

# An Investigation of the Effects of Using ChatGPT on Vocabulary Acquisition in Chinese- as-a-Foreign-Language High School Classes in the U.S.A.

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## Abstract

Artificial Intelligence (AI), with its accompanying potentially powerful assistance in language learning, has been explored rapidly in the field of Chinese-as-a-Foreign-Language (CFL). Nevertheless, little research has been done regarding the effect of using AI on vocabulary acquisition in the learning of Chinese as a foreign language for American CFL high school students. Specifically, almost no research has been done on the impact of integrating ChatGPT AI chatbot in the learning of Chinese vocabulary in the American CFL classrooms. This study proposes to investigate the effect of ChatGPT AI chatbot as a media to assist Chinese vocabulary learning for American high school students in the CFL classroom setting. The results should provide guidance for CFL teachers in addressing AI-related factors that could enhance CFL high school students' performance in their Chinese vocabulary acquisition, and how the ChatGPT AI chatbot could transform CFL teachers' teaching practices.

**Keywords:** Artificial Intelligence (AI), ChatGPT, Large Language Models (LLMs), vocabulary acquisition, Chinese-as-a-Foreign-Language (CFL).

## Introduction

Mandarin Chinese is one of the hardest languages to learn, particularly for those non-native Chinese speakers. It is well known that Chinese language learning is very challenging for Chinese- as-a-Foreign-Language (CFL) students (Wang, Lam, & Xiao 2023, p. 583).

Like constructing a building, Chinese vocabulary is the fundamental building material for Chinese-as-a-Foreign-Language (CFL) learners. It's impossible to make sentences without being familiar with Chinese vocabulary. Furthermore, the number of vocabularies a CFL student knows is usually used as a main factor to determine a student's Chinese language competent level (Pamintuan et al., 2018, p. 27). Without any doubt, Chinese vocabulary acquisition is critical for CFL learners worldwide including the ones in the US. However, how to enhance and improve American students' Chinese vocabulary learning (including the American high school students) in the CFL classroom? A lot of CFL high school teachers who are (or were) our students in the U.S. have worked very hard trying to solve this challenging problem.

With the advanced emerging technology in Artificial Intelligence (AI), AI has been used in a variety of areas globally such as in gaming, art, performance, fashion, computer science, business, science, healthcare, transportation, electric vehicles, military, education, and so on. In military, among others, AI

applications were tremendously (though, we hope not to see this happening in the wars at all) used in drones and Starlink satellite internet service in the Russia- Ukraine war (intensified on 24 February, 2022 which was extended from February 2014), and in the Israel-Hamas war (beginning on October 16, 2023).

Recently, more and more CFL teachers and students have heard about Artificial Intelligence (AI), specifically, since late November in 2022, a lot of teachers and students have been talking about ChatGPT. What is AI? What is ChatGPT? Is ChatGPT a good tool in helping American CFL high school students on vocabulary acquisition? Before we explore the answers through an experimental study, let us understand what AI is? And what ChatGPT is?

## Literature Review

What is AI? Back to 1950, Dr. Alan Mathison Turing, the father of theoretical computer science and artificial intelligence, proposed a then very mysterious and challenging but smart and great question: "Can machines think?" (Turing, 1950, p. 433). After conducting a series of question-and-answer through a game, or 'imitation game' (as coined by Alan Turing, p. 433) between computer and human (including three people, a man, a woman, and an interrogator who may be of either sex), he began believing that computer could learn and think like human. "This type of thinking, one that mimics aspects of human intelligence

and behavioral traits, is called Artificial Intelligence (AI)” (Bonner et al., 2023, p. 27).

To follow Turing’s innovative idea, in the summer of 1956, a group of researchers got together at a workshop on the campus of Dartmouth College in the U.S. (Kaplan & Haenlein, 2019). This workshop founded the field of AI research which was quickly developing and blooming in full swing by the advocated AI researchers in the variety of fields.

In Turing’s imitation game in 1950 (mentioned previously in this section), a question was asked to the computer: “Q: Do you play chess? A: Yes” (Turing, 1950, p. 434). While a computer can play chess, can the computer beat human? During past decades, in various chess tournaments, AI-driven chess robots have achieved significant victories over human players (Colodro, 2023). One of the notable examples is Deep Blue (an IBM supercomputer) defeated Garry Kasparov (then world chess champion) in a rematch chess tournament held in New York City in May 1997. The AI-driven Deep Blue’s victory testifies to Turing’s belief that computer can beat human player in chess game and set a landmark in the history of artificial intelligence. (AI) As Bonner et al. (2023) stated that “Machine learning helps AIs improve their intelligence and performance by processing incredibly large amounts of data and being trained to identify patterns” (p. 27), then the trained data are “stored in categories, and tagged with content features very logically. Neural networks...organize this training data in a much more human-like fashion, categorizing information not only by its features but also by its relationship with other information” (p. 28).

Thanks to so many diligent and intelligent advocates’ contributions in the field of AI, unlike the traditional AI, modern AI is able to conduct machine learning deeply itself to learn the patterns and structure from the input training data and then generate new data such as text, audio, video, or other media. The generation of new data is continuously itself, that is, the more training data input, the more intelligent the AI is. Consequently, AI is learning continuously and quickly from AI itself, and becoming more and more intelligent AI itself. Such kind of AI was called generative artificial intelligence (generative AI or GenAI). While using generative AI in education, we need to make sure that we are not talking about its application in the field of computer science, we are focusing on its application in education. It’s interesting to learn that generative AI used in education was coined by Su and Yang (2023) as “‘educative AI’, which refers to the use of AI in educational settings to enhance teaching and learning outcomes” (p. 356).

As the technique of generative AI keeps generating more and more new data and the overall data are organized in a huge manner and keep expanding in the Large Language Models (LLMs). As Bonner et al. (2023) noticed “...a new kind of AI, Large Language Models (LLMs), has emerged as perhaps the most powerful tool that is affecting language teaching and learning today. LLMs have been trained on billions of human-generated texts that allows them to predict the next word in a given sequence, allowing it to generate coherent and contextually appropriate text” (p. 24). What is the “Large Language Models (LLMs)”’? They were summarized earlier by Bonner et al. (2023) as “a kind of neural network, are able to interpret natural human input by drawing from their own humanlike memory, searching for the topic and related topics that best apply” (p. 29). Can LLMs support teaching and

learning in education? “LLMs ...can support the teacher by processing vast amounts of information about the students and their learning process, then use this information to support the creation of adaptive learning environments that are catered to the needs of individual learners” (Bonner et al., 2023, p. 29). Perkins (2023) also mentioned that Large Language Models (LLMs) can help teachers and students to develop huge amounts of fresh texts resulting from their brief and short inquires.

Among others, the most popular AI tools using Large Language Models (LLMs) in education contain OpenAI’s GPT (e.g., GPT-3.5 and GPT-4 that were used in ChatGPT), Google Bard, Microsoft Bing, Meta’s Llama 2, and so on. For the purpose of this study in focusing on language teaching and learning, we will use ChatGPT-3.5. In addition to ChatGPT-3.5 being free of charge for teachers and students, “ChatGPT is a form of generative AI that uses algorithms to generate new text similar to what a human might write. It is a language model that uses deep learning to generate human-like responses to natural language queries. ChatGPT is designed to be used in a conversational setting, allowing users to interact with the model naturally and intuitively. As a powerful AI application, ChatGPT can answer questions, write stories, summarize documents, and compose essays” (Su & Yang, 2023, p. 356). Perkins (2023) also emphasized that we can use ChatGPT-3.5 in formal assessments.

What is ChatGPT? ChatGPT stands for Chat Generative Pre-trained Transformer (OpenAI, 2022, as cited in Bozkurt et al., 2023), is an Artificial Intelligence (AI) driven chatbot that was developed by OpenAI and released broadly to the public on November 30, 2022. Based on OpenAI’s website <https://openai.com/chatgpt>, through ChatGPT (3.5-based version), a valid account user is free of charge (except for ChatGPT Pro version such as Plus and Enterprise) to “get instant answers, find creative inspiration, and learn something new”. As of October 2023, ChatGPT has more than 100 million users in many countries worldwide. This makes it a fastest-growing software application ever (Walsh, 2023).

In fact, nowadays, more and more students and teachers are using ChatGPT in both of their academic and personal life. While ChatGPT is still in its infancy (younger than one year old as of this writing), it’s getting popular for advocated researchers to explore how ChatGPT could benefit and impact teaching and/or learning. Can ChatGPT facilitate teaching and learning in education (including language education)? Su and Yang (2023) stated that “in the field of education, ChatGPT can be used to create virtual tutors, answer student questions, and provide personalized learning experiences” (p. 356) because “it is designed to generate human-like text based on a large corpus of text data and is trained to perform various language tasks, such as answering questions, writing stories, composing code, and generating essays” (p. 357).

In terms of language education, Baskara and Mukarto (2023) testified that “ChatGPT in language learning is an emerging area of interest. ChatGPT, in particular, has garnered significant attention due to its ability to generate human-like text and has been proposed as a promising tool for language education (pp. 344-345).

Furthermore, among a variety of phenomenal features of ChatGPT in language education, one of the powerful features is its translation ability among different languages. With ChatGPT, “learners can input text in their native language and have it automatically translated into their target language. They can also use ChatGPT to practice translating texts from their target language into their native language, providing an opportunity for additional practice” (Baskara & Mukarto, 2023, p. 347). ChatGPT’s translation ability is even more powerful with the upgraded GPT-4 that was launched on March 15, 2023 by OpenAI (but it is not free of charge, though). Is it really good in its language translation ability? By investigating with a number of benchmark test sets (see example scripts and data at <https://github.com/wxjiao/>), Jiao et al. (2023) concluded that “ChatGPT has already become a good translator, with GPT-4 as the engine!” (p. 2). Thus, the authors of this study are interested in exploring its translation function and try to figure out how ChatGPT could be applied to Chinese vocabulary acquisition in Chinese-as-a-Foreign-Language (CFL) education. In order to design and prepare for conducting the experiments for this study, one of the authors of this study has played a question-and-answer game with ChatGPT-3.5. Here is an example of chat history from its initial try (that is, without regenerating the original Qs and As): Q: Please translate “dragon” into Chinese.

A: The word "dragon" is translated as "龙" in Chinese. It is pronounced as "lóng" in Mandarin.

Q: Please use the Chinese character "龙" to write at least three vocabulary words for me.

A: Certainly! Here are three vocabulary words using the Chinese character "龙" (lóng), which means "dragon":

龙船 (lóng chuán) - Dragon Boat  
龙头 (lóng tóu) - Dragon's Head  
龙虾 (lóng xiā) - Lobster

These words incorporate the character "龙" into different contexts, reflecting its versatile usage in the Chinese language. These dialogues and translations between human (i.e., one of the authors) and computer (i.e., ChatGPT) are amazing! This shows that ChatGPT has great potentials in helping American high school students to learn Chinese in the Chinese-as-a-Foreign-Language (CFL) classrooms. In particular, it would be interesting in exploring further and conducting an experimental study on how ChatGPT could assist Chinese vocabulary learning for American high school students in the CFL classroom setting.

However, nothing is perfect, though. ChatGPT could be a powerful AI tool that could change the ways we teach and learn. However, using ChatGPT in education has its drawbacks. For example, Perkins (2023) was concerned that ChatGPT could raise academic ethical integrity issues due to its ability to generate original text and assist student in the writing process which is hard to identify whether the final outcome is written by student or by ChatGPT. Baskara and Mukarto (2023) emphasized that using ChatGPT could bring the ethical and social consequences when using it inappropriately in language learning.

Then, how to use ChatGPT in education appropriately? Su and Yang (2023) suggested that while using ChatGPT in education, we need to (1) identify the objectives and desired outcomes of using ChatGPT in teaching and learning, (2) determine the appropriate level of automation in using ChatGPT as a fully automate in teaching and learning or as a supplement to

traditional teaching methods, (3) ensure ethical considerations of using ChatGPT on potential biases, and their impact on teachers and students, and (4) evaluate the effectiveness of using ChatGPT in reaching the desired teaching and learning outcomes.

Recent research studies state that ChatGPT, an AI-driven chatbot, has great potential and could play a critical role in education as well as in foreign language education (including Chinese- as-a-Foreign-Language education). Indeed, it is fun in exploring the potential benefits and challenges on how ChatGPT works in the Chinese-as-a-Foreign-Language (CFL) education in the U.S. Because ChatGPT is available on November 30, 2022, less than one year as of today’s writing, it is understandable that very few empirical studies have been conducted on using ChatGPT to support CFL vocabulary learning because it usually takes months and years to conduct an experimental study in the field, not to mention reporting, submitting, reviewing, and publishing the study results in a journal. Therefore, the authors of this study are interested in conducting an empirical research as one of the pilot studies on the impact of ChatGPT toward Chinese vocabulary learning in American high school CFL classrooms. Hence, the purpose of the study was to investigate the impact of ChatGPT on American high school students’ Chinese vocabulary learning. The research question of this study is: Would there be any difference in Chinese vocabulary learning between the American high school students using ChatGPT and those not using ChatGPT?

### Method Design

The present study will use a quantitative approach and collect numerical data to examine the effects of using ChatGPT or not in American high school students’ Chinese vocabulary learning. Specifically, quasi-experimental design with a control group and pre-post tests will be used to allow us to draw conclusions on the causal relationship between generative AI application and Chinese-as-a-Foreign-Language (CFL) student achievement.

### Participants

High school students enrolled in Level I Chinese-as-a-Foreign-Language (CFL) classes at an urban public high school located in the Midwestern region of the United States will be invited to participate in our study. During the study, all Level I CFL classes will be randomly assigned into two groups: control group and experimental group. The control group will use the traditional method while the experimental group will use ChatGPT to learn Chinese vocabularies.

### Instruments

Data will be collected from the participants in the form of pre- and post-surveys, as well as pre- and post-tests. The pre-survey consists of two sections. The first section includes demographics questions (gender, age, ethnicity, etc.) and questions on students’ family and foreign language learning backgrounds. The second section consists of two Likert-type scales to measure student attitudes towards learning Chinese as a foreign language and foreign language learning strategies, and a rating scale on self-perceived Chinese proficiency. For the two Likert-type scales, students will be asked to rate the extent they agree or disagree with each statement. For the rating scale, students will be asked to indicate their confidence level from 1 to 100 for each aspect of CFL performance. The post-survey is identical to the pre-survey except in the first section of demographics questions. In

In addition to the surveys, the study will also involve the use of pre- and post-tests adapted from Hanyu Shuiping Kaoshi (HSK) tests, i.e., standardized Chinese proficiency tests developed and validated by the Chinese government's Department of Education. Pre-post tests are not identical but A/B forms of the same test that are supposed to be equal.

### Procedures

All participants will be administered later the same pre-survey at the beginning of the study and the same post-survey at the end of the study. Parental consent forms will be distributed in the classroom, and participants will be told to bring them home for their parents to sign and return them to their teacher the next week. All participants will also be asked to complete the tests developed by the HSK tests that will be used to assess their level of Chinese vocabulary learning as pre-test and post-test.

### Data Analysis

Descriptive analysis will be conducted with data collected from the first section of the pre-survey to describe the participants and to examine if there is any significant difference in terms of demographic characteristics and family and language learning backgrounds between the control and experimental groups. Inferential statistics, specifically analysis of covariance (ANCOVA) will be conducted with data from the second section of the pre-post surveys and the pre-post tests to examine if there are statistically significant differences between the two groups in their attitudes towards CFL, language learning strategies, perceived CFL competency, and actual CFL vocabulary test performance, while controlling for pre-test differences.

### Scholarly Significance of the Study

These empirical study findings will add knowledge to the field of Chinese-as-a-Foreign-Language (CFL) teaching and learning in better understanding the usage of generative AI applications such as ChatGPT. Practically, it will provide recommendations to CFL teachers on potential strategies to improve American CFL high school students' vocabulary acquisition by using ChatGPT. Our findings will also help understand how different students may benefit differently from an Artificial Intelligence-based learning environment.

Generative AI with its machine learning mechanism will continue to increase its capacity of LLMs to generate more digital products (with hope for more accuracy) to serve human beings. Without any doubt, we, as humans, assumed we are superior to machines and should continue to improve our own learning and to serve our human beings better. It is thus expected that as time goes by we will only be better at promoting American CFL high school students' vocabulary acquisition by using AI-driven ChatGPT. While there are still a lot for us to learn and to explore on how to apply ChatGPT to best assist American CFL high school students' vocabulary acquisition, this pilot study is a good start and it will be fun in continuing our journey for such an adventure. We hope to be able to bring significant contributions to the field of foreign language, particularly the Chinese-as-a-Foreign-Language teaching and learning toward Chinese vocabulary acquisition for American CFL high school students. We believe that "We can only see a short distance ahead, but we can see plenty there that needs to be done" (Turing, 1950, p. 460).

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### Conflict of Interest

There is no conflict of interest between the authors.

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