Enhancing English Education in Japan: Integrating AI to foster Critical Thinking Skills and Personalized English Learning

Saeun Lee and Juuso Eronen

Abstract

The recent emergence of advanced generative AI has significantly influenced various fields, including language learning in higher education. This technology introduces new possibilities, such as personalized learning experiences tailored to individual needs, 24/7 accessibility, instant feedback, and adaptive content delivery, all aimed at improving learning outcomes. However, in Japan's predominantly test-focused and teacher-centered English education system, students have limited opportunities to use AI tools to develop diverse skills essential for future careers. Learning often remains passive, emphasizing memorization, comprehension, and testing, while higher-order skills like analysis, evaluation, and creativity are equally important. To address this gap, we propose an AI-enhanced language teaching approach that integrates higher-order thinking skills (HOTS) — such as analysis, evaluation, and creation — alongside lower-order thinking skills (LOTS), as outlined in Bloom's revised taxonomy. While LOTS can be improved through passive learning in traditional classrooms, HOTS require deeper engagement and critical thinking. For instance, activities such as synthesizing information and generating appropriate solutions are crucial for developing HOTS. By incorporating AI into learning, students can strengthen their abilities to analyze and evaluate AI-generated outcomes, expand their knowledge creatively, and enhance language proficiency. Additionally, the method enables personalized learning tailored to students' English proficiency levels and interests, further enriching their educational experience. Once students achieve a certain level of HOTS and confidence, they can apply their skills in academic and professional contexts. While concerns about reduced human interaction, privacy risks, algorithmic bias, and accessibility challenges persist, AI-integrated language education offers unique advantages in the Japanese higher education setting. By creating a supportive and non-judgmental environment, AI can help overcome communication barriers, build student confidence, and address hierarchical challenges common in traditional English classrooms. Ultimately, this approach supports the

digital transformation of Japan's education system and contributes to the development of globally competent human resources.

Keywords: English Education, Large Language Models, Personalized Learning, Critical Thinking Skills

1. Introduction

The integration of advanced AI technology into language education offers a transformative opportunity to redefine traditional teaching methods. Envision a future where language learning adapts to the unique needs of each student, providing personalized experiences that boost engagement and enhance learning outcomes. However, this transition to AI-driven education poses challenges, particularly within Japan's educational system, which emphasizes tradition and passive, memorization-based learning.

This study investigates the potential of AI-enhanced language teaching while addressing the practical challenges specific to Japan's context. AI technology in language education promises individualized learning experiences that accommodate diverse learning styles and preferences. By utilizing generative AI, language learning platforms can assess students' strengths and weaknesses, delivering targeted feedback and support. Furthermore, AI-driven content delivery systems can dynamically adapt to students' progress, ensuring lessons remain both engaging and relevant.

Based on an established educational framework called Bloom's revised taxonomy, this research seeks to enhance language education through AI integration. By fostering both lower-order and higher-order thinking skills, our approach aims to provide a comprehensive learning experience that equips students for success in a digitalized world. However, implementing AI in Japan's education system requires a significant shift from its long-standing focus on standardized testing and teacher-centered instruction, necessitating a reevaluation of traditional pedagogical methods. Through a detailed exploration of both opportunities and challenges, this research offers actionable insights for educators and policymakers seeking to modernize language education.

2. Background

2.1 English Education in Japan

Japan's education system is characterized by its traditional approach, which prioritizes rote

memorization and standardized testing as core elements (Nemoto, 1999). In the realm of English education, this often leads to a predominant focus on passive learning and comprehension, rather than fostering critical thinking and creativity. Opportunities for personalized learning tailored to individual student needs and preferences remain limited (Cummings, 2014).

The system faces numerous challenges in adapting to the evolving demands of 21st-century education. Chief among these is the overemphasis on standardized testing as the primary metric of academic success (Doyon, 2001). This test-centric culture creates a highly competitive environment that elevates stress levels among students while stifling the development of critical thinking, problem-solving skills, and creativity.

Teachers also face significant barriers, including excessive workloads and administrative responsibilities, which limit their ability to deliver dynamic and personalized instruction (Murray, 2013). Additionally, systemic factors such as the rigid structure and conservative nature of Japan's education hierarchy hinder the adoption of innovative teaching methods and tailored learning approaches (Nuske, 2014). This preference for stability and conformity over experimentation and flexibility further exacerbates the system's resistance to change.

These entrenched challenges highlight the pressing need for comprehensive reforms and innovative strategies to ensure that Japan's education system remains relevant and effective in equipping students with the skills needed to navigate the complexities of the modern world.

2.2 Artificial Intelligence in Language Education

The integration of AI technology, particularly large language models like ChatGPT, offers a transformative opportunity to address the limitations of Japan's education system while enhancing the learning experience for students. AI-powered tools and platforms can create personalized learning pathways tailored to individual students' abilities, interests, and learning styles. By analyzing students' strengths and weaknesses, AI algorithms enable educators to adapt their instruction to meet specific needs. Additionally, AI fosters adaptive learning environments where content delivery adjusts in real-time based on students' progress and comprehension, ensuring they receive the appropriate level of challenge and support. This approach enhances engagement and promotes deeper understanding (Milano et al., 2023; Koraishi, 2023).

Moreover, AI can assist educators with administrative tasks such as grading and

classroom resource management, allowing teachers to dedicate more time to personalized instruction and meaningful student interactions. This shift enables educators to focus on creating impactful learning experiences and fostering critical thinking skills in their students (Jeon & Lee, 2023).

Ultimately, integrating AI technology has the potential to revolutionize Japan's education system by enabling personalized learning, enhancing critical thinking, and improving overall educational outcomes. Our objective is to harness AI-driven tools and methodologies to establish a dynamic, adaptive learning environment that equips students with the skills needed for global success.

2.3 Bloom's Taxonomy

To address the limitations of Japan's traditional language learning approach, one promising strategy involves reimagining the learning process using Bloom's taxonomy. Renowned for its role in facilitating mastery learning (Bigge, 1964), Bloom's taxonomy outlines the cognitive skills and knowledge essential for advancing learners' mental processes (Bümen, 2006; Gronlund, 1998; Johnson and Fuller, 2006; McBain, 2011; Oermann et al., 2014; Özden, 2011; Poole, 2006; Valcke et al., 2009). Introduced by Benjamin Bloom in 1956, the taxonomy investigates cognitive skills to enhance learning and inform teaching strategies that progress from lower-order to higher-order cognitive abilities (Lovell-Troy, 1989). Anderson and Krathwohl (2001) later revised the framework, identifying six components:

- Remembering: Retrieving, recognizing, and recalling knowledge from long-term memory.
- Understanding: Interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining to construct meaning from various sources.
- Applying: Executing or implementing a procedure.
- Analyzing: Breaking material into parts, understanding relationships, and discerning the overall structure or purpose.
- Evaluating: Judging based on criteria or standards through checking and critiquing.
- Creating: Generating, planning, or producing a new whole by reorganizing elements.

Bloom's taxonomy serves as a critical tool for cultivating higher-order thinking skills (HOTS), essential for life and career readiness. Lessons designed with this framework encourage a shift towards student-centered learning, emphasizing cognitive engagement

and empowering students to take charge of their education. A key aspect of the taxonomy involves student self-assessment and self-evaluation, which align with principles of double-loop learning (Argyris, 1977), self-regulation, and self-management in student-centered classrooms (Daniels & Bizar, 1998).

Within this framework, learning expands beyond evaluating outcomes to include reflecting on learning processes, fostering deeper engagement, and enhancing HOTS. However, a significant challenge lies in how much teachers can support students in achieving in-depth mastery. To address this, self-regulated learning, paired with consistent guidance, is essential.

AI-based learning technologies offer a solution to this challenge by enabling students to practice HOTS and develop cognitive skills through continuous interaction with AI systems. These tools provide personalized support, facilitating deeper engagement and mastery in ways traditional methods often cannot achieve.

3. Implementation

3.1 Artificial Intelligence System

The integration of AI-powered learning solutions using Large Language Models (LLMs) is now feasible thanks to significant advancements in Natural Language Processing (NLP). LLMs, trained on extensive text datasets, are capable of understanding and generating human-like language with high accuracy. These capabilities enable educational tools powered by LLMs to provide personalized learning experiences tailored to individual students' needs, preferences, and learning styles. This breakthrough technology paves the way for intelligent educational tools and platforms that can meaningfully interact with human language, transforming how educators deliver and enhance learning experiences.

The implementation of such AI-powered solutions can follow different approaches, primarily determined by considerations like infrastructure, privacy, and control. Broadly, two methods are available:

Using Third-Party Managed Models

Pre-trained LLMs, such as ChatGPT, are hosted and maintained by external providers. These models can be integrated into educational platforms or chatbot applications, offering ready-to-use natural language understanding and generation capabilities. This approach reduces development time and effort, making it an attractive option for institutions with limited resources or technical expertise.

Running a Local LLM

Alternatively, educational institutions can choose to deploy LLMs locally, either centrally or in a distributed fashion:

- Centralized Setup: A single server hosts the LLM, managing requests from students and educators.
- Distributed Setup: Each student has a dedicated device running a localized instance of the LLM. This setup prioritizes privacy and data security by keeping information on-premises. It also allows for greater customization and provides offline access, enhancing usability in remote or resource-constrained environments.

However, running LLMs locally has its challenges. Specialized hardware is required to support these models, and performance limitations on edge devices remain a concern. Yet, with the rapid pace of advancements in AI and hardware technologies, these limitations are expected to diminish in the near future.

By adopting LLM-powered educational tools, educators can deliver adaptive and personalized learning experiences that cater to the unique needs of their students. These systems promise to revolutionize education by enhancing engagement, fostering critical thinking, and preparing students for success in an increasingly digital world.

3.2 Lesson Plan

This section introduces two lesson plan examples that incorporate AI technology into writing and reading, as well as speaking and listening activities. These lesson plans aim to create interactive and engaging learning experiences while leveraging AI-powered feedback to enhance students' skills. By combining traditional teaching methods with AI tools, educators can design dynamic and personalized learning environments tailored to students' diverse needs and preferences.

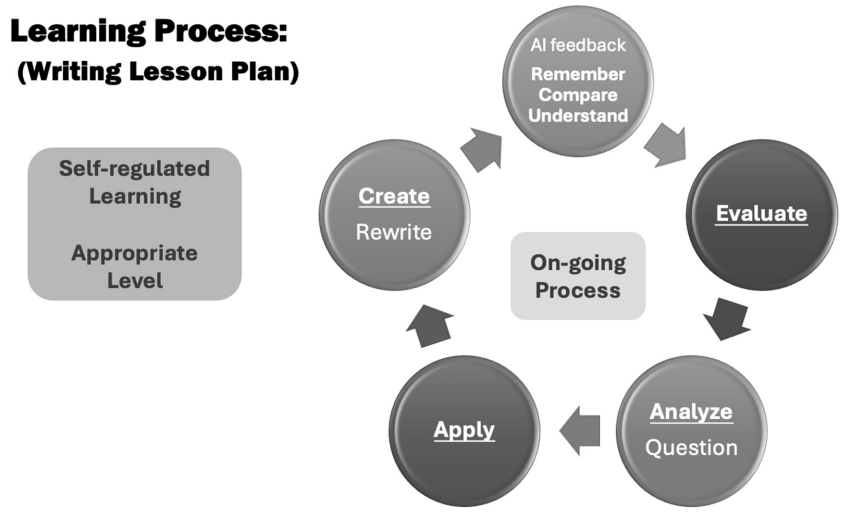

Figure 1: Learning process of AI integrated writing lessons

Writing & Reading Lesson plan example

TASK: Write an Essay

TOPIC: Recently, the number of car accidents due to smartphone use has increased. Provide three solutions to reduce accidents resulting from smartphone use in public areas.

1. Brainstorming and search about the problem and solutions (understand) AI
2. Plan ideas & write an outline.
3. Write a draft
4. Get help with AI: e.g., paraphrasing, finding synonym, rewriting-restructuring, academic voice tone)
5. Feedback from AI: Organization, Grammar, Spelling, etc.→Apply feedback (Revise multiple times)
6. Final draft, submit

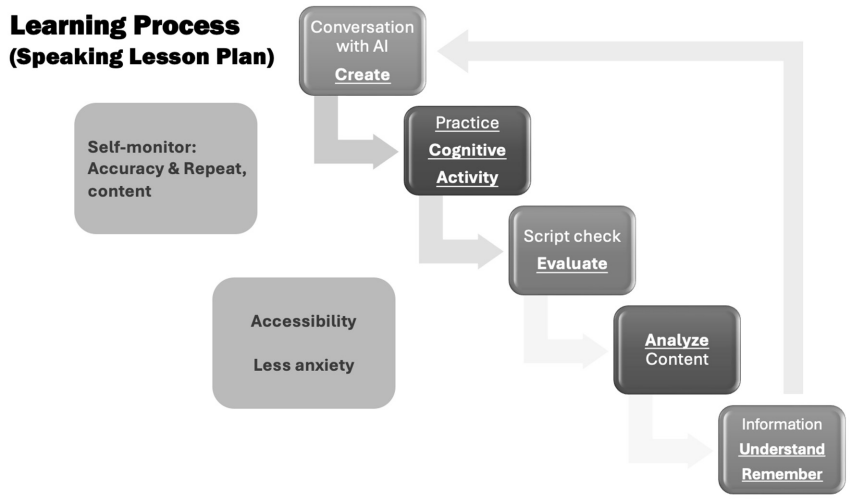

Figure 2: Learning process of AI integrated speaking and listening lessons

Speaking & Listening Lesson plan example

Conversation with AI

TOPIC: Career path: Find out your career journey.

1. Prepare a few questions (prompting) What should I prepare? Where do you recommend to work? What can I do in in XX company? Can you give me some advice? Etc.
2. Ask questions and have conversation (active interaction)
3. create, evaluate (AI given content), analysis (Q&A content), Apply knowledge, Understanding
4. Self evaluation
5. Feedback from AI: review and practice again
6. Submit the conversation script

In the writing and reading lesson plan, students progress through brainstorming, researching, outlining, drafting, receiving AI feedback, and revising, ultimately producing a polished final draft. AI feedback plays a critical role by evaluating essay organization, grammar, and spelling, enabling students to improve iteratively.

The speaking and listening lesson plan engages students in a simulated conversation with an AI device, where they prepare and ask questions about a hypothetical trip. By submitting and reviewing the conversation script, students gain insights into their speaking

and listening skills, fostering self-awareness and growth.

These lesson plans demonstrate how AI can enhance language learning experiences by providing personalized feedback, promoting active engagement, and supporting skill development in meaningful and practical ways.

4. Limitations and Future Research

The integration of AI in education offers substantial potential, but several limitations must be acknowledged to ensure its effective and ethical implementation. One major concern is the potential reduction in meaningful teacher-student interactions. While AI-driven tools can enhance learning, they may inadvertently diminish opportunities for personal connections, which are vital for students' social and emotional development. Furthermore, the use of student data for personalization raises privacy concerns. Safeguarding sensitive information is critical to ensure ethical and secure practices in AI-powered education. Algorithm bias is another significant challenge. AI models, trained on existing datasets, can unintentionally perpetuate inequities or favor specific demographics, leading to unequal educational outcomes. Accessibility also remains a pressing issue, as students without access to technology or sufficient digital literacy skills risk being excluded from the benefits of AI-enhanced learning environments.

The overemphasis on standardization is another limitation. While AI can streamline assessment processes, focusing excessively on standardized testing may limit opportunities for fostering critical thinking and creativity, which are crucial for holistic education. Additionally, dependence on technology introduces vulnerabilities such as system failures or cyberattacks, which could disrupt learning processes.

Teachers' resistance and the need for adequate training pose further challenges. Many educators may be reluctant to adopt AI tools due to a lack of understanding or necessary skills. At the same time, institutions with limited resources may struggle to invest in training programs. Financial barriers also extend to the implementation of AI systems themselves, which can be costly and difficult to sustain in resource-constrained settings. Lastly, overreliance on AI may hinder students' ability to develop independent learning and problem-solving skills, which are essential for lifelong success.

However, the future of AI in education holds immense potential to transform personalized learning, content creation, and assessment. AI can design tailored learning pathways, produce high-quality educational resources, and deliver instant feedback. It enhances ac-

cessibility through inclusive tools and language translation, while predictive analytics support data-driven decision-making. Additionally, AI promotes lifelong learning, workforce training, and global collaboration. Ultimately, its integration promises more personalized, inclusive, and effective educational experiences, equipping students for success for their future use.

5. Conclusions

The emergence of advanced generative AI has opened new avenues in fields like higher education language learning. This technology enables personalized learning tailored to individual needs, offers 24/7 accessibility, provides instant feedback, and delivers adaptive content to improve learning outcomes. However, in Japan's test-oriented, teacher-centered English education system, AI's potential remains underutilized. This limits students' exposure to essential skills for future careers, as traditional approaches often emphasize memorization and comprehension over critical higher-order thinking skills (HOTS) like analysis, evaluation, and creativity.

To bridge this gap, we propose an AI-enhanced language teaching approach that integrates both lower-order thinking skills (LOTS) and HOTS, guided by the revised Bloom's taxonomy. While LOTS are often cultivated in passive, traditional learning settings, HOTS demand deeper engagement and critical thinking. AI can facilitate this by enabling students to analyze, evaluate, and synthesize information, fostering tailored learning experiences that align with their English proficiency and interests. This approach empowers students to confidently apply their knowledge in academic and professional contexts, preparing them for real-world challenges.

Although concerns about reduced human interaction, privacy, algorithmic bias, and accessibility exist, the benefits of AI integration in Japanese higher education outweigh these challenges. AI-driven tools provide a safe, non-judgmental environment that helps students overcome communication barriers and gain confidence, addressing hierarchical constraints common in traditional classrooms. The digitalization of Japan's education system through AI fosters globally competitive human resources, cultivate students with essential skills for success in the advanced technology era.

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