

The Acceptance and Diffusion of Generative Artificial Intelligence in Education: A Literature Review

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ABSTRACT

The last century can be considered the era of technology. There are always new technologies blooming. The time span between the developments of technology shortened. The acceptance and adoption of each new technology can be different. However, the technology acceptance model (TAM) and diffusion of innovation theory (DOI) propose that there are some patterns for usage of any new technologies. Meanwhile, there is tremendous interest on artificial intelligence (AI) technologies after the ChatGPT trend. Thus, the purpose of this study is to explore the most current literature review of the acceptance and adoption of ChatGPT and Google Bard type Large Language Models (LLM) and generative AI by educational settings. The study used literature review methodology. The review was a systematic perspective which going through the study on acceptance and adoption of some popular technology in education settings in the current days. The review of the literature shows that there is an acceptance of the models in education but with doubts.

KEYWORDS

ChatGPT; Google Bard; Large Language Models; artificial intelligence; generative AI.

INTRODUCTION

The relation between education and technology is similar to the relation between egg and chicken. It is still discussable whether a new technology leads education or education leads technology. The term technology used in this context is any tool developed for a purpose. Thus, this new technology can be used for people to teach something to other. However, it is still a dilemma that the outcomes of learning process lead a new technology. This discussion will go on probably in the next centuries.

Even though there are always discussion on what is technology and what is not, this paper follows the description by Grine et al. (2009). In their description, stone tools can be considered as the first technological tools. Within that perspective, the development of fire in Paleolithic period from million years ago, the development of agricultural tools in the Neolithic period from ten thousand years ago, and the invention of wheel in Iron Age from thousand years ago are some of the milestones in technology history. During last few centuries, the span of between these developments shortened. However, the invention of the printing press in Middle Ages from hundred years ago is one of the main developments for education after the invention of writing in the Bronze Age. Steam engines, the telegraph, and the light bulb in the Early Modern period made big changes in the societies. However, the development of airplane, the television, the computer, and the internet in the 20th century brought totally new perspectives to life and communication. This, of course, affected the education. The 21st century started with stunning developments in technology. The invention of smartphones and their application changed the daily life and education settings rapidly (Baytak & Hırça, 2013).

Another development of technology that got high attention during the end of the 20th century was artificial intelligence. This technology arouses curiosity. There have been always discussions that can be out of control and invade human beings. There are even several movies scripting these concerns. For example, the movie, *Eagle Eye* by D.J. Caruso in 2008 demonstrates how an artificial intelligence manipulates various aspects of society to orchestrate dangerous situations.

The technology used in education has similar chronology. After the invention of writing and the printing press, there had been main shifts. The last development such as radio, television, and computer provide new learning environments for learners and educators. The internet, however, made a big change. Learners and teachers can easily access billion pages of information in seconds. Accessing the content from anywhere and at any time, changed the distance education as well.

Generative artificial intelligence (AI) powered chatbots like ChatGPT (GPT 3.5 free version and hereafter ChatGPT) and Google Bard (Experiment version and hereafter Bard) are rapidly developing field with the potential to revolutionize education. ChatGPT was launched in November 2022 and Bard was launched March 2023. However, the foundation of these platforms, AI, was first mentioned by Alan Turing in his book “Computer Machinery and Intelligence” in 1950. Over time AI developed and various generative AI and Large Language Models (LLM) were developed. In technical terms, ChatGPT and Bard are LLM platforms. In recent years the term

“4IR tools” has been used represent artificial intelligence, virtual reality, robotics, intelligent tutoring and natural language processing systems (Ayanwale, 2023). Since the scope of this paper is limited to LLMs, the broader term, “4IR tools”, will not be used.

The usage of generative AI and LLMs is tremendous. According to a recent report ChatGPT acquired *1 million* users just *5 days* after launching in November 2022 but Instagram reached this usage in *2.5 months*. ChatGPT currently has over *100 million* users as of May 13, 2023 (Duarte, 2023). The same report shows that ChatGPT main platform openai.com gets approximately *1 billion* visits per month. Another LLM, Google Bard, also got attention. Just in the same month of launching, it got 30 million monthly active users (Mark, 2023).

However, each technological development encountered various obstacles. People could have affective, behavioral and cognitive resistance to change (Laumer & Eckhardt, 2010). Even though there is popularity among users, educational settings are and should be more skeptical to tools. This study aims to explore the most current literature review of the acceptance and adoption of ChatGPT and Google Bard type generative AI and Large Language Models by educational settings.

RQ1: What are the patterns of these literatures?

RQ2: What are educational settings that these technologies have been studied at most?

THEORETICAL FRAMEWORK

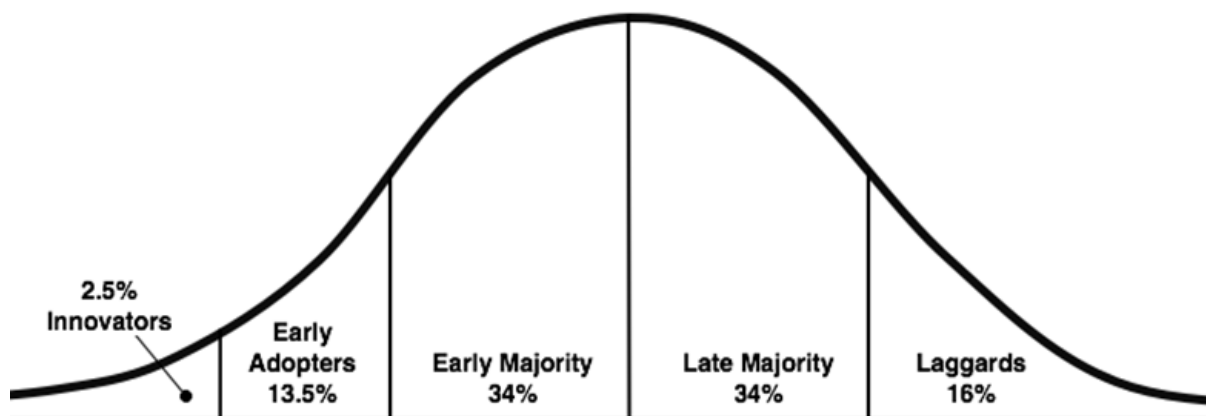
There are two main theories that have studied adoption and acceptance of technology; the diffusion of innovation theory (DOI) and technology acceptance model (TAM).

The Diffusion of Innovation Theory (DOI)

DOI theory explains how, over time, an idea or product gains momentum and diffuses through a specific population or social system (Rogers, 1983). For adoption something has to be done differently than what it had been done previously. Diffusion becomes possible when the idea, behavior, or product is perceived as new or innovative. This adoption of innovations does not happen with the same patterns among all people. Based on the time period of adoption of an innovation varies based on the adopters' characteristics (Rogers, 1983). Even though the borders are not divided with keen lines, there are some points where people of a society can be divided based on their adoption of innovation time periods. According to Rogers (1983), people's adoption period from the earlier to later can be categorized as follows; Innovators who are the first to try the innovation; Early adopters who are opinion leaders; Early majority who are before the average person; Late majority who are skeptical of change; and Laggards who are very conservative. The following graphic show how people can be distributed based on their adoption time scale.

Figure 1.

The distributions of adopters of an innovation over time.



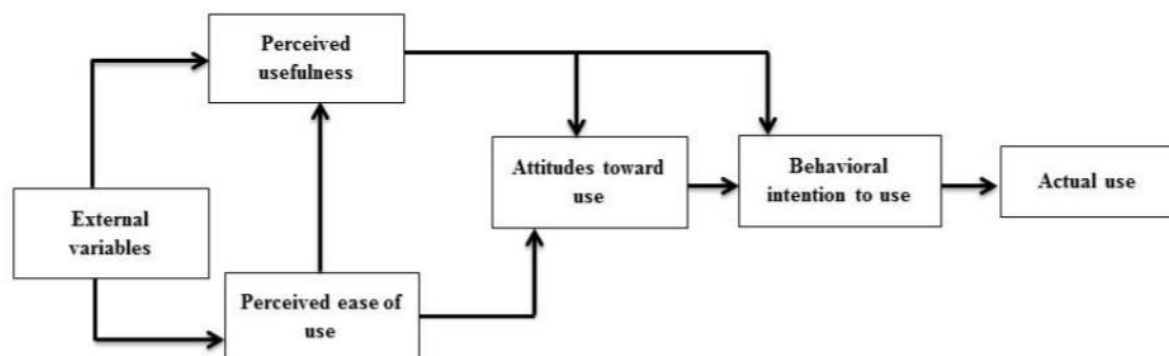
Source: (Rogers, 1983)

Technology Acceptance Model (TAM)

Davis (1989) introduced the technology acceptance model, which explores how users' perceived usefulness and ease of use influence their acceptance and adoption of information technology, including computers in education. TAM is an important process to understand how people adopt and use new innovations. Perceived usefulness and perceived ease of use are two main factors of TAM. Perceived usefulness is the degree to which a person believes that using a new technology will improve their work performance. For instance, an educator might believe that using a new device will help him/her to teach his/her students more effectively. Perceived ease of use is the degree to which a person believes that using a new technology will be easy to learn and use. For instance, this educator might believe that using this new device will be easy to learn and use since it has a user-friendly interface.

Figure 2.

Technology acceptance model



The diffusion of innovation theory and technology acceptance model have been studied and implemented in numerous educational researches. As part of this paper, how DOI and TAM have been studied with the some key technological will be briefly explained. To keep the content short, studies about only television, computers, the internet and social media have been listed.

Television is one of the key technological devices that have been used in modern educational settings. There are studies discussed diffusion of television on education. Salomon (1981) discusses the use of television in education, focusing on the social and psychological interactions that occur during the learning process. He explored how television can facilitate communication and enhance educational outcomes. There are other studies also about use of television in education (Clark, 1994; Cuban, 1986; McKenna et al., 2003). Hirschbuhl and Goolsby (1994) investigated the factors that influence teachers' attitudes and behaviors toward using television and multimedia technologies for educational purposes.

Computers also became a part of society with a great surprise. These devices, which were bought with great enthusiasm at first, were later realized that they could not work without a command. With the developing software, it became more noticeable how functional computers are. The educators sought ways to integrate these new super-devices into lessons. There are numerous academic studies that have been done and continue to be done on teachers' computer adoption (Al-Qaysi et al., 2020; Ertmer & Ottenbreit-Leftwich, 2010; Law & Chow, 2008; Rogers, 2003; Suppes, 1966).

With the addition of the internet feature to computers, the functions of computers began to change more. Accessing web pages, using communication platforms, and doing some work on the web with the Internet changed social life. Educators also benefited from the opportunities of the internet in the learning environments. Numerous studies have been conducted on the use of the Internet in the field of education. There are several studies seeking users' acceptance and adoption of internet-based technologies (Albirini, 2006; Picciano, 2021; Venkatesh & Davis, 2000; Zhao et al., 2002). Social media platforms are one of the fruit of the internet. Social media platforms increased the use of the internet. Educators also studied the adoption of social media in education settings (Hew & Cheung, 2014; Junco et al., 2011; Wang et al., 2019).

METHODOLOGY

The purpose of this study was to explore the most current literature about the acceptance and adoption of ChatGPT and Google Bard type artificial intelligence systems by educational settings. To achieve this goal, the study conducted a literature review method.

In order to search the literature for relevant sources, Google Scholars was used. The following keywords were used to reach the target literature: *ChatGPT, artificial intelligence and education, Large Language Models, adoption of ChatGPT, acceptance of ChatGPT, adoption of Bard, acceptance of Bard, ChatGPT and education, Bard and education.*

The selection criteria of the target sources were strict. Since this literature review only focused on research papers, the sources should be either published a peer-reviewed journal, should

be a thesis or a conference proceeding. Since artificial intelligence has been around in more than 20 years, this study limits its sources to the last one year to focus specifically on ChatGPT and Bard type AIs. Similarly, the study excluded sources which do not have publication date and methodology. Since the study focuses only on education field, the studies which are not related to use of these technologies in educational settings were also excluded from the study.

The data analysis of this study was based on summarizing the key findings of the sources and identifying patterns or trends. After the collection of the sources from the related web platforms, the sources were divided based on the AI. The study also classified the sources based on their methodologies. While conducting this study, the researcher evaluated the sources using a set of criteria that ensured that the sources were credible and relevant.

FINDINGS

This study aims to explore the most current literature review of the acceptance and adoption of ChatGPT and Google Bard type artificial intelligence systems by educational settings. After the collection of the articles, the exclusion process was taken place. The articles with the scope of this study are listed at the Table 1.

The pattern of the literature

In the analyses, it was found that the articles were conducted on LLM as general and most of them were on ChatGPT, which is more popular among the LLMs. In the first evaluations, it was revealed that the researches should be used and tested by the students, such as trying a new invention. Students' engagement in lessons with tools such as ChatGPT, the effect of these tools in online lessons, communication solutions, and adoption to these devices have been studied frequently.

Since LLM is within the scope of artificial intelligence due to its structure, it has been found that some studies have been working on personalized instruction. The individualized learning contribution of these systems, which produce content according to the needs and demands of the participants, has been examined.

When the studies were examined as methodology, some of them were literature reviews, while others were conducted as research. It has been understood that the majority of the researches are interview-oriented qualitative research.

Educational settings that these technologies have been studied at most

It was interestingly found that the studies carried out intensively in higher education. Whether the students studying in higher education do plagiarism, whether the content produced by tools such as ChatGPT is reliable, and the reaction of these adult students to these devices have been examined in different studies.

The article analysis showed that the students' use of LLM has changed as the fields they do. The articles mainly focus on testing how reliable and valid these systems are in the field of medicine. However, it was found that the articles examined in this study were used for different educational environments. Some studies were used for tourism education, while some studies were

used for medical education. The literature review also shows that it is used especially in areas that require writing and synthesizing information.

Table 1.

The list of related articles

Article	Subject	Platform
Liao et al. (2021)	Student engagement and learning	LLM
Kahlon et al. (2021)	Quality in asynchronous online discussions	LLM
Stieglitz et al. (2021)	Review of Chabot applications in learning and teaching	LLM
Fuchs (2023)	Personalized instruction	ChatGPT and Google Bard
Castillo-González (2023)	Benefits for students	ChatGPT and Google Bard
Cooper (2023)	Personalized instruction	ChatGPT and Google Bard
Sallam (2023)	Health care education	ChatGPT
Lund & Wang, (2023)	Potential impact on academia and libraries	ChatGPT
King (2023)	Plagiarism in Higher Education	ChatGPT
Thorp (2023)	Reliability	ChatGPT
Trust et al. (2023)	Teacher education	ChatGPT
Lo (2023)	Literature review	ChatGPT
Kasneci et al. (2023)	Challenges and opportunities	ChatGPT
Strzelecki (2023)	Predictors of adoption and use of ChatGPT	ChatGPT
Ivanov & Soliman (2023)	Tourism education	ChatGPT
Aydin (2023)	Using in literature review	Bard
Milano et al. (2023)	Higher education reaction	LLM
Ahn (2023)	Medical education	LLM
Koraishi (2023)	Material and assessment for Language learning	ChatGPT
Raman et al. (2023)	Influence university students' intentions	ChatGPT
Sallam et al. (2023)	Scale to measure the acceptance and adoption of ChatGPT	ChatGPT
AlAfnan et al. (2023)	Communication and learning	ChatGPT

DISCUSSION AND CONCLUSION

This study was designed to explore the most current literature review of the acceptance and adoption of LLMs. In the recent months, there have been many different large language models and generative artificial intelligence systems bloomed to create content and image based on users' prompts (Mearian, 2023). Based on the analysis of the literature review, the study found that there are patterns among the literature.

The results of this study show that students' engagement in lessons with LLMs, the effect of these tools in online lessons, communication solutions, and adoption to these devices have been discussed among the literature. However, as Greenhalgh et al. (2004) questioned years ago for the diffusion of computers, the studies rarely discussed how people reject innovations. Even though there were some studies discussing plagiarism and reliability of the content, there were no in-depth discussions how these tools were should be rejected.

This study found that most of the literatures focus on the ChatGPT. A literature review related to diffusion of innovation theory on using computer in education found similar results. According to Sahin, (2006) technology education teachers use more mainstream computer applications than computer specialized applications. So, there are many studies related to using ChatGPT in education settings but there are also several plugins that uses ChatGPT and produce different content. Indeed, there are tools such as *Dall.e* (<https://labs.openai.com/>) or *Midjourney* (accessible from Discord) to create image based on users' text or image prompts.

When the literature review was conducted with the scope of TAM, perceived usefulness was assured by some studies that they have studied how using a ChatGPT could improve the work performance (Ivanov & Soliman, 2023). Some studies have also assured the perceived easiness of use that implementing ChatGPT type of system in education settings easy to learn and use (Strzelecki, 2023). Raman et al. (2023), for example, found that the students participating in their study viewed ChatGPT as innovative, compatible, and user-friendly.

The diffusion of LLMs and specifically ChatGPT was found at different level. Based on the literature review, most of the studies can be classified in the innovation level according to Rogers' DOI theory (1983). Research conducting about the discussing plagiarism and reliability of the content were found more at Late Majority level. However, Shahsavar and Choudhury (2023) studied what influence users' intentions to use ChatGPT and they found that users are more likely to use ChatGPT if they believe that it is accurate and reliable.

Overall, AI-powered chatbots like ChatGPT and Bard are almost new to our life. Even though there is an incredible interest in these platforms, educational institutions and settings have not implement these platforms to their settings yet. It should be acceptable that every new technology should be integrated into educational settings only after they are academically tested. Thus, this study explored how the recent literature accepted and adopted LLMs in education.

Similar to simple media such as radio or television, ChatGPT or Bard are useful tools developed by scientists. These platforms can be used for personalized instruction and instant feedbacks. After the Covid-19 pandemic, there has been a huge demand for distance education

platforms. Thus, these LLMs which provide synthesized information can help students at different levels to learn at their own pace and in their own way. The acceptance and diffusion of LLMs in education will take time for educators to become comfortable with using this new technology. However, the experience from the television, computers and the internet technologies show that LLMs will eventually become a mainstream or supportive educational tool. Since there have been only few months of the launch of ChatGPT and Bard, there are not enough academic resources to make an absolute decision about the acceptance and diffusion these platforms in education. However, this study is an initial source to enlighten the way for those working in the field. The findings can be expanded for further studies.

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