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The Impact of Integration of AI in Statistics Learning on Student Motivation and Learning Engagement in Higher Education Sector

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Abstract

This study looks into how using ChatGPT in statistics classes affects students' participation and motivation in UAE higher education. A difficult subject that is frequently seen negatively, statistics can lower students' motivation and involvement. This study investigates how such integration might enhance students' learning experiences by utilizing ChatGPT, an AI-driven platform that offers interactive and tailored help. Regression analysis was used in a quantitative study design to evaluate the connection between ChatGPT integration and shifts in student involvement and motivation. University students were given a structured survey to complete in order to get data on their motivation and level of involvement after utilizing ChatGPT for their statistics assignment. The findings show that ChatGPT has a statistically significant beneficial impact on motivation and engagement, indicating that AI-based tools can be crucial in fostering a more encouraging and stimulating learning environment. By demonstrating ChatGPT's capacity to satisfy students' demands for independence and individualized instruction, these results advance educational theory in line with Self-Determination Theory. In order to improve learning results and student happiness in higher education, the study's managerial implications for educational institutions suggest using AI tools to boost student motivation and engagement.

Keywords: ChatGPT, Statistics Learning, Student Motivation, Learning Engagement

Introduction

According to Bukhatwa et al. (2023), statistics is a field of mathematics that focuses on gathering data, table-presenting it, creating graphical representations of mathematical facts, and determining acceptable measurements. Due to its significance, statistics has been incorporated into university curricula and is regarded as one of the required and foundational courses. The goal is to equip students with the knowledge and abilities necessary to apply statistics in their scientific and professional endeavors (Saddam, 2020). Statistical reasoning is regarded as the most important statistical skill that pertains to the student's manner of thinking about statistical concepts and comprehending statistical information (Rohana & Ningsih, 2020). It is defined as the capacity to interpret statistical concepts, processes, and results, identify relationships between them, and provide justification for their use (Al-Ganaam, 2018; Wahba *et al.,* 2024).

Statistics is regarded as one of the most significant and well-known fields (Garfield & Ben-Zvi, 2007). A subfield of applied mathematics known as statistics comprises theories and techniques focused on data collection and description, extrapolation, and decision-making (Zayed, 2007). Mathematical statistics and applied statistics, which are further subdivided into descriptive statistics and inferential statistics, are the two primary fields of statistics, which Moreno (1998) claims originated from probability theory (Gawad, Abdel-2021). Furthermore, by forecasting events using a variety of statistical studies, statistics are crucial in creating future strategies (Abdel-Barr, 2016). Thus, given the significance of statistics, Rohana and Ningsih (2020) stress the value of teaching statistics to students, and Al-Sarhani (2023) highlights the value of statistics education in helping students build the skills and competencies they need to manage their academic and professional lives in the digital age. According to Ben-Zvi and Makar (2016), teaching statistics is crucial for students' skill development because many real-world events call for statistical knowledge and abilities to enable them to interpret and analyze data in order to gain a clear understanding of numerous phenomena.

According to earlier research, students' performance in statistical reasoning remained subpar (Garfield, 1998; Tempelaar, 2004). In order to support the teaching of statistics, Biehler et al. (2013) proposed a future direction for the use of technology in fostering students' statistical reasoning. This includes a variety of technological tools, including spreadsheets, applications, multimedia materials, statistical software packages, and educational software. Additionally, a study of the literature shows how effective technology is at helping students strengthen their statistical reasoning (Wahba *et al.,* 2024). The rapid development of artificial intelligence technologies in the modern digital age presents both new potential and difficulties for the education industry. With the help of ChatGPT, a cutting-edge natural language processing technology, students may receive individualized instruction and learning support, which would increase their motivation and academic success. This study examines ChatGPT's effects on university students' motivation to learn and evaluates both its theoretical and practical implications (Zhou & Li, 2023).

Literature Review

According to Bromage et al. (2022), a lot of the major obstacles to teaching and understanding statistics stem from unfavorable perceptions about them. The findings of the studies show that students have a low level of statistical thinking (Chana et al., 2013) and that negative

attitudes predominate over their beliefs regarding this subject (Shtayyeh & Al-Sharaa, 2022), despite the importance of statistical reasoning and the belief that it is an essential learning objective that teachers strive to teach to their students (Sabbag et al., 2018). Many students struggle to understand statistics, even though they are crucial for everyday tasks including data analysis, conclusion-making, problem-solving, and future decision-making (Atwan, 2015¸ Chan & Ismail, 2013). Accordingly, Koparan (2015) identified a number of challenges in the study and instruction of statistics, including the complexity of statistical rules and students' anxiety brought on by the volume of data that necessitates various interpretations and specialized knowledge.

With a focus on the necessity of careful planning to integrate technology into the statistics learning process, some research have thus emphasized the significance of technology in comprehending statistical concepts (Ausat et al., 2023). There are more potential to grow and enhance the educational system the more artificial intelligence (AI) applications are deployed, according to recent trends in education (Mokhtar, 2020). Nowadays, one of the main forces behind sustainable growth is artificial intelligence (AI). AI technology makes it easier to be creative and innovative, which can help meet the Sustainable Development Goals (SDG). Since the development of a sophisticated AI-supported language model, ChatGPT has gained widespread usage across a range of industries, including education. Among the most significant are probably the disciplines of statistics in particular (Wahba *et al.,* 2024).

There are more potential to grow and enhance the educational system the more artificial intelligence (AI) applications are deployed, according to recent trends in education (Mokhtar, 2020). ChatGPT is arguably the most well-known and recent of these technologies. As a generative model, OpenAI created this conversational AI interface, which can produce new text depending on the input it gets (Hassani & Silva, 2023; Hill-Yardin, et al., 2023). ChatGPT has been utilized in a number of industries, particularly education. With its features and benefits, ChatGPT may support the educational sector in a number of ways (Biswas, 2023; Shidiq, 2023; Wahba *et al.,* 2024). Thus, various research emphasized the necessity of careful planning to integrate technology into the statistics learning process in order to explain the significance of technology in comprehending statistical concepts (Ausat et al., 2023).

Research Questions

The research questions guiding this study are strategically designed to address following key questions:

1. What is the impact of the integration of ChatGPT in statistics learning on student motivation in UAE Higher Education?
2. What is the impact of the integration of ChatGPT in statistics learning on learning engagement in UAE Higher Education?

Research Contribution

Numerous studies suggest that attempts to enhance statistical abilities must be directed and integrated, as there is a general lack of interest and weakness in teaching statistics in the Arab world (Hijazi & Alfaki, 2020; Abdel-Naim, 2020; Wahba et al., 2024). This research has theoretical significance since it offers a customized learning support program based on ChatGPT technology that can fit students' needs in terms of increasing their engagement and motivation to learn. New concepts and approaches for teaching design and practice in the

education sector are also offered by this study. In practical use, ChatGPT can improve learning results (Zhai & Center, 2023). Educational institutions can use ChatGPT, for instance, to create individualized learning support resources, give students timely, varied feedback and direction, assist them in comprehending and mastering material, and raise student motivation and engagement. Additionally, educators can use ChatGPT to develop individualized learning materials, give students more precise learning materials and assistance, and raise students' motivation and academic performance.

As an intelligent learning support and individualized teaching service, ChatGPT may provide university students with a variety of timely feedback and assistance, meet their needs for autonomy, competence, and relatedness, and improve their motivation and academic performance. In order to improve educational outcomes, this study also looks at the possible drawbacks of ChatGPT technology, how to mitigate them, and how to use it sensibly in teaching design and practice. As a result, ChatGPT technology has a lot of potential for use in the educational field and merits more investigation.

Research Framework and Hypothesis Development

Integration of ChatGPT in Statistics Learning and Student Motivation

The internal drive and motivation that university students create, sustain, and control their learning behavior during the learning process is referred to as learning motivation. It has a significant impact on students' academic happiness and learning success (Gopalan et al., 2017; Zhou & Li, 2023). The study results by Wahba *et al.* (2024) demonstrated the effectiveness of using ChatGPT in developing statistical reasoning and fostering positive attitudes toward statistics. These findings encourage statistics instructors to incorporate ChatGPT into their teaching methods and motivate students to utilize it in their learning of statistics (Wahba *et al.,* 2024). Good learning motivation has been shown to support students' increased attention, independence, and initiative during the learning process. Students' engagement with learning materials can boost their motivation and interest in the current technology environment (Heaven, 2020; Kuo et al., 2014). By enhancing engagement with students, ChatGPT can be used in the education sector to determine their learning objectives and areas of concentration. It can also help students become more motivated to learn (Mhlanga, 2023; Rudolph et al., 2023; Zhai & Center, 2023). Thus, more research is necessary to determine how ChatGPT affects students' motivation to learn (Zhou & Li, 2023).

For example, a study found that employing a chatbot that resembled a human and had a good social presence significantly increased the motivation of students to learn English as a second language (Ebadi & Amini, 2022). Similar results were obtained in a study by Chiu et al. (2023), which discovered that while instructor support and advice improved students' learning outcomes, using AI-based chatbots increased students' enthusiasm to learn (Zhou & Li, 2023). Based on the previous discussion, research hypothesis 1 is stated as:

H1*: The integration of ChatGPT in statistics learning has a positive influence on student motivation in UAE higher education.*

Integration of ChatGPT in Statistics Learning and Learning Engagement

Numerous research have been carried out with the goal of enhancing students' statistical literacy. The Gehrke et al. (2021) study concentrated on teaching data-centric statistics in tertiary education by rethinking the curriculum with a strong emphasis on the data-

generating process within the scientific inquiry, while Mubarak's (2015) study confirmed the need to focus on practical applications in teaching mathematics and statistics and use modern educational methods that employ technology in learning statistics, involve students in the lesson, and teach them to think. Examples of these methods include using various statistical programs like Excel and the Statistical Package for the Social Sciences (SPSS) and other statistical software. Using ChatGPT and Google Colab to find numerical solutions to mathematical equations was the goal of Seebut et al.'s (2023) study. The study showed that these applications could give students the ability to find numerical solutions to differential equations and that students had a high level of self-efficacy, so they worked on using these two tools to solve problems.

By creating individualized teaching plans and educational programs, improving learning engagement and experience, and offering timely and varied feedback and guidance through intelligent dialogue, ChatGPT, an intelligent learning support and personalized teaching service, can meet the autonomy, competence, and relatedness needs of university students (Zhou & Li, 2023). Additionally, ChatGPT technology may help students become more independent and efficient learners. To help students better understand and master knowledge, ChatGPT technology, for example, can provide individualized teaching services and learning support based on students' learning progress and ability levels. Through intelligent interaction and feedback, ChatGPT technology may simultaneously help students recognize their learning challenges and issues, enhancing their capacity for self-reflection and problem-solving (Zhou & Li, 2023). In light of the above conversation, research hypothesis 2 is expressed as follows:

***H2**: The integration of ChatGPT in statistics learning has a positive influence on learning engagement in UAE higher education.*

Research Methodology

The steps taken to examine the effects of integrating ChatGPT into statistics instruction on student engagement and motivation in UAE higher education are outlined in the Research Methodology. This study looked at the possible benefits of ChatGPT on motivation and engagement using a quantitative design and regression analysis. A sociodemographic factors table provides specifics about the sample's demographics. The sample consisted of university students in higher education in the United Arab Emirates, and information was collected on their motivation and engagement levels both before and after they used ChatGPT as a tool for studying statistics. Data was gathered using a structured survey that included questions designed especially to gauge how ChatGPT's use affected motivation and engagement. The sample included students from different majors at Abu Dhabi University. In order to address the study objectives and evaluate the hypotheses, sophisticated statistical methods—most notably regression analysis—were then employed to find connections between ChatGPT integration and student outcomes. This methodology offers a methodical way to assess how well ChatGPT works as a teaching tool to raise student engagement and motivation.

Finding

Descriptive Analysis

The study participants' demographic data is arranged by primary categories in the table titled "Table 1: Sociodemographic Variables": gender and age. Each category offers information about how participants are distributed across different attributes. According to the table,

there are 69 female participants, or 57% of the sample, and 52 male participants, or 43% of the total. This suggests that there were more female study participants. According to the age distribution, the bulk of participants—114, or 94.2%—are between the ages of 18 and 23. This suggests that the study is largely intended for younger people, perhaps students or those just starting their careers. There is little representation from senior people, as only 7 participants (5.8%) are 24 years of age or older. All things considered, the table offers a thorough summary of the participants' sociodemographic traits, emphasizing a youthful age group, and a preponderance of females. Table 1 presents Sociodemographic Variables.

Table 1
Sociodemographic Variables

Statement		***Frequency***	***Percentage***
Gender	Male	52	43%
	Female	69	57%
Age	18-23 years old	114	94.2%
	24 years and more	7	5.8%

Test Hypothesis 1

The research question 1 stated as "What is the impact of the integration of ChatGPT in statistics learning on student motivation in UAE Higher Education?" Table 2's regression analysis results show that using ChatGPT to teach statistics has a positive and statistically significant effect on students' motivation in higher education in the United Arab Emirates. The coefficient for ChatGPT integration is 0.263, which indicates that student motivation rises by 0.263 units for every unit increase in ChatGPT utilization. A high t-value (3.798) and a significance level of $p < 0.001$ support this link, indicating that the effect is unlikely to be due to chance. Furthermore, ChatGPT appears to have a moderately beneficial impact on motivation, as indicated by the standardized beta coefficient of 0.329. When ChatGPT is not integrated, the baseline motivation level is represented by the constant value of 3.363, which is similarly statistically significant. By showing that ChatGPT's integration into learning statistics considerably increases student motivation, these findings address the research question and suggest that the tool may offer an interesting, interactive learning environment that motivates students to take an active role in their education. Table 2 shows regression analysis results.

Table 2
Regression Analysis Results

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.363	.266		12.634	.000
	Integration of ChatGPT in Learning Statistics	.263	.069	.329	3.798	.000
a. Dependent Variable: Student Motivation						

Test Hypothesis 2

The research question 2 stated "What is the impact of the integration of ChatGPT in statistics learning on learning engagement in UAE Higher Education?" The findings of the regression analysis in Table 3 show that including ChatGPT into statistics instruction significantly improves students' learning engagement in higher education in the United Arab Emirates. With a coefficient of 0.392 for ChatGPT integration, learning engagement increases by 0.392 units for every unit increase in ChatGPT usage. A high t-value (4.378) and a significance level of $p < 0.001$ support this link, indicating that the effect is unlikely to be due to chance. Furthermore, ChatGPT appears to have a reasonably substantial impact on learning engagement, as indicated by the standardized Beta value of 0.372. The baseline level of involvement in the absence of ChatGPT integration is represented by the constant value of 2.265, which is likewise statistically significant. By showing that ChatGPT integration dramatically raises student involvement, our results provide an answer to the research question and suggest that it creates a more dynamic and captivating statistical learning environment. Table 3 shows regression analysis results.

Table 3
Regression Analysis Results

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.265	.345		6.574	.000
	Integration of ChatGPT in Learning Statistics	.392	.090	.372	4.378	.000
a. Dependent Variable: Learning Engagement						

Discussion Research Question 1

Building on previous research that emphasizes the motivational advantages of interactive learning aids, especially in difficult disciplines like statistics, the first study question investigates how ChatGPT integration in statistics learning affects student motivation in UAE higher education. AI tools like ChatGPT can improve statistical reasoning and cultivate positive attitudes, addressing typical unfavorable conceptions of statistics, according to previous study (Wahba et al., 2024; Bromage et al., 2022). Research shows that by providing tailored help and lowering learning anxiety, technology-driven settings boost motivation (Heaven, 2020; Kuo et al., 2014). Furthermore, according to Self-Determination Theory (SDT), ChatGPT and similar tools that offer tailored feedback and promote relatedness, competence, and autonomy can greatly increase motivation (Zhou & Li, 2023). Further evidence that AI-driven technologies can promote intrinsic motivation by facilitating self-directed, captivating learning experiences comes from Mhlanga (2023) and Zhai & Center (2023). According to the material currently in publication, ChatGPT may significantly contribute to improving motivation in statistics education by offering engaging, encouraging learning environments that meet the needs of students.

Discussion Research Question 2

In line with earlier research on AI's potential to improve student engagement in learning environments, the second research question asks, "What is the impact of integrating ChatGPT in statistics learning on student engagement in UAE Higher Education?" According to

research, AI tools can greatly increase student engagement, especially in difficult areas like statistics. While Gehrke et al. (2021) showed that a data-centric curriculum design promotes student involvement in statistics, Mubarak (2015) discovered that the use of educational tools like SPSS and Excel encouraged students to actively participate. According to Zhou & Li (2023), AI solutions like ChatGPT offer individualized, varied help that raises students' sense of autonomy and involvement. In a similar vein, Mhlanga (2023) emphasized how AI-powered solutions produce customized, engaging settings that promote engaged student engagement. According to these studies, integrating ChatGPT could have a significant impact on student engagement by fostering a dynamic and encouraging learning environment that inspires students to interact extensively with statistical material.

Theoretical Implications

This study's theoretical contribution is its investigation of ChatGPT as a cutting-edge learning aid, particularly in the teaching of statistics. By presenting ChatGPT as a personalized learning support tool that raises student motivation and engagement, especially in UAE higher education, the study fills in holes in the literature. By investigating how AI-driven, conversational interfaces like ChatGPT can affect student motivation and engagement, this study builds on preexisting theories and is based on educational psychology and learning theories. According to the study, ChatGPT can satisfy students' desires for autonomy, competence, and relatedness—all of which are fundamental components of Self-Determination Theory (SDT)—offering a fresh viewpoint on incorporating AI in education. ChatGPT supports an enhanced learning environment that inspires students and encourages active participation by attending to these demands. By offering insights into how individualized, interactive learning tools might transform conventional educational models and promote a deeper comprehension of difficult subjects like statistics, this theoretical framework creates new opportunities for leveraging AI technologies to serve educational aims. In conclusion, by showing how AI may change student experiences and engagement, this research advances educational theory and promotes more research into AI applications in a range of educational domains.

Managerial Implications

The study's managerial implications highlight the possible advantages of incorporating ChatGPT into learning environments, especially when it comes to improving statistics instruction in higher education. By giving students individualized academic support and prompt feedback that closes the gap between students and challenging course material, ChatGPT can enhance teaching tactics. Additionally, because ChatGPT's interactive features enable students to get more interested in their studies, program managers and administrators can use it to increase student motivation and engagement. By customizing support to meet the needs of each student, the platform also makes individualized learning easier and improves the quality of the educational process. Additionally, ChatGPT's capacity to provide immediate feedback might lighten the workload for teachers, freeing them up to concentrate on more in-depth facets of instruction. The study also emphasizes how crucial it is to train teachers to effectively use AI tools like ChatGPT so they can continue to be proficient in contemporary teaching techniques. Additionally, ChatGPT's integration supports sustainable and high-quality learning experiences, which is in line with education's larger sustainability objectives. When taken as a whole, these management implications offer school

administrators and decision-makers a road map for strategically utilizing AI to improve teaching quality, raise student engagement, and promote academic achievement.

Conclusion

This study highlights the significant impact of integrating ChatGPT into statistics learning on improving student motivation and engagement in UAE higher education. The findings reveal that the use of ChatGPT facilitates a supportive and interactive learning environment, which significantly enhances students' statistical reasoning and positive attitudes toward the subject. The study underscores the importance of adopting AI-driven tools like ChatGPT to address common learning challenges in complex subjects such as statistics. Based on these findings, educational institutions are encouraged to incorporate AI tools into their teaching strategies to foster active learning and motivation among students. Additionally, future research should explore the long-term implications of AI integration in various educational contexts, considering factors such as scalability and accessibility, to maximize its benefits in promoting student-centered learning experiences.

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