-Academic Speaking.

4. Discussion and Conclusion

Machine translation is expected to exert the most significant impact on the four fundamental skills of the English language, namely Reading, Listening, Speaking, and Writing. However, it is widely acknowledged that Writing will likely experience the most profound transformation as a result of the present input/output method of machine translation. In the context of Writing, machine translation permits the precise transfer of information from the source language to the target language. Although the impact on Speaking and Reading is indirect, machine translation can be employed to vocalize the output and interpret English into Japanese, respectively. Presently, Listening is the skill that is least affected by current technology, although this is anticipated to change as new technologies emerge, such as the concurrent use of speech recognition and machine translation, which will enable comprehension of spoken English with Japanese subtitles.

While it is difficult to rank the influence of the four fundamental skills, Writing is considered the most significant in terms of the effect of machine translation. However, the outcomes of a study analyzing the impact of machine translation on the English language proficiency of freshmen and sophomores indicate that the use of this technology did not impair language proficiency. Specifically, the results revealed that freshmen maintained or improved their English proficiency in Writing, Speaking, and Reading, as evidenced by their scores on the GTEC-Academic and TOEIC-IP exams. In contrast, sophomores experienced no significant score increase in any skill, except for Reading on the TOEIC-IP, implying that the use of machine translation either preserved or did not diminish their English proficiency.

In order to rigorously verify the impact of machine translation on English proficiency, it would be ideal to conduct a comparison between the same target students who were prohibited from using all machine translation for one year with those who were not. However, such a comparison would be practically unfeasible. Furthermore, it is worth noting that even though machine translation was officially introduced in September 2022, there would have been a significant number of students who had been using machine translation personally before that time. In this regard, their English scores might have been higher had they been completely barred from using machine translation. However, it is impractical to measure this aspect.

Alternatively, the scores may have gone up due to the significant educational outcomes of PEP, thus boosting GTEC-Academic Writing and Speaking scores and outweighing any potential "bad effects" of machine translation. While these are merely speculations, and we should refrain from drawing simplistic conclusions, it is hoped that further verifications would demonstrate a positive correlation between machine translation and growth in English proficiency.

It should be emphasized that we do not intend to generalize from these results that machine translation automatically improves English proficiency. Nevertheless, this case study demonstrates that the use of machine translation does not cause a drastic decline in English proficiency, nor does it have no effect at all.

The current study sheds light on the relationship between machine translation and English language proficiency, and highlights the need for further analysis and application of English educational logic in this context. Despite the observed increase in English proficiency, it remains unclear why this phenomenon occurs, and what unique effects machine translation may have. Thus, this study has limitations in terms of explaining the underlying mechanisms of the observed growth and maintenance of English proficiency.

In the realm of foreign language education, there exists a prevalent opposition to the use of machine translation. However, we posit that this opposition may stem from false assumptions and misunderstandings. It is imperative that new technological innovations do not result in the learner being disadvantaged, thus losing valuable learning opportunities. Consequently, there is an urgent need to establish public opinion on machine translation and its role in English language education, based on objective data. Further research and analysis are required to examine the potential implications of machine translation in foreign language education, and to elucidate the underlying factors driving the observed increase in English proficiency.

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