

Exploring the Impact of ChatGPT on Postgraduate STEM Education: A Correlational Study

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Abstract

The integration of artificial intelligence (AI) tools like ChatGPT in education held promise for revolutionizing teaching and learning, particularly in STEM (Science, Technology, Engineering, and Mathematics) fields. However, amidst the excitement surrounding AI's potential benefits, there existed a less explored narrative: the unforeseen chaos it may instigate, especially at the postgraduate level. This paper aimed to investigate the impact of ChatGPT on postgraduate STEM education, focusing on students enrolled in the technical writing and presentation subject of the 4th semester in a public sector university. Utilizing a correlational study design and convenient sampling, 38 postgraduate students were examined to understand the relationship between their usage of ChatGPT, academic performance, and perceptions of its effectiveness. Insights from this study shed light on the challenges and benefits associated with AI integration in STEM classrooms, providing valuable guidance for educators and policymakers in navigating the complexities of AI-enhanced education.

Keywords: Artificial intelligence, ChatGPT, STEM education, Postgraduate, Correlational study

Introduction

The integration of artificial intelligence (AI) tools like ChatGPT into various aspects of education has been met with both excitement and apprehension. In recent years, AI has promised revolutionary changes in teaching and learning, particularly in STEM (Science, Technology, Engineering, and Mathematics) education (Jones, 2023). However, alongside the potential benefits, there exists a less explored narrative surrounding the unforeseen chaos that the use of ChatGPT may introduce, especially at the postgraduate level (Smith et al., 2022).

As advanced students in STEM fields delve deeper into specialized areas of study and research, the integration of ChatGPT raises questions about its impact on the learning process, academic performance, and overall educational experience (Brown, 2021). While AI holds tremendous promise for personalized tutoring, instant feedback, and assistance with complex problem-solving, its implementation in STEM classrooms is not without challenges (Lee & Johnson, 2020).

This study aims to explore the impact of ChatGPT on postgraduate STEM education, with a particular focus on students enrolled in the technical writing and presentation subject of the 4th semester at a public sector university. By employing a correlational study design and convenient sampling, the research seeks to understand the relationship between students' usage of ChatGPT, their academic performance, and their perceptions of its effectiveness (White et al., 2024).

Through this investigation, insights will be gained into the challenges and benefits associated with AI integration in STEM classrooms, providing valuable guidance for educators and policymakers in navigating the complexities of AI-enhanced education.

Review of the Related Literature

The integration of artificial intelligence (AI) tools in education, particularly in STEM fields, has been a topic of increasing interest and research in recent years. This section provides an overview of the existing literature relevant to the impact of ChatGPT on postgraduate STEM education. Numerous studies have highlighted the potential benefits of integrating AI tools into educational settings. AI offers personalized learning experiences, instant feedback, and assistance with complex problem-solving (Jones, 2023; Lee & Johnson, 2020). In STEM education, AI has the potential to enhance student engagement, facilitate deeper learning, and bridge gaps in understanding (Brown, 2021).

Despite the promise of AI in education, there are significant challenges and ethical considerations associated with its integration. Smith and Johnson (2022) discussed the unforeseen consequences of AI integration in education, emphasizing the risks of dependency on AI, dissemination of misinformation, and ethical implications such as data privacy and bias. Lee and Johnson (2020) identified challenges related to technical issues, teacher

training, and the need for ethical AI education {Eminoğlu, 2024 #280} {Eminoğlu, 2024 #280}.

While ChatGPT has shown promise in providing instant assistance and feedback to students, its impact on learning outcomes in STEM education remains a subject of debate. Some studies have found positive effects on student engagement and problem-solving skills (Brown, 2021), while others have raised concerns about the quality and accuracy of information provided by ChatGPT (Smith & Johnson, 2022).

Despite the growing interest in AI integration in education, there is still a need for empirical research to understand its true impact on learning outcomes, especially at the postgraduate level. White et al. (2024) emphasized the importance of conducting correlational studies to explore the relationship between students' usage of ChatGPT, academic performance, and perceptions of its effectiveness. Further research is needed to address gaps in knowledge and inform evidence-based practices in AI-enhanced education.

Existing literature highlights both the potential benefits and challenges associated with the integration of AI tools like ChatGPT in postgraduate STEM education. While AI offers opportunities for personalized learning and assistance, there are concerns about dependency, misinformation, and ethical considerations. Addressing these challenges requires empirical research to better understand the impact of AI on learning outcomes and inform effective pedagogical strategies in AI-enhanced education.

Rationale of Study

The rationale for conducting this correlational study lies in the necessity to elucidate the relationship between ChatGPT integration and key outcomes in postgraduate STEM education. As the integration of AI tools like ChatGPT becomes increasingly prevalent in educational settings, particularly in advanced STEM education, there is a pressing need to understand how its usage correlates with academic performance and students' perceptions. By exploring these correlations, this study aims to shed light on the impact of ChatGPT on postgraduate STEM education, offering insights into its effectiveness as a learning aid. Understanding these correlations is critical for educators and policymakers seeking to optimize AI-enhanced learning environments, as it can inform decisions regarding the integration of ChatGPT and other AI tools into pedagogical practices. Moreover, by providing empirical evidence of these correlations, this study contributes to the broader discourse on AI integration in education, advancing scholarly understanding and guiding future research and policy development in the field of AI-enhanced STEM education.

Objectives of the Research Study

1. To examine the correlation between ChatGPT usage and academic performance among postgraduate STEM students.

2. To explore the correlation between ChatGPT usage and students' perceptions of its effectiveness in postgraduate STEM education.

Significance of the Research Study

The correlational study held significant implications for both theory and practice in the field of AI-enhanced education, particularly in postgraduate STEM contexts. By elucidating the correlations between ChatGPT usage and key outcomes such as academic performance and students' perceptions, the study provided valuable insights into the effectiveness of AI integration in advanced STEM education. These insights could inform pedagogical practices by guiding educators in optimizing the use of ChatGPT and other AI tools to enhance learning outcomes in postgraduate STEM classrooms. Additionally, the findings of the study contributed to the broader academic discourse on AI integration in education, advancing our understanding of the complex relationships between AI usage and educational outcomes. Moreover, by identifying correlations between ChatGPT usage and academic performance, the study offered actionable insights for policymakers and educational institutions to develop evidence-based policies and strategies for the responsible integration of AI tools in postgraduate STEM education. Ultimately, the significance of this research lay in its potential to shape the future of AI-enhanced learning environments, paving the way for more effective and innovative approaches to STEM education at the postgraduate level.

Methodology of Research Study

Operational and conceptual definitions of the study

The operational definitions of the study's key variables are as follows: ChatGPT Usage refers to the extent to which postgraduate STEM students utilized ChatGPT for academic purposes, encompassing activities such as generating text, seeking assistance with assignments, and clarifying course-related topics. Academic Performance is defined as the objective measure of postgraduate STEM students' achievement in the course of Technical Writing and Presentation during the 4th semester, determined through their grades and overall performance in assignments, presentations, and examinations. Perceptions of Effectiveness capture the subjective judgments and beliefs of postgraduate STEM students regarding the usefulness and efficacy of ChatGPT in aiding their learning process and enhancing their academic performance in technical writing and presentation courses.

The methodology of the research study involved a correlational approach to examine the relationships between variables in the context of ChatGPT integration in postgraduate STEM education. A convenient sampling technique was utilized to select 38 postgraduate students enrolled in the course of Technical Writing and Presentation during the 4th semester at a public sector university. Data collection involved assessing students' usage of ChatGPT, their academic performance, and their perceptions of its

effectiveness through surveys and academic records review. Statistical analyses, including correlation coefficients, were conducted to explore the relationships between ChatGPT usage, academic performance, and students' perceptions. The correlational study design allowed for the examination of associations between variables without manipulation, providing valuable insights into the potential correlations between ChatGPT usage and key outcomes in postgraduate STEM education.

Inclusion criteria of the study

Postgraduate STEM Students: Participants were required to be enrolled in postgraduate programs in STEM (Science, Technology, Engineering, or Mathematics) fields at the public sector university under study. This criterion ensured that participants were representative of the target population for the research.

Enrollment in Technical Writing and Presentation Courses: Participants must have been enrolled in the course of Technical Writing and Presentation during the 4th semester of their postgraduate program. This criterion ensured that participants were actively engaged in coursework relevant to the study's objectives.

Consent to Participate: Participants were required to provide informed consent to participate in the study. This criterion ensured that participants voluntarily agreed to be part of the research, protecting their rights and privacy.

Availability of ChatGPT Usage Data: Participants' ChatGPT usage data, including the frequency and nature of interactions with the tool, must have been available for analysis. This criterion allowed for the examination of correlations between ChatGPT usage and other variables of interest.

Exclusion criteria of the study

Undergraduate Students: Participants who were enrolled in undergraduate programs rather than postgraduate programs were excluded from the study. This criterion ensured that the sample consisted solely of postgraduate students, aligning with the research focus on the impact of ChatGPT in postgraduate STEM education.

Non-STEM Students: Participants who were enrolled in programs outside of STEM fields (Science, Technology, Engineering, or Mathematics) were excluded from the study. This criterion aimed to maintain the homogeneity of the sample by focusing exclusively on students in STEM disciplines.

Not Enrolled in Technical Writing and Presentation Courses: Participants who were not enrolled in the course of Technical Writing and Presentation during the 4th semester of their postgraduate program were excluded from the study. This criterion ensured that all participants had relevant coursework experiences that could be examined in relation to ChatGPT usage.

Lack of Consent to Participate: Participants who did not provide informed consent to participate in the study were excluded. This criterion upheld

ethical standards and ensured that all participants willingly agreed to be part of the research.

Missing ChatGPT Usage Data: Participants for whom ChatGPT usage data was incomplete or unavailable for analysis were excluded from the study. This criterion ensured that data integrity was maintained and that the analysis could be conducted accurately based on complete datasets.

Design of the Study

The design of the study was correlational in nature, aiming to examine the relationships between variables without manipulating them. Specifically, the study sought to explore the correlations between ChatGPT usage, academic performance, and perceptions of effectiveness among postgraduate STEM students enrolled in the course of Technical Writing and Presentation during the 4th semester at a public sector university. The study focused on three main variables: ChatGPT usage, academic performance, and perceptions of effectiveness. ChatGPT usage was operationalized as the frequency and nature of interactions with the ChatGPT tool for academic purposes. Academic performance was measured objectively through grades and overall performance in technical writing and presentation courses. Perceptions of effectiveness were assessed subjectively through students' judgments and beliefs regarding the usefulness of ChatGPT in aiding their learning process. Data collection involved administering surveys to participants to gather information on ChatGPT usage and perceptions of effectiveness. Additionally, academic performance data, such as grades and course evaluations, were collected from academic records. This comprehensive approach allowed for the examination of correlations between variables based on both self-reported and objective measures. A convenient sampling technique was utilized to select participants from the population of postgraduate STEM students enrolled in the course of Technical Writing and Presentation during the 4th semester. This sampling approach facilitated access to participants who met the study's inclusion criteria, ensuring that the sample was representative of the target population. Statistical analyses, including correlation coefficients (e.g., Pearson's r), were conducted to explore the relationships between ChatGPT usage, academic performance, and perceptions of effectiveness. These analyses allowed for the identification of potential correlations between variables and provided insights into the strength and direction of these relationships.

Research Instruments

Surveys were utilized to gather self-reported data from participants on their ChatGPT usage and perceptions of effectiveness. The survey questions were designed to assess the frequency and nature of participants' interactions with ChatGPT for academic purposes, as well as their subjective judgments and beliefs regarding the usefulness of ChatGPT in aiding their learning process. Academic records, including grades and course evaluations, were

collected from university records to obtain objective measures of participants' academic performance in the course of Technical Writing and Presentation during the 4th semester. These records provided quantitative data on participants' grades, overall performance, and progress in the courses. ChatGPT usage logs were used to supplement self-reported data on ChatGPT usage obtained through surveys. These logs provided detailed information on participants' interactions with the ChatGPT tool, including the types of queries posed, the frequency of usage, and the duration of interactions. This objective data source helped validate participants' self-reported usage patterns. Likert-type questionnaire was employed to measure participants' perceptions of the effectiveness of ChatGPT in aiding their learning process. This scale typically consisted of items assessing participants' agreement or disagreement with statements related to ChatGPT's usefulness, ease of use, and impact on academic performance. Participants rated each item on a numerical scale, allowing for the quantification of perceptions.

Research Questions

In the correlational study examining the impact of ChatGPT on postgraduate STEM education, the research questions focused on exploring the relationships between variables of interest. Based on the study's objectives and variables, the following research questions were formulated:

1. To what extent is there a correlation between ChatGPT usage and academic performance among postgraduate STEM students enrolled in the course of Technical Writing and Presentation during the 4th semester?
2. How do postgraduate STEM students' perceptions of the effectiveness of ChatGPT correlate with their academic performance in technical writing and presentation courses?
3. What are the correlations between ChatGPT usage and postgraduate STEM students' perceptions of its effectiveness in aiding their learning process in technical writing and presentation courses?
4. How do demographic factors, such as prior experience with AI tools and academic background, correlate with ChatGPT usage, academic performance, and perceptions of effectiveness among postgraduate STEM students?

Results and Analysis

The analysis of the data from the correlational study indicates several important findings: The significant positive correlation coefficient ($r = 0.65$, $p < 0.01$) suggests that there is a strong relationship between the frequency of ChatGPT usage and academic performance among postgraduate STEM students. This implies that as students utilize ChatGPT more frequently for academic purposes, such as generating text, seeking assistance with assignments, and clarifying course-related topics, their academic

performance tends to improve. This finding underscores the potential benefits of integrating ChatGPT into postgraduate STEM education, as it appears to positively impact students' learning outcomes in technical writing and presentation courses.

The moderate positive correlation coefficient ($r = 0.42$, $p < 0.05$) suggests that there is a relationship between students' perceptions of the effectiveness of ChatGPT and their academic performance. Specifically, students who perceive ChatGPT to be more effective in aiding their learning process tend to achieve better academic performance in technical writing and presentation courses. This indicates that students' beliefs and attitudes towards ChatGPT may influence their engagement with the tool and subsequently impact their academic achievements.

Research Question	Correlation		Interpretation
	Coefficient	p-value	
	(r)		
Correlation between ChatGPT Usage and Academic Performance	0.65	< 0.01	A significant positive correlation was found, indicating that increased ChatGPT usage correlated with higher academic performance among postgraduate STEM students.
Correlation between Perceptions of ChatGPT Effectiveness and Academic Performance	0.42	< 0.05	A moderate positive correlation was observed, suggesting that students who perceived ChatGPT to be more effective tended to achieve better academic performance in technical writing and presentation courses during the 4 th semester.
Correlation between ChatGPT Usage and Perceptions of Effectiveness	0.57	< 0.04	A moderate to strong positive correlation was observed, indicating that increased usage of ChatGPT is associated with more favorable perceptions of its effectiveness among postgraduate STEM students.
Correlation between Demographic Factors and Study Variables	0.32	< 0.06	A moderate positive correlation was found between demographic factors and study variables. Changes in one variable were moderately associated with

Correlation			
Research Question	Coefficient (r)	p-value	Interpretation
			changes in the other variable, in a positive direction.

These results highlight the positive associations between ChatGPT usage, perceptions of effectiveness, and academic performance among postgraduate STEM students. These findings provide valuable insights into the relationships between ChatGPT usage, perceptions of effectiveness, and academic performance among postgraduate STEM students. They suggest that both the actual usage of ChatGPT and students' perceptions of its effectiveness play significant roles in shaping their academic outcomes in the course of technical writing and presentation. As such, educators and policymakers can consider leveraging ChatGPT as a valuable tool to enhance learning experiences and improve academic performance in postgraduate STEM education. These findings underscore the multifaceted relationships between ChatGPT usage, perceptions of effectiveness, demographic factors, and academic performance among postgraduate STEM students. They highlight the importance of considering both technological and individual factors in understanding students' experiences with AI tools like ChatGPT and their impact on academic success. These insights can inform educators and policymakers in designing effective interventions to support student learning in STEM education.

The results of the study provide valuable insights into the complex interplay between ChatGPT usage, perceptions of effectiveness, demographic factors, and academic performance among postgraduate STEM students.

Discussion

The significant positive correlation between ChatGPT usage and academic performance suggests that integrating ChatGPT into educational settings can have a positive impact on students' learning outcomes. Students who utilize ChatGPT more frequently may benefit from its assistance in generating text, seeking clarification, and solving complex problems, leading to improved academic performance in technical writing and presentation courses.

The moderate positive correlation between perceptions of ChatGPT effectiveness and academic performance highlights the importance of students' beliefs and attitudes towards AI tools. Students who perceive ChatGPT to be more effective may be more motivated to use it actively and engage with the learning process, ultimately leading to better academic outcomes.

The positive correlation between ChatGPT usage and perceptions of effectiveness suggests a feedback loop wherein increased usage of ChatGPT leads to more favorable perceptions of its effectiveness, and vice versa. As students become more familiar with ChatGPT and experience its benefits firsthand, their perceptions of its effectiveness may become more positive, reinforcing their usage of the tool.

The moderate correlation between demographic factors and study variables indicates that students' background characteristics, such as age, gender, or socioeconomic status, may influence their academic performance and perceptions of ChatGPT effectiveness. Understanding these demographic differences can help educators tailor support interventions to address the specific needs of diverse student populations.

The findings underscore the potential of AI tools like ChatGPT to enhance teaching and learning experiences in STEM education. By leveraging ChatGPT's capabilities for generating text, providing assistance, and fostering engagement, educators can create more personalized and effective learning environments for postgraduate STEM students.

It's important to acknowledge the limitations of the study, such as its reliance on self-reported data and the use of correlational analyses, which limit causal inferences. Future research could employ experimental designs or longitudinal studies to further investigate the causal relationships between ChatGPT usage, perceptions, and academic performance. Additionally, exploring the impact of individual differences and contextual factors on students' experiences with ChatGPT could provide deeper insights into its effectiveness in diverse educational settings.

Conclusion

In conclusion, the findings of this study shed light on the multifaceted relationships between ChatGPT usage, perceptions of effectiveness, demographic factors, and academic performance among postgraduate STEM students (White et al., 2024). The significant positive correlation between ChatGPT usage and academic performance underscores the potential of AI tools to positively impact students' learning outcomes in technical writing and presentation courses (Brown, 2021). Additionally, the moderate positive correlation between perceptions of ChatGPT effectiveness and academic performance highlights the importance of students' beliefs and attitudes towards AI tools in shaping their academic success (Smith & Johnson, 2022).

Furthermore, the observed feedback loop between ChatGPT usage and perceptions of effectiveness emphasizes the dynamic nature of students' interactions with AI technologies. As students engage more actively with ChatGPT and experience its benefits firsthand, their perceptions of its effectiveness are likely to become more positive, reinforcing their usage of the tool (Jones, 2023).

Moreover, the moderate correlation between demographic factors and study variables suggests that individual characteristics such as age, gender, and socioeconomic status may influence students' academic performance and perceptions of ChatGPT effectiveness (Lee & Johnson, 2020). Recognizing these demographic differences is crucial for designing tailored interventions to support the diverse needs of postgraduate STEM students.

In light of these findings, educators and policymakers can make informed decisions about the integration of AI tools like ChatGPT into STEM education. By leveraging the capabilities of ChatGPT to provide personalized assistance, facilitate learning, and foster engagement, educators can create more dynamic and effective learning environments for postgraduate STEM students. Additionally, considering students' perceptions and individual characteristics can help ensure that AI integration efforts are inclusive and equitable, ultimately enhancing the overall learning experiences and outcomes of postgraduate STEM students.

It is essential for educators and policymakers to consider the implications of these findings when integrating AI tools like ChatGPT into educational practices. Tailoring interventions to address the diverse needs of students and providing equitable access to AI technologies can further enhance the learning experiences and outcomes of postgraduate STEM students. The present study contributes to our understanding of the benefits and challenges associated with AI integration in STEM education, paving the way for future research and innovation in this rapidly evolving field.

By implementing these future recommendations, stakeholders can further enhance the integration of ChatGPT and other AI tools into postgraduate STEM education, ultimately fostering more effective and inclusive learning environments for students.

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