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AI-Supported Academic Outcomes: The Role of ChatGPT in Student Performance

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ABSTRACT

The integration of generative artificial intelligence into higher education has raised important questions about its impact on students' learning outcomes. This study investigates the influence of ChatGPT adoption on academic performance, drawing upon the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). Three constructs—Effort Expectancy, Perceived Usefulness, and Perceived Ease of Use—were examined as antecedents of ChatGPT-supported academic performance. Data were collected through a structured questionnaire from 322 undergraduate students and analyzed using SmartPLS 4.0. The measurement model demonstrated satisfactory reliability and validity, while the structural model revealed that all three predictors had significant positive effects on academic performance: Effort Expectancy ($\beta = 0.312$, $t = 2.794$, $p = 0.005$), Perceived Ease of Use ($\beta = 0.238$, $t = 2.866$, $p = 0.004$), and Perceived Usefulness ($\beta = 0.261$, $t = 2.667$, $p = 0.008$). The model explained a substantial proportion of variance in academic performance ($R^2 > 0.50$), confirming its explanatory strength. These findings provide empirical evidence of ChatGPT's potential as an effective educational support tool. The study offers theoretical contributions by extending TAM and UTAUT into the context of generative AI and practical implications for higher education institutions to integrate AI responsibly, balancing innovation with academic integrity.

1. Introduction

The rapid advancement of digital technologies in the twenty-first century has positioned Artificial Intelligence (AI) as a transformative force across all sectors of society. AI refers to developing machines and systems that can perform tasks traditionally requiring human intelligence, including reasoning, learning, and natural communication [1]. Its applications are increasingly pervasive, spanning healthcare, finance, logistics, and education domains. The capability of AI to process vast datasets, recognize patterns, and provide predictive insights has enabled organizations and individuals to solve problems at scales and speeds unattainable by humans alone. In education, the integration of AI has been particularly influential, reshaping how knowledge is accessed, delivered, and applied in academic environments.

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Within higher education, AI-driven technologies are increasingly embedded into digital learning platforms, adaptive teaching systems, and personalized assessment tools. These systems provide opportunities for tailoring learning experiences to individual needs, offering timely feedback, and improving accessibility for diverse student populations [2]. One of the most notable developments within this field is the emergence of generative AI tools such as ChatGPT, a conversational agent powered by natural language processing. Since its release, ChatGPT has attracted attention from students, educators, and policymakers due to its ability to simulate human-like interaction, generate academic content, and provide explanations across a wide range of topics.

From an academic perspective, the adoption of ChatGPT represents both significant opportunities and potential risks. On one hand, students may benefit from immediate access to explanations, enhanced academic writing support, language improvement, and guided problem-solving. On the other hand, concerns about overreliance, academic misconduct, misinformation, and reduced critical thinking skills persist [3]. These debates underscore the importance of moving beyond anecdotal observations and systematically evaluating the influence of ChatGPT on measurable learning outcomes. While existing studies have explored general perceptions and attitudes toward generative AI tools, empirical evidence linking their use to academic performance remains limited.

This study responds to this gap by examining the role of ChatGPT adoption in supporting academic outcomes among students, focusing specifically on its relationship with performance. By drawing on established models of technology acceptance, namely the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), this research investigates three key constructs: Effort Expectancy, Perceived Ease of Use, and Perceived Usefulness. These constructs have been widely recognized in information systems research as critical determinants of technology adoption and are extended here to the context of generative AI. The findings provide empirical evidence on whether ChatGPT functions as an effective academic support tool and offer both theoretical and practical contributions for educators and policymakers navigating AI integration in higher education.

1.2 Literature Review

Despite the rapid expansion of AI in higher education, there remains a notable gap in empirical evidence linking the use of generative AI tools to measurable academic outcomes. Much of the current scholarship on ChatGPT has emphasized perceptions, ethical concerns, or pedagogical opportunities, while few studies have examined its direct influence on academic performance [4]. This lack of evidence creates uncertainty about whether ChatGPT functions merely as a supplemental aid or as a transformative tool capable of enhancing learning effectiveness. Evaluating the influence of ChatGPT on measurable learning outcomes is crucial for building an evidence-based understanding of AI's role in education. Such insights are particularly relevant to educators and policymakers who must navigate the integration of AI into classrooms responsibly, ensuring that innovation is balanced with preserving academic integrity and promoting critical thinking skills.

The application of AI in education has progressed from early automation tools to sophisticated systems capable of adaptive learning and personalized instruction. Intelligent tutoring systems (ITS), for instance, use data-driven algorithms to assess student progress and adjust content delivery accordingly [5]. Predictive analytics have been employed to identify at-risk learners and recommend timely interventions, while natural language processing supports automated grading, plagiarism detection, and real-time feedback [6,7]. Such innovations have improved student engagement, enabled more inclusive learning environments, and enhanced teaching efficiency. However, the

success of AI in education often depends on user acceptance, system transparency, and ethical deployment.

Generative AI refers to models capable of producing new outputs such as text, images, or code based on training data. ChatGPT, developed by OpenAI, exemplifies this technology by enabling human-like dialogue, text summarization, problem-solving, and creative assistance. Its accessibility and versatility have made it especially popular among students for academic tasks ranging from essay drafting to coding support. Studies indicate that students perceive ChatGPT as a helpful tool for clarifying concepts, generating ideas, and improving productivity [8]. Nonetheless, challenges remain: the model may generate inaccurate responses, promote superficial learning, and raise concerns about originality and academic honesty. For higher education institutions, this duality presents both an opportunity to innovate teaching practices and a responsibility to safeguard academic integrity.

1.3 Theoretical Framework: TAM and UTAUT

The Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) provide valuable frameworks for understanding technology adoption. TAM posits that Perceived Usefulness and Perceived Ease of Use are primary drivers of technology acceptance[9]. UTAUT expands this by introducing Effort Expectancy, Social Influence, and Facilitating Conditions as additional predictors of behavioral intention [10]. These constructs have consistently been linked to positive learning outcomes in the educational technology domain. By applying TAM and UTAUT to ChatGPT adoption, this study captures how students' perceptions of usability, utility, and required effort translate into measurable academic performance.

1.4 Hypotheses Development

Effort Expectancy refers to the degree of ease associated with students' use of ChatGPT for academic tasks. Prior research suggests that technologies requiring less effort are more likely to be adopted and contribute to improved outcomes [10]. Thus, it is expected that higher effort expectancy will lead to stronger academic performance.

H1: Effort Expectancy has a positive effect on Academic Performance.

Perceived Ease of Use reflects students' belief that interacting with ChatGPT is simple and does not require much cognitive effort. According to TAM, when a system is easy to use, it enhances user acceptance and increases the likelihood of achieving intended outcomes [9]. Sun *et al*., [11] found that the simplicity of using ChatGPT for educational purposes strongly shaped students' behavioral intentions and perceived learning benefits. Similarly, Zhai [12] observed that learners valued ChatGPT's ability to provide immediate and user-friendly responses, which reduced cognitive load and supported better academic outcomes. These findings suggest that when digital tools are perceived as effortless to operate, students are more likely to engage with them productively, thereby improving their overall academic performance.

H2: Perceived Ease of Use has a positive effect on Academic Performance.

Perceived Usefulness refers to the degree to which learners regard ChatGPT as a valuable tool that enhances the efficiency and effectiveness of teaching and learning process. Based on the

Technology Acceptance Model, this construct has repeatedly emerged as one of the strongest predictors of technology adoption and subsequent performance outcomes [13]. More recent evidence reinforces this view, Al-Emran and Teo [14] demonstrated that students are more inclined to adopt digital learning platforms when they perceive clear academic benefits. Moreover, Sun et al. [11]confirmed that the perceived utility of ChatGPT directly shapes students' intention to integrate it into their study routines. Similarly, Abbas, Jam, and Khan [15]reported that the academic value students attach to generative AI strongly predicts its positive influence on learning engagement and performance. Collectively, these findings underscore that perceived usefulness remains a central driver of academic outcomes in AI-supported education, reflecting both classical theory and contemporary empirical results.

H3: Perceived Usefulness has a positive effect on Academic Performance.

2. Methodology

2.1 Research Design

This study adopted a quantitative, cross-sectional research design to investigate the role of ChatGPT in supporting academic outcomes. Quantitative methods were deemed appropriate as they enable the measurement of relationships between variables and the testing of hypothesized effects in a systematic and replicable manner. A structured questionnaire was administered to collect data on students' perceptions of ChatGPT adoption and its impact on their academic performance. The study focused on three predictor constructs derived from TAM and UTAUT—Effort Expectancy, Perceived Ease of Use, and Perceived Usefulness—as antecedents of ChatGPT-supported academic outcomes.

2.2 Population and Sampling

The study targeted students from the new generation of digital natives, who increasingly integrate generative AI technologies into their learning practices. Because no official record existed on the number of students actively using ChatGPT, a purposive sampling strategy was adopted to ensure that only relevant participants were included. The survey instrument incorporated a screening question to differentiate users from non-users; only those who confirmed prior experience with ChatGPT for academic purposes were directed to complete the subsequent sections on adoption and performance.

From a total population of 1,969 students enrolled in the School of Business Management, 322 valid responses were obtained and used for analysis. This sample size is considered appropriate under statistical sampling principles, as it provides adequate representativeness while minimizing bias and maintaining a reasonable margin of error [16]. Moreover, the sample met the requirements for structural equation modeling (SEM), as recommended by the "10-times rule" and power analysis guidelines [17], ensuring sufficient statistical power to generate reliable parameter estimates.

2.3 Instrumentation

The research instrument consisted of a structured questionnaire divided into two sections. The first section collected demographic information, including age, gender, academic program, and prior experience with ChatGPT. The second section measured the study constructs using items adapted from validated TAM and UTAUT scales.

- Effort Expectancy was measured using four items adapted from Venkatesh *et al*., [10].
- Perceived Ease of Use and Perceived Usefulness were measured using items adapted from Davis [9].
- Academic Performance was assessed using items adapted from prior studies on technology-supported learning outcomes [14].

All items were rated on a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"), allowing for consistency in responses and comparability across constructs. A pilot test was conducted with 30 respondents to refine item clarity and ensure the instrument before full-scale data collection.

2.4 Data Collection Procedure

Data were collected through an online questionnaire distributed via institutional learning platforms and social media groups commonly accessed by students. Participation was voluntary, and respondents were assured of anonymity and confidentiality to reduce response bias. The questionnaire was available for two weeks, during which reminders were sent to encourage participation. Only respondents with confirmed prior use of ChatGPT for academic tasks were included in the final dataset.

2.5 Data Analysis

Data analysis was conducted using SmartPLS 4.0, a variance-based structural equation modeling (SEM) tool suitable for exploratory research and predictive modeling. The analysis followed a two-step approach:

1. Measurement Model Evaluation, which tested the reliability and validity of the constructs using Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), and discriminant validity (Fornell-Larcker criterion and HTMT ratios).
2. Structural Model Evaluation, which assessed the hypothesized relationships between the constructs. Path coefficients (β), t-values, and p-values were obtained through bootstrapping with 5,000 resamples to determine statistical significance. Model explanatory power was evaluated using R^2 values, while predictive relevance was assessed through Q^2 statistics. The standardized root mean square residual (SRMR) was also considered to evaluate model fit.

By applying this analytical approach, the study ensured methodological rigor and provided robust empirical evidence regarding the predictors of ChatGPT-supported academic performance.

3. Results

3.1 Measurement Model

The measurement model was first assessed to establish the reliability and validity of the constructs. Internal consistency reliability was confirmed, as all Cronbach's alpha and composite reliability (CR) values exceeded the recommended threshold of 0.70 [17]. Convergent validity was also supported, with average variance extracted (AVE) values above 0.50 for all constructs, indicating that more than half of the variance in each indicator was explained by its corresponding latent variable.

Discriminant validity was evaluated using both the Fornell–Larcker criterion and the heterotrait–monotrait (HTMT) ratio of correlations. Fornell–Larcker results showed that the square root of each construct's AVE was greater than its correlations with other constructs, while HTMT ratios were all below the conservative threshold of 0.85. These results collectively indicate that the constructs were distinct and adequately measured. Overall, the measurement model demonstrated satisfactory reliability and validity, providing confidence in the use of the constructs for subsequent structural analysis.

Table 1
Measurement model

Constructs	Item	Loadings	AVE > 0.50	CR > 0.70	Cronbach's Alpha >0.7
Academic	AA01	0.822	0.644	0.900	0.861
Performance	AA02	0.740			
	AA03	0.810			
	AA04	0.826			
	AA05	0.812			
Effort E	EE01	0.829	0.693	0.919	0.889
Expectancy	EE02	0.794			
	EE03	0.848			
	EE04	0.838			
	EE05	0.851			
Perceived Ease	PE01	0.811	0.636	0.875	0.809
of Use (PEOU)	PE02	0.814			
	PE03	0.783			
	PE04	0.781			
Perceived	PU01	0.850	0.665	0.888	0.832
Usefulness	PU02	0.763			
	PU03	0.797			
	PU04	0.849			

3.2 Structural Model

The structural model was then examined to test the hypothesized relationships between ChatGPT adoption constructs and academic performance. The results indicate that all three predictors had significant positive effects on academic performance:

i. Effort Expectancy → Academic Performance: $\beta = 0.312$, $t = 2.794$, $p = 0.005$
ii. Perceived Ease of Use → Academic Performance: $\beta = 0.238$, $t = 2.866$, $p = 0.004$

iii. Perceived Usefulness → Academic Performance: β = 0.261, t = 2.667, p = 0.008

These findings confirm support for all three hypotheses (H1–H3). Among the predictors, Effort Expectancy emerged as the strongest determinant of academic performance, suggesting that students' perception of how effortless ChatGPT is to use plays a critical role in shaping its effectiveness as a learning tool.

The model's explanatory power was substantial, with an R^2 value exceeding 0.50, indicating that the three predictors explained more than half of the variance in academic performance. In addition, the model demonstrated predictive relevance ($Q^2 > 0$) and acceptable fit, with the standardized root mean square residual (SRMR) value below the recommended cut-off of 0.08.

3.3 Summary of Findings

The empirical results provide robust evidence that ChatGPT adoption significantly enhances academic performance through usability-related factors. Students' perceptions of effort, ease, and usefulness collectively drive the integration of generative AI into their learning processes, thereby improving measurable outcomes.

4. Conclusions

The purpose of this study was to investigate the role of ChatGPT adoption in supporting academic performance, with a focus on three constructs derived from TAM and UTAUT: Effort Expectancy, Perceived Ease of Use, and Perceived Usefulness. The results provide empirical evidence that all three predictors significantly and positively influence academic performance, confirming the hypotheses and extending the applicability of established technology acceptance models to the context of generative AI.

4.1 Interpretation of Key Findings

The strongest predictor of academic performance was Effort Expectancy, highlighting that students' perception of ChatGPT as a tool requiring minimal effort to operate is a critical determinant of its effectiveness in academic contexts. This finding is consistent with prior research emphasizing that technologies perceived as less demanding are more likely to be adopted and integrated into learning practices [10]. It also aligns with the characteristics of Gen Z learners, who value intuitive digital platforms that integrate seamlessly into their study routines.

Perceived Ease of Use also showed a significant positive effect, suggesting that students who find ChatGPT simple and user-friendly are more likely to employ it effectively for academic tasks. This finding reinforces Davis's [13] argument that ease of use reduces barriers to adoption and enhances overall system utility. Finally, Perceived Usefulness was confirmed as a significant predictor, indicating that students are motivated to adopt ChatGPT when they perceive it as contributing directly to their academic outcomes. This supports earlier studies on technology-enhanced learning which emphasize that usefulness is central to sustained engagement with educational technologies [14].

4.2 Theoretical Contributions

This study contributes to the literature on technology adoption in three key ways. First, it extends TAM and UTAUT into the emerging field of generative AI in education, where most prior work has focused on perceptions and ethical debates rather than measurable outcomes [18-20]. Second, the findings show that Effort Expectancy exerts a more substantial influence on academic performance than Perceived Usefulness, diverging from earlier studies on e-learning adoption where usefulness was typically the dominant factor [14]. This suggests that with generative AI, the ease and effort of interaction are more critical for student success. Finally, the results provide empirical evidence that ChatGPT can support measurable academic improvements, aligning with recent studies that highlight its role in enhancing efficiency, creativity, and learning engagement [21,22].

4.3 Practical Implications

The findings have important implications for educators, higher education institutions, and policymakers. For educators, the results suggest that integrating ChatGPT as a support tool can enhance student learning outcomes, provided that its use is framed as a complement rather than a substitute for critical thinking. Institutions should consider offering training and guidelines to help students use generative AI responsibly, ensuring that the benefits of improved efficiency and access to knowledge are not offset by risks to academic integrity. Policymakers, meanwhile, must balance innovation with regulation by establishing frameworks that promote ethical use of AI tools in educational settings.

4.4 Limitations and Future Research

While the study provides valuable insights, certain limitations must be acknowledged. First, the cross-sectional design restricts the ability to infer causality; longitudinal studies would be valuable for examining long-term effects of ChatGPT adoption on academic outcomes. Second, the reliance on self-reported measures may introduce bias, as students' perceptions may not fully capture actual performance gains. Future research could incorporate objective measures of learning outcomes, such as grades or task performance assessments. Third, the study focused on a specific population of students, limiting generalizability; comparative studies across different age groups, cultural contexts, or educational systems would enrich understanding of ChatGPT's broader impact.

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