Impact of Artificial Intelligence Chatbot Usage on Students' Learning and Academic Performance

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Abstract

The use of artificial intelligence (AI) chatbots in higher education settings has significantly transformed how students learn and access knowledge. Unlike traditional instructional approaches, the use of AI chatbots promotes student engagement during learning by providing instant feedback and supporting personalized learning. Despite their increased usage, there are limited empirical studies evaluating how AI chatbot usage influences students' learning perception and academic performance. The purpose of this study is to evaluate the impact of AI chatbot usage on students' learning perceptions and academic performance in higher education. The research question to be addressed is: How does generative AI chatbot usage influence students' learning perceptions and academic performance? The study will be guided by the Technology Acceptance Model (TAM) and aim to explore how perceived usefulness and ease of use of AI chatbots influence students' learning experience. A quantitative cross-sectional survey design will be adopted in the study. Participants will include undergraduate and graduate students enrolled at a private university located in the southeastern United States with a diverse student population. Data will be collected through structured Google Form Questionnaires distributed online. The collected information will include students' chatbot familiarity, frequency of use, perceived impact on learning, and objective measures of academic performance, which will include quiz scores. Data will be analyzed using R statistical software. Means, standard deviations, and frequencies will be used to summarize participant characteristics. Pearson correlation and regression analysis will be conducted to examine relationships among variables, with statistical significance set at $p < .05$.

Keywords: Artificial intelligence, chatbot usage, learning perception, academic performance, higher education, technology acceptance Model (TAM), quantitative study

Table of Contents

List of Figures

Chapter 1: Introduction and Overview

Health, technology, and education are some of the major sectors that have been significantly impacted by the rapid growth of AI. The integration of AI in education, in particular, has contributed to improving the learning process and outcomes, such as the academic growth of students (Dong et al., 2025). Various AI-driven techniques, such as adaptive learning platforms, automated assessment tools, natural language processing, artificial neural networks, machine learning algorithms, intelligent tutoring systems, and conversational chatbots, are widely used tools to transform traditional instructional education methods. A significant improvement in academic performance and engagement among learners has been demonstrated through the integration of such tools (Dong et al., 2025).

The AI tools can be leveraged to promote personalized learning by aligning the educational content in a way that makes it easily accessible to learners. Personalized learning results in enhanced self-efficacy and positive attitudes towards education (Viera & Petrea, 2025). Considering the continuous adoption of AI-powered tools in academic settings, there is a need for empirical studies to examine how their usage impacts student learning perception and measurable academic performance. This quantitative study aims to evaluate the relationships between AI chatbot usage on student perceptions and academic performance. This chapter contains the background of the study, purpose, significance, assumptions, limitations, delimitations, and definitions of terms.

Background of the Study

Artificial intelligence was developed in the 1930s by Alan Turing, who was a pioneering mathematician and computer scientist (Koley, 2025). Turing was later joined by John McCarthy in 1955 and introduced the term “Artificial Intelligence,” defining it as “the science and

engineering of making intelligent machines" (Koley, 2025). Knowledge from mathematics, neuroscience, engineering, linguistics, psychology, cognitive science, and philosophy is incorporated in AI (Koley, 2025). AI comprises 11 major subfields, such as machine learning, deep learning, neural networks, neural language processing, pattern recognition, cognitive computing, computer vision, robotics, chatbots, data mining, and data science (Koley, 2025).

Artificial intelligence was first introduced in higher education in the mid-20th century to help automate routine tasks and enhance the instructional process (Young, 2024). Devices such as the intelligent teaching system were also introduced in the 1970s and 1980s to improve learning by providing personalized instructions by leveraging lesson materials and pacing into individual performance. With time, AI has significantly evolved and has transformed how students learn and interact with academic content. Various applications, such as intelligent tutoring systems, educational robots, adaptive learning platforms, learning analytics platforms, and human-computer interaction technologies, have been introduced to enhance learning (Vieriu & Petrea, 2025).

Traditional instructional approaches have been proven to be ineffective in improving student learning outcomes (Davar et al., 2025). In settings where traditional instructional learning is practiced, students often report experiencing delays in receiving answers to their questions, which results in disengagement. Also, student learning needs are not considered, particularly those from remote or underserved areas with inadequate access to resources and support (Davar et al., 2025). Incorporating AI chatbots in particular can effectively address such gaps, as they can provide real-time feedback promoting student engagement and also promote personalized learning (Davar et al., 2025). The chatbots can act as a virtual teaching assistant and deliver real-time feedback. They can also improve student engagement in a blended learning

environment, such as flipped classrooms, functioning as virtual tutors. In addition, chatbots have opened new opportunities, such as being utilized as research support tools and assisting learners in comprehending complex concepts (Davar et al., 2025).

The adoption of AI chatbots in higher education, however, has prompted a growing debate surrounding their educational value (Mosaiyebzadeh et al., 2023). Ethical concerns, such as plagiarism and inaccurate information, and other issues involving unequal access and ability among students to effectively use AI tools, data privacy, and the potential for misuse in academic assessments. While most existing literature has focused on students' perceptions and experiences of AI chatbots in higher institutions, there are limited quantitative studies linking chatbot use to objective outcomes like academic performance.

Purpose of the Study

The purpose of this quantitative study will be to evaluate the impact of AI chatbot usage on students' learning perceptions and academic performance in higher education.

Research Question

RQ1: How does generative AI chatbot usage influence students' learning perceptions and academic performance?

Hypotheses

H1: Students with greater familiarity and use of AI chatbots will have higher quiz scores.

H2: Students with more positive perceptions of AI chatbots will report better self-assessed learning outcomes.

H3: The effect of AI chatbot use on performance differed between science, technology, engineering, and mathematics (STEM) and non-STEM students.

Significance of the Study

The study is significant in three ways. First, it will contribute to enhancing the existing body of literature by offering an empirical quantitative study highlighting the impact of AI chatbot usage in higher education, considering its continuous adoption in the setting. Second, policymakers and college and university administrators will benefit from the study findings, as they will be informed about the potential benefits and challenges of AI chatbot usage in learning. Third, higher institutions will understand how students perceive the usage of AI chatbots, enabling the development of effective interventions to enhance learning.

Assumptions

The first assumption of the study is that students will respond truthfully and accurately when completing the distributed questionnaires about their perceptions and usage of AI chatbots. The second assumption is that the collected data will accurately reflect student experiences and performance, and the quiz scores will be a valid measure of academic performance.

Limitations

The first limitation of the study is that it will be conducted in a single institution, which could limit the generalizability of the study findings (Prabhu, 2020). The second limitation is a potential response bias, as data will be collected through a self-reported survey, and participants will be required to record their perception of AI chatbot usage (Anvari et al., 2023).

Delimitations

This is how the study will be delimited: The study will only focus on AI chatbot usage for academic learning. Other AI applications, such as grading systems and plagiarism detection, will be excluded. In addition, only quiz performance and self-reported learning outcomes will be considered as measures of academic performance.

Definition of Terms

Artificial Intelligence

Artificial intelligence entails designing computer systems that can perform tasks intelligently by modelling aspects of human cognitive behavior (Koley, 2025).

Chatbot

A conversational AI tool that interacts with users using natural language, often used for academic support and tutoring (Davar et al., 2025).

STEM Major

Academic disciplines related to science, technology, engineering, and mathematics (Masjutina et al., 2025).

Non-STEM Major

Academic disciplines outside the STEM fields, such as the humanities, social sciences, and arts (Masjutina et al., 2025).

Summary

The integration of AI chatbots in higher education can be effective in improving student engagement and enabling personalized learning. However, the potential challenges include ethical concerns, accuracy issues, and integrity concerns. The purpose of the study of the quantitative study is to evaluate the impact of AI chatbot usage on students' learning perception and academic performance in higher education. The study is critical because it will contribute to enhancing the existing body of literature by providing empirical evidence of the impact of AI chatbot usage on student performance and perception. The study findings could also inform colleges and universities' administrators, policymakers, and technology developers about the advantages and disadvantages of incorporating AI chatbots in student learning. A comprehensive

review of relevant studies related to AI chatbot usage in higher education in promoting student learning outcomes and academic achievement will be included in chapter 2.

Chapter 2: Literature Review

The purpose of this quantitative study is to evaluate the impact of AI chatbot usage on students' learning perceptions and academic performance in higher education. Various AI chatbots, including ChatGPT, Gemini, and Copilot, have recently attracted significant attention for their ability to assist in completing a range of tasks in different fields, including health care, education, and customer service (Bobro 2024; Aithal & Aithal, 2023). Particularly in education settings, AI chatbots are continuously utilized by students to improve their learning experiences. The existing evidence demonstrates the effectiveness of AI chatbots in higher education, such as positively influencing the student learning process by providing customizable instructions to promote understanding. However, ethical concerns, such as plagiarism and inaccurate information regarding its usage, have been raised (Bobro 2024; Aithal & Aithal, 2023).

The introduction of the new technology in higher education settings necessitates an extensive understanding of how it is being perceived by learners and its measurable academic outcomes to help regulate or enhance it further. The objective of this literature review is to critically synthesize the existing evidence on the use of AI chatbots in higher education with a focus on how these tools influence learners' perception and academic performance. This chapter contains the search strategy, review of related research and literature, theoretical framework, and a summary.

Search Strategy

The articles reviewed used digital searches of various scholarly databases, including CINAHL, Scopus, ERIC, ProQuest Education, APA PsycINFO, Elsevier, Science Direct, Springer, EBSCOhost, and Google Scholar, to gather information about AI chatbot usage in higher education. The keywords searched included: Artificial Intelligence in higher education, AI

chatbots, ChatGPT, Generative AI in education, higher education, university students, college learning, student learning perception, academic performance, and learning outcomes. Boolean operators such as “AND”,” OR” were applied to combine keywords, creating search phrases. The search phrases developed included "*AI chatbots*" AND "*higher education*" AND "*academic performance*", "*ChatGPT*" OR "*generative AI*" AND "*student learning perception*", "*Artificial intelligence*" AND "*university students*" AND "*learning outcomes*", "*Conversational agents*" AND "*education*". After searching, a total of 100 articles were identified. An inclusion-exclusion criterion was also applied, narrowing the articles to 30. Articles were selected if they were written in English and available in full text, published between 2020 and 2025, and contained relevant information related to the topic of focus. Articles were excluded if they were not seminal literature and not published between 2019 and 2025, written in any language other than English, irrelevant to the research topic, or not peer-reviewed.

Review of Related Research and Literature

The three major themes explored in this literature review include: (1) Evolution and integration of AI in higher education, (2) AI chatbots as educational tools in Higher learning, and (3) students’ learning perceptions of AI chatbots.

Evolution and Integration of AI in Higher Education

From just a theory in computer science, artificial intelligence has evolved and contributed in transforming various fields, including education. The introduction of AI in higher learning has significantly changed how education is delivered, accessed, and evaluated (Bobro 2024; Bull et al., 2025).

Historical Evolution of AI in Education

The programmable computing technologies started advancing in the mid-20th century. It began in the 1940s when Allan Turing, recognized as the father of AI, expressed the concept of imagining that machines can think and respond like humans (Panda, 2024). The term "Artificial Intelligence" was then introduced in 1956 by John McCarthy while at the conference at Dartmouth. According to Bull et al. (2025), the historical development of AI and educational computing is interconnected. FORTRAN (FORmula TRANslation) was the first high-level programming language developed in the 1950s, particularly to be used by engineers to compute scientific tasks using mathematical notations instead of machine code. In 1959, John McCarthy contributed in advancing this language by introducing a LIST processing feature which allowed users to edit lists containing symbols such as words, sentences and numbers (Bull et al., 2025).

The advanced programming language was introduced for educational purposes in 1966 by Seymour Papert, who was the co-director of the MIT AI laboratory, Wally Feurzeig, and Cynthia Solomon. The three further enhanced the programming language to create Logo, recognized as the first programming language for children (Bull et al., 2025). More educational software started emerging in the 1960s and 1970s, signifying the rise of Computer-assisted learning (CAL). Programmed Logic for Automatic Teaching Operations (PLATO) is one of the notable software programs developed during that period (1960s-1970s). The software was developed at the University of Illinois and was utilized to help personalize learning through computer-based instruction (Panda, 2024). During the 1980s and 1990s, significant changes in technology were noted, making it sophisticated. Intelligent tutoring systems (ITS) and expert systems were developed to stimulate human expertise. Diagnostic software in medicine and mechanical problem-solving were some of the tools developed, which relied on rule-based AI to provide customized feedback and guidance (Panda, 2024).

The Evolution of Chatbots

Alan Turing introduced the concept of chatbots in the 1950s when he presented the Turing Test, which posed the famous question, “Can machines think?”. Through this challenge, Joseph Weizenbaum in 1966 developed the first chatbot called “ELIZA.” The chatbot was developed in the AI laboratory of MIT.ELIZA, to help mimic Carl Rogers’s psychotherapy techniques. ELIZA chat was used to mimic a therapist asking open-ended questions and follow-up trends (Davar et al., 2025). This advancement raised the interest of many developers who were eager to replicate the concept of human-mimicking interactions. The success of ELIZA marked a turning point in the use of natural language processing (NLP) and inspired the growth of the AI chatbot industry (Davar et al., 2025).

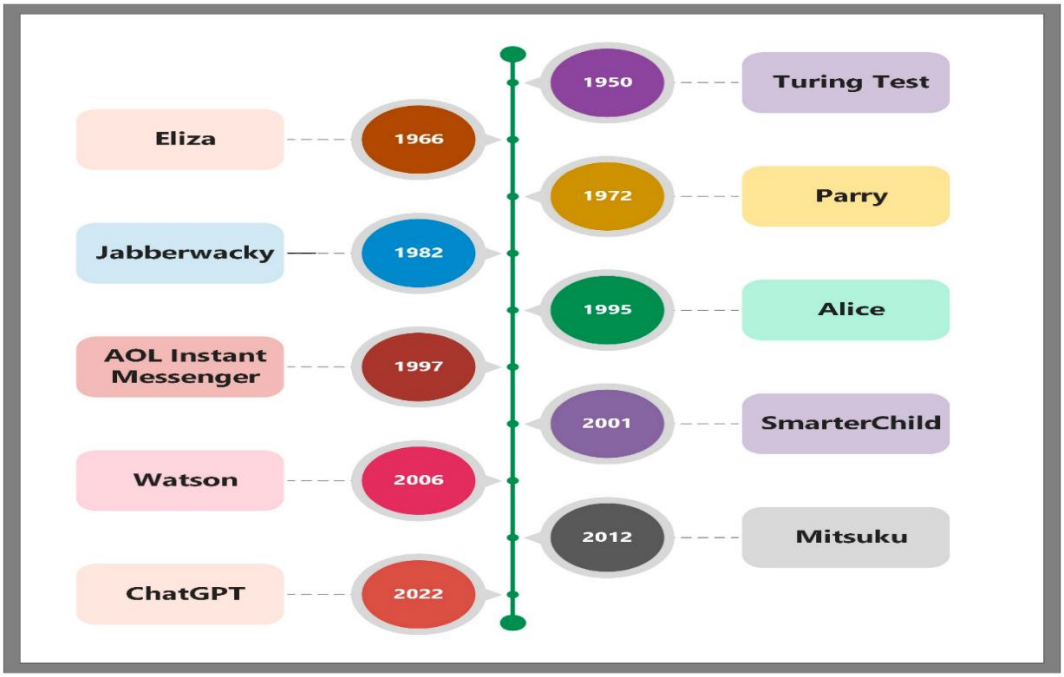
In 1972, another chatbot called PARRY was developed by Kenneth Colby. PARRY was a refinement of ELIZA (Davar et al., 2025; Bolarinwa et al., 2023). PARRY was more aggressive and confrontational compared to ELIZA, which was neutral, and it was nicknamed “ELIZA with an attitude.” PARRY was particularly used to mimic the conversation patterns of individuals diagnosed with paranoid schizophrenia. Another well-known chatbot, ALICE (Artificial Linguistic Internet Computer Entity), was made in 1995. This chatbot won the Loebner prize because it had special features that made it mimic human-like conversation. The chatbot was able to clearly define conversational rules and responses because of features such as pattern matching and the Artificial Intelligence Markup Language (AIML) (Davar et al., 2025; Bolarinwa et al., 2023). There were also more advanced technological developments in the early 2000s, which led to the creation of chatbots like SmartChild, which is thought to be a forerunner to modern digital assistants. More advanced systems in conversational AI, such as Apple’s Siri,

Google Assistant, Amazon Alexa, Microsoft Cortana, and IBM Watson, have been developed since then (Davar et al., 2025; Bolarinwa et al., 2023).

Mitsuku, which was developed by Steve Worswick in 2012, was another chatbot that stood out (Davar et al., 2025). The AIML-built chat was well-known for its conversational intelligence and capacity to hold users' attention in a natural dialogue. Since 2016, the chatbot technology evolved, and resulted in creation of various intelligent systems in different industries, including health care, education, and customer service (Davar et al., 2025). The introduction of the ChatGPT chatbot in 2022 marked a major transformation. The chatbot is powered by GPT-3.5 and natural language processing models, enabling it to offer human-like interactions (Davar et al., 2025) (see Figure 1).

Figure 1:

Evolution of Chatbots (Davar et al., 2025)



AI Chatbots as Pedagogical Tools in Higher Learning

The introduction of AI chatbots in higher education changed the learning experience. Machine learning algorithms integrated into these chatbots enabled these tools to provide personalized instructions and instant feedback because they processed and understood natural language. This section entails a review of literature highlighting how chatbots were used as educational tools, their effectiveness, and challenges.

Functionality of AI Chatbots in Education

AI-powered chatbots in education settings served two major functions: Administrative and educational support (Ajiniyaz et al., 2024; Aithal & Aithal, 2023). For administration support, the tools were leveraged to automate tasks that were regular, including sharing class schedules, course registration management, and providing answers to the frequently asked questions from students and faculty, particularly during enrollment. The technology is also significant to educators in reducing workload because it will be utilized to automate grading, making the evaluation of assignments easy (Bobro, 2024; Aithal & Aithal, 2023).

Learners' prior knowledge can also be evaluated by these AI-powered chatbots (adaptive), and then, based on the results, the tools adjust the level of difficulty of instructions to support the student educational experience (Aithal & Aithal, 2023). Students' self-regulated learning can also be supported by these chatbots because they provide real-time feedback, thus promoting independent study habits. The tools also have the capability of simplifying complex tasks by breaking them into small components to promote understanding (Aithal & Aithal, 2023). Completing homework assignments, studying, personalized learning, and developing skills are the three main ways students use AI chatbots, according to Labadze et al. (2023).

AI chatbot technology has been embraced by various higher institutions to promote student learning experience. Georgia State University is a good example of an institution that incorporated various AI chatbots into its systems. As reported by Tsoi and Strgnen (2024), Georgia University used an AI chatbot called "Pounce" to help with administrative tasks during the admissions process for new students. Roca et al. (2024) also noted that Georgia University made an AI-powered chatbot called "Jill Watson" in 2016 to help moderate forum posts from students who were taking a programming class. Students had a very positive view of the chatbots, and there was a noticeable increase in engagement. In programming courses, students used AI chatbots in six different ways: error detection and code debugging, enhancing conceptual understanding, generating and refining solution code, explaining programming logic, and solving mathematical problems (Groothuijsen et al., 2024). Roca et al. (2024) also highlighted that other schools, like the University of Murcia in Spain and Dian Nuswantoro, included "Quiroga Perez" and "Diana" chatbots in their systems to help answer questions from new students in matters pertaining to admissions.

Effectiveness of AI Chatbots in Enhancing Learning Outcomes and Academic Performance

The effectiveness of AI chatbots in improving student learning outcomes has been illustrated by various empirical studies. Integrating a pretest-posttest research design involving 68 participants, Essel et al. (2022) noted increased performance for students who had previously interacted with AI chatbots compared to those who had entirely engaged with the course instructor. Essel et al.'s (2022) study findings were further supported by Yusup (2023). Using a randomized control trial research design involving 65 undergraduate students, Yusup (2023) found that students in the experimental group who used the AI chatbots performed better than their counterparts in the control group, who only interacted with the course instructor. He further

emphasized that chatbots were a major innovation in improving learning outcomes, particularly in complex subjects such as multimedia programming.

To evaluate the impact of a digital game-based AI chatbot on students' Academic performance, higher-order thinking (including problem-solving, computational thinking, and creativity), and behavioral patterns in an information technology curriculum, Xu et al. (2024) used a quasi-experimental design. The authors discovered that the digital game-based AI chatbot markedly enhanced students' academic performance, problem-solving abilities, computational thinking, motivation to learn, and overall flow experience. There was no noticeable change in creativity. Xu et al. (2024) discovered that students who utilized more systematic learning strategies performed significantly better than those who relied on external assistance, such as consulting AI chatbots. In general, the authors found that AI chatbots could help students in information technology classes learn more and improve their higher-order thinking skills.

Unlike the findings of Essel et al. (2022), Yusup (2023), and Xu et al. (2024), Eteng-Uket et al. (2025) found no significant differences between AI chatbot usage and learning outcomes. Eteng-Uket et al. (2025) deployed a quasi-experimental analysis involving 186 students in higher education (90 in the experimental group and 96 in the control group) and found that the differences recorded between the groups were not significant. The author emphasized the need to use both the traditional instructional and AI chatbot approaches for optimal benefits. In addition, Bognár & Khine (2025) argued that while AI chatbots can provide initial benefits, their long-term ability to sustain engagement may decline over time due to difficulties in consistent integration or the diminishing novelty effect.

Challenges and Ethical Considerations

Despite the significance demonstrated by the incorporation of AI chatbots in higher learning, challenges have also identified. According to Stöhr et al. (2024), with the capability of AI chatbots to mimic students' work, educators find it difficult to differentiate between original work and AI-generated content, making it hard to offer genuine grades or prove learners' understanding and weaknesses. Other concerns are related to ethical, legal, copyright, data privacy, accuracy of the information, and unequal access to AI chatbots among all students (Davar et al., 2025; Stöhr et al., 2024).

Students' Learning Perceptions of AI Chatbots

Students' perceptions of AI chatbots are important in assessing the efficacy of their integration in educational contexts and their impact on student engagement and learning outcomes. Vanichvasin (2022) and Stöhr et al. (2024) emphasize that various factors, such as usability, reliability, ethics, and perceived usefulness, impacted whether or not students will use AI in their studies. This section contains evidence that shows how students thought about learning.

Stöhr et al. (2024) performed a quantitative study with 5,894 university students to investigate their adoption and utilization of various AI chatbots, including ChatGPT, Bing AI, Copilot, Bard AI, ChatSonic, and Socratic, in their educational processes. Stöhr et al. (2024) discovered that most students held ChatGPT in high regard, as it facilitated effective learning (p-value =0.000). The majority of students who expressed the highest levels of positive engagement with AI chatbots were from the Faculty of Engineering. Minimal engagement will be reported from students who were in the field of medicine and humanities. Most students (61.9%) expressed concerns about ethical and academic integrity because using chatbots to complete

assignments or examinations constituted cheating. This opinion was opposed by 58% of the participants, who emphasized that using chatbots did not undermine the purpose of education. Additionally, 60.3% did not agree with banning the use of AI chatbots in academic environments (Stöhr et al., 2024). Also, only 19.1% of students reported that their institutions had established rules for the responsible use of AI chatbots. Most students (54.2%) raised concerns about the future of AI chatbots on student learning (Stöhr et al., 2024).

Vanichvasin (2022) reported findings similar to those of Stöhr et al. (2024). Vanichvasin (2022) conducted a study with 24 first-year graduate students enrolled in a master's degree program in entrepreneurship education, revealing that the students had a favorable perception of chatbots. Students reported higher levels of satisfaction and learning outcomes (Mean = 4.65, S.D. = 0.44). The students stressed that using AI chatbots made learning fun, new, and interesting. Schei et al. (2024) conducted a scoping review methodology that synthesized 24 empirical studies published between January 1, 2022, and September 5, 2023, revealing that students regarded AI chatbots as advantageous. The tools helped them study well, finish personal tasks, and write and code. The analyzed articles by Schei et al. (2024) involved participants (students) from various disciplines, with the majority pursuing STEM courses.

Some groups of students have also criticized the use of AI chatbots. Schei et al. (2024) observed that certain students expressed apprehensions regarding the accuracy and reliability of the information produced by these tools. Some students said that using chatbots limited their ability to think critically, be self-disciplined, and be creative. Additionally, Hind et al. (2024), in their cross-sectional study of medical students, discovered that a significant majority of respondents (77%) exhibited apprehension regarding the utilization of AI chatbots. The fear originated from insufficient transparency concerning the utilization of personal data, with 66%

expressing concerns about diminished professional autonomy. Baek et al. (2023) also found that some students are reluctant to use AI chatbots because they are afraid of getting in trouble with the school by being accused of plagiarism and cheating. Other concerns raised were limited accessibility, worries of losing opportunities to learn and grow, and uncertainty of proper use.

Research Gaps

After a thorough review of the existing literature to guide the current study, three gaps were identified. The first gap is limited quantitative studies illustrating the influence of AI chatbot utilization on students' academic performance. Research by Essel et al. (2022) and Yusup (2023) emphasized the purported performance advantages of AI chatbots in STEM courses. There persisted a quantitative evidence deficiency regarding the statistical correlation between chatbot utilization and measurable academic performance, particularly in the comparison of STEM and non-STEM courses. The second limitation is the absence of a comprehensive analysis of both performance and student perceptions of AI chatbots. While Stöhr et al. (2024) investigated perceptions and Xu et al. (2024) assessed performance, no research directly evaluated whether favorable learning perceptions of chatbots predict enhanced academic outcomes. The third gap is limited quantitative research focused on ethical, motivational factors that influence students' perception and learning behaviors when using AI chatbots.

Theoretical Frameworks

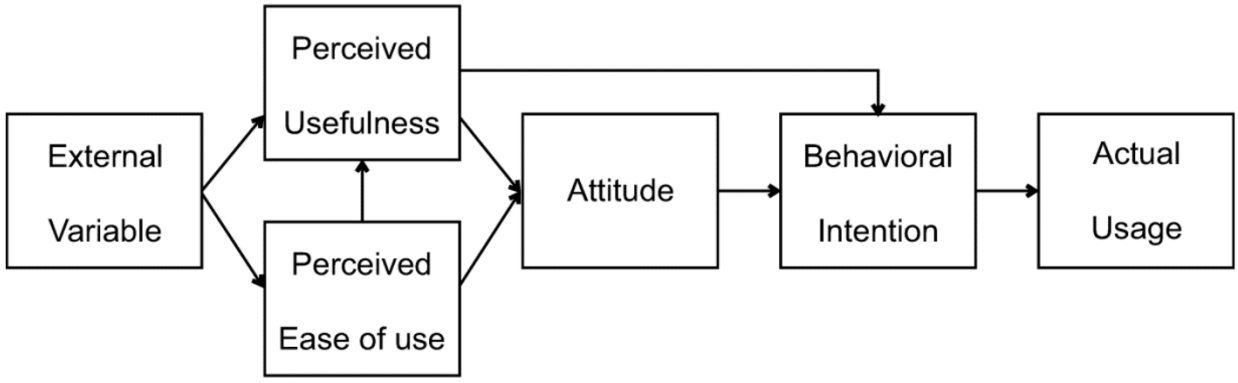
The Technology Acceptance Model (TAM) will be incorporated to guide this study. The TAM was proposed by Davis in 1987 to help study users' adoption of technological innovations (Davis, 1987). The TAM is critical in providing insight into how behavioral intention is formed. In its original formulation, the model emphasizes that an individual's attitude toward using a

system is influenced by two key beliefs: Perceived usefulness and perceived ease of use (Davis, 1987) (see Figure 2).

Perceived usefulness entails the extent to which an individual believed that using a specific system would enhance their performance. Perceived ease, on the other hand, is the level to which a person believed that interacting with the system would require minimal effort. These two factors influence the user's attitude toward the system and subsequently affect their attention to adopt it (Davis, 1987). In the current study, TAM can be incorporated to frame AI chatbot usage in higher education in terms of frequency and familiarity as predictors of academic performance (Quiz scores) and perception (self-reported learning outcomes), aligning with hypotheses one and two (H1: Students with greater familiarity and use of AI chatbots will have higher quiz scores, H2: Students with more positive perceptions of AI chatbots will report better self-assessed learning outcomes). The applicability of TAM to promote technology acceptance among individuals is supported by Mlekus et al.'s (2024) study. They found that perspicuity (H2a: $\beta = 0.67$, $f^2 = 0.66$) and dependability (H2b: $\beta = 0.16$, $f^2 = 0.04$) were significant predictors for the ease of use of technology in their study.

Figure 2

Technology Acceptance Model (Davis, 1987)



Summary

Various sources of literature highlighted the effectiveness of AI chatbots in transforming learning in higher education. Different AI chatbots, including ChatGPT, Gemini, and Copilot, were commonly incorporated to offer personalized learning, as research tools, and adaptive educational support. Evidence has highlighted the effectiveness of AI chatbot usage in higher education in promoting student engagement, self-regulated learning, and overall academic outcomes. Some studies concluded that AI chatbot usage had no significant impact on long-term learning and performance. Inability to distinguish between original work and AI-generated content, ethical and legal concerns linked to copyright, data privacy, the generation of incorrect information, and unequal access to all students were some of the critical challenges identified in relation to AI chatbot usage in higher education. Additionally, some of the elicited skepticism against AI chatbot usage includes negative effects on learning, such as limited critical thinking, self-discipline, and creativity. The three identified research gaps include limited quantitative evidence linking chatbot use to academic performance, a lack of integrated analysis of both performance and student perception of AI chatbots, and limited quantitative research focused on ethical and motivational factors that influence students' perception and learning behaviors when using AI chatbots. The research methodology, design, and procedures will be highlighted in Chapter 3.

Chapter 3: Methodology

The AI chatbot usage in higher education is on the rise. The AI chatbots are commonly used to promote student engagement and offer personalized support (El mourabit et al., 2025). However, according to Rafiq et al. (2024), barriers such as technical difficulties, restricted resource availability, and ineffective training prevent effective usage of these tools among students. In addition, other raised concerns about the integration of AI chatbots are linked to plagiarism, inaccurate information, ethical and integrity issues (El mourabit et al., 2025). Given these challenges, there is a need for further research to promote understanding of how students in higher learning perceive these tools and how they impacted academic outcomes. The purpose of this quantitative study is to evaluate the impact of AI chatbot usage on students' learning perceptions and academic performance in higher education. This chapter contains a discussion of the project design, sample setting, instrumentation, data collection, data analysis methods, and ethical considerations.

Project Design

A quantitative approach will be adopted for this project. Quantitative methodology will be the most ideal for this study for four reasons. First, quantitative methodology promotes high-level accuracy and objectivity (Zyoud et al., 2024). This approach promotes numerical data collection through structured questionnaires, critical for minimizing potential bias from the researcher and promoting consistency. Second, quantitative methodology allows extrapolation of the study sample findings to a larger population through the use of statistical methods (Zyoud et al., 2024), ensuring the study findings from the selected student sample can be generalized to the broader higher education population.

Third, quantitative methodology facilitates large-scale data collection and analysis. In the current study, large-scale data collection and analysis are important because they will enable the

researcher to effectively identify the trends, patterns, and relationships that may not be noted in qualitative data sets, which are usually small (Zyoud et al., 2024). Fourth, quantitative methodology allows systematic and objective measurement of relationships between various variables, thus aligning with the current study. In this study relationship between variables such as student familiarity with AI chatbots and quiz scores, AI chat perception, and self-assessed learning outcomes, and variations between STEM and non-STEM courses will be evaluated.

Additionally, a cross-sectional survey design will be incorporated in the study to collect data from participants at a single point in time (Wang & Cheng, 2020). This design allowed the researcher to evaluate the current relationships between AI chatbot usage, students' learning perceptions, and academic performance across various academic disciplines in the study site. The strengths of this design are that it will be cheap and relatively quick to conduct, and will be most effective in determining the prevalence, and will allow study of various exposures and outcomes (Wang & Cheng, 2020).

Sample and Setting

The study will be conducted at a private university located in the southeastern United States with a diverse student population. The institution is well known for offering a diverse academic environment, and most students are leveraging AI chatbot tools such as ChatGPT to enhance their learning experiences. Both undergraduate and graduate students from various academic fields, including those enrolled in the Artificial Intelligence in Product Innovation (AIPI) program, as well as students who have taken courses like Business Fundamentals for Engineers (MENG 570), Sourcing Data for Analytics (AIPI 510), and Modeling Process and Algorithms (AIPI 520), will be the target participants. To recruit participants, a convenience sampling approach will be utilized. Participants were selected based on their accessibility and availability. This non-probability technique allowed the selection of study participants from the

target population based on ease of access and will be cost-effective, simple to operate, and time-efficient (Golzar et al., 2022).

A prior power analysis will be conducted to determine the exact sample size for the primary analyses. Utilizing TTestIndPower (statmodels) with $\alpha = 0.05$, power = 0.80, and a presumed substantial effect (Cohen's d = 0.8) indicated that approximately 26 participants per group (STEM vs non-STEM courses), which were approximately 52, were needed to identify a between-groups difference (Kang, 2021). Considering smaller effect sizes typical in educational research, the final target sample will be increased to accommodate incomplete responses and allow subgroup analysis (Kang, 2021).

Instrumentation, Reliability, and Validity Tests

Information to evaluate the impact of AI chatbot usage on students' learning perceptions and academic performance will be collected through a self-reported questionnaire. The questionnaire was developed by the researcher under the guidance of existing literature, which includes four sections: (1) Demographic information and studying hours, (2) attitudes towards using Gen AI to learn, (3) attitudes towards their class performance, and (4) Objective assessments. The objective assessment includes a short quiz to test students' knowledge in specific subject areas, such as business, data, and modeling (see Appendix A).

The researcher will leverage various methods to enhance the validity of the questionnaire. For example, to ensure content validity, the researcher will consult a team of 3 to 5 subject matter experts. To improve face validity, a pilot test with a small group of students will be carried out to further refine the questions (Mason et al., 2020). The measurement scales that will be used in the study, particularly for assessing the students' AI chatbot perception (SQ8, SQ10, SQ11) and academic performance and perception (SQ13, SQ15, SQ17), will be evaluated for reliability

using Cronbach's alpha. The validity of the questionnaire will be determined using Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA).

Data Collection

Before beginning the data collection process, the researcher will first obtain approval from the university's Institutional Review Board (IRB). Once approved, the process of recruiting participants will begin. The recruitment process will involve contacting students through digital communication tools such as WhatsApp, GroupMe, and Discord. These platforms are commonly used by students for academic collaboration, which is why they are thought to be effective. The researcher will subsequently disseminate a link to a structured Google Forms questionnaire to students who consent to participate in the study. Participants will be guaranteed confidentiality and informed about their right to discontinue the data collection process at any time without facing consequences. The responses from participants will be automatically saved in Google Sheets and then extracted as a CSV file at the end of the data collection period for analysis.

Data Analysis Methods

The collected data will be analyzed using R Studio software version 4.5.1 to evaluate the impact of AI chatbot usage on students' learning perceptions and academic performance. This will be the best software because it is an open source and has a lot of packages that can be incorporated for quantitative research (Daswito et al., 2023). The extracted data from the Google Forms questionnaire will be cleaned to ensure that there are no missing values, outliers, or any other inconsistencies. Listwise imputation will be used to deal with outliers. To summarize the demographics of participants, descriptive statistics such as mean (M), frequencies (n), and standard deviation (SD) were used (Kotronoulas et al., 2023). Additionally, Pearson correlation analysis will be used to evaluate the relationship between study variables (chatbot usage, learning perception, and academic performance), while regression analysis will be utilized to

predict the effect of AI chatbot usage and perception on students' academic performance, considering academic major (STEM vs non-STEM) (Kotronoulas et al., 2023). The statistical significance will be set at $p < .05$.

Ethical Considerations

Throughout the study process, the researcher will ensure that ethical standards governing human subjects are adhered to (Capili & Anastasi, 2024). This consideration will include obtaining approval from the university IRB before starting to collect data. Informed consent will be included at the beginning of the online questionnaire, outlining the purpose of the study, potential benefits, and risks (Capili & Anastasi, 2024). Participants will be assured of their rights, including voluntary participation, withdrawal at any time without penalty, and confidentiality. No personal identifiers will be collected, and the information will be kept in a password-protected device accessible only by the researcher (Capili & Anastasi, 2024).

Summary

This study will adopt a quantitative cross-sectional survey approach. The methodology will be ideal for this study because it promotes high-level accuracy, allows extrapolation of study findings to a large population, and enables large-scale data collection and analysis of relationships between various variables. The study will be conducted at a private university located in the southeastern United States with a diverse student population, and power analysis will be conducted to determine the exact sample size. Self-reported Google form questionnaires will be utilized to collect information. Both descriptive and inferential statistics will be used to analyze the study findings using R Studio software. Descriptive statistics will be used to summarize participant demographics, while inferential statistics will help evaluate the impact of AI chatbot usage on students' learning perceptions and academic performance. Data analysis findings from these analyses will be presented in Chapter 4.

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Appendix A

Evaluating AI Chatbots' Impact on Student Learning in Universities

Thank you for agreeing to take part in this survey. My name is [Name], and I am conducting this research as part of my academic work at [University Name]. This questionnaire is designed to explore students' familiarity, perceptions, and use of AI chatbots such as ChatGPT, and how these factors relate to learning experiences and academic performance. The target audience for this study includes undergraduate and graduate students across both STEM and non-STEM disciplines. Your participation will help us better understand whether AI chatbots enhance learning outcomes and whether differences exist in how students from various academic backgrounds engage with these tools. Insights from this study may be used to guide educational institutions in integrating AI technologies to support student learning more effectively. The questionnaire will take approximately 5–10 minutes to complete. Your responses are anonymous and confidential, and no personally identifying information will be collected or reported. Please answer all questions as accurately and honestly as possible. Thank you for taking the time to contribute to this research.

General Demographic / Studying Hours Questions

SQ1. What's your **Student ID***?* _____
(Leave blank if not a student at the University)
SQ2. What's your **major**? _____
SQ3. Are you an **AIPI** Student at the University?

- Yes
- No

SQ4. Are you an **Undergraduate** or **Graduate** Student?

- Undergraduate
- Graduate

SQ5. Study Time Spent per day in **Hours**? ____
SQ6. How much do you feel you have participated **in class**?

- Not at all, 1, 2, 3, 4, 5, A lot!

SQ7. How much do you feel you use what you have learned **outside of class**?

- Not at all, 1, 2, 3, 4, 5, A lot!

The Attitude Towards Using Gen AI to Learn

SQ8. How comfortable are you with using generative AI tools like **ChatGPT** to assist with your learning?

- Very uncomfortable, 1, 2, 3, 4, 5, Very comfortable!

SQ9. In which **aspects** of your learning **have you used** generative AI tools?

- Writing Assignments
- Research
- General Problem-Solving
- Studying for Exams
- Other:_____

SQ10. How **frequently** do you use generative AI tools for **learning-related tasks**?

- Never, 1, 2, 3, 4, 5, Daily

SQ11. To what extent do you feel generative AI has **improved** your **academic performance**?

- Not at all, 1, 2, 3, 4, 5, A lot!

SQ12. What **concerns**, if any, do you have about using generative AI in your learning process?

- Accuracy of Information (Prevalence of Hallucinations)
- Ethical Concerns (Privacy)
- Dependency on AI
- No Concerns
- Other:_____

Students' Attitudes Towards Their Class Performance

SQ13. How would you rate your **overall academic performance** in the **past few weeks** of the semester?

- Poor, 1, 2, 3, 4, 5, Great!

SQ14. How have your **grades** in **assignments** changed as the semester has progressed?

- Improved
- Stayed mostly the same
- Declined
- Varied significantly across different subjects

SQ15. How closely do your current grades **align** with your **expectations**?

- Below expectations, 1, 2, 3, 4, 5, Above expectations!

SQ16. Have you noticed any specific **trends** in your **grades** across different subjects throughout the semester?

- Consistently strong in all subjects
- Strong in some subjects but weak in others
- I'm all over the place

SQ17. How much do you believe your study habits or external factors have **influenced** your **grades** this semester?

- Not at all, 1, 2, 3, 4, 5, A lot!

Objective Assessment

SQ18. If you are an AIPI student, indicate which class you feel you understand the most. (If you are not an AIPI student and have taken any of the following courses, indicate which one you feel you understand the most), otherwise, choose N/A.

- MENG 570 - Business Fundamentals for Engineers
- AIPI 510 - Sourcing Data for Analytics
- AIPI 520 - Modeling Process & Algorithms
- N/A

MENG 570 Questions (Business Fundamentals for Engineers)

Only fill this out if you indicated this to be your strongest subject!

BQ1. In the Lean Canvas, what is the purpose of the Unique Value Proposition (UVP)?

- To describe the top 3 problems customers face
- To define a clear, compelling message that differentiates your product
- To list your direct competitors and their weaknesses
- To outline how you will generate revenue

BQ2. What is the main role of early adopters in the Lean Start-Up approach?

- To buy the product in bulk and distribute it

- To provide feedback and help validate the product-market fit
- To fund the start-up during the early stages
- To advertise the product through word of mouth

BQ3. What does market segmentation help a business achieve?

- Increase the overall price of the product
- Reduce competition by controlling market share
- Target specific customer groups with tailored marketing strategies
- Develop more complex products to compete in larger markets

BQ4. According to the Lean Canvas, what is an "Unfair Advantage"?

- A temporary price cut to win over more customers
- A unique feature that cannot be easily copied or bought by competitors
- An agreement with a supplier to lower production costs
- A quick go-to-market strategy to capture market share

BQ5. What does "customer discovery" aim to achieve in the Lean Start-Up process?

- Identifying the most cost-effective channels for product promotion
- Understanding customer needs and validating business assumptions
- Recruiting early customers to invest in the business
- Testing the pricing strategy for different market segments

AIPI 510 Questions - Sourcing Data for Analytics

Only fill this out if you indicated this to be your strongest subject!

DQ1. What is the primary **purpose** of sourcing data for analytics?

- To generate reports based on past performance
- To collect data from various sources for analysis and decision-making
- To store data securely in a data warehouse
- To increase the speed of data retrieval

DQ2. Which of the following is a key **challenge** when sourcing data from external sources?

- Ensuring the data is in a compressed format
- Verifying the quality and accuracy of the data
- Using a specific programming language to access the data
- Limiting the number of external sources to reduce data load

DQ3. What is a common reason for using **APIs** in data sourcing?

- To create complex machine learning models
- To extract real-time data from various online platforms
- To store data in relational databases
- To encrypt data before analysis

DQ4. What is one advantage of using **web scraping** to source data for analytics?

- It provides structured data in a pre-organized format
- It can extract data from websites without needing API access
- It ensures 100% accuracy in the data
- It minimizes the legal concerns of using external data sources

DQ5. Which type of data source is best suited for **real-time analytics**?

- Batch processing systems
- Data lakes
- Streaming data sources

- Data warehouses

AIPI 520 Questions - Modeling Process & Algorithms

Only fill this out if you indicated this to be your strongest subject!

MQ1. What does the **'no free lunch theorem'** imply when it comes to algorithm selection?

- Some algorithms are better suited for all tasks
- No single algorithm performs best across all tasks
- Machine learning algorithms perform equally well on all tasks
- The simplest algorithm is always the best

MQ2. Which of the following is **NOT** a key assumption in linear regression models?

- The relationship between the inputs and the output is linear
- Errors have constant variance (homoscedasticity)
- There are significant multicollinearity issues in the data
- The errors are independent of each other

MQ3. In a **residual** plot, what does a 'hill-shaped' pattern of residuals indicate?

- The model is fitting the data perfectly
- The model is underfitting the data
- The model is violating the assumption of linearity
- The model has high bias and high variance

MQ4. When constructing a confidence interval, what does a **95% confidence level** mean?

- There is a 95% chance that the sample mean is within the interval
- The true population parameter lies within the interval 95% of the time
- The interval contains the true population parameter with 95% certainty
- 95% of the time, the sample mean will be outside the interval

MQ5. Which of the following is a common reason why a model might **underfit** the data?

- The model has too many parameters
- The model is too simple to capture the data's underlying patterns
- The model is overly complex and fits the noise in the data
- The model uses a high number of features relative to the sample size