The Perspectives of Undergraduate Students on the Effects of Generative AI on Academic Achievement

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***Abstract*—With the growing integration of generative Artificial Intelligence (AI) tools such as ChatGPT, Claude, DeepSeek, and Gemini in higher education, understanding their impact on undergraduate learning has become increasingly essential. This study investigated how students in the United Arab Emirates perceive the academic influence of generative AI, drawing on data from 1260 undergraduate survey responses. Utilizing the Generative AI Academic Impact Scale (GAI-AIS), the research explored students' frequency of AI use, self-rated proficiency, perceived academic benefits, and ethical considerations. Statistical analyses, including Analysis of Variance (ANOVA), Pearson correlation, and multiple linear regression, revealed that frequent AI use and greater conceptual understanding were positively associated with academic performance. However, a negative relationship between self-rated proficiency and Cumulative Grade Point Average (CGPA) suggested possible overconfidence or misalignment between perceived and actual skills. Thematic analysis of open responses indicated that students predominantly use AI for writing support, test preparation, and clarification of academic concepts. In response to these findings, the study proposes the development of an AI-Based Academic Support System (AI-BASS), a centralized, curriculum-aligned platform designed to facilitate structured, ethical, and pedagogically grounded AI use in undergraduate education. By promoting responsible engagement, enhancing digital literacy, and safeguarding academic integrity, AI-BASS offers a forward-thinking framework for integrating generative AI within higher education. These insights contribute to broader discussions on AI in academia and inform institutional policies and curriculum design.**

***Keywords*—generative-Artificial Intelligence (AI), academic performance, student's perception, academic integrity, curriculum development**

I. Introduction

The rapid emergence of generative Artificial Intelligence (AI) technologies, such as ChatGPT, Claude, Gemini, and Deepseek, is transforming the landscape of higher education. These tools offer exciting possibilities for personalized learning, immediate feedback, and support with academic tasks, yet they also raise pressing ethical and pedagogical questions [1, 2]. In academic contexts that prioritize critical thinking, integrity, and independent learning, the rise of AI calls for close scholarly attention [3]. Recent research highlights how students are integrating AI into their academic routines, using it to draft assignments, analyze data, and explore complex topics [4–6]. Some studies even suggest that generative AI tools can support academic literacy by helping students clarify concepts and organize research [7]. However, this increasing reliance may also undermine students' critical thinking and problem-solving abilities, especially when used to generate essays or paraphrase content without deep engagement [8, 9]. A recent empirical study found that over 40% of university students regularly use AI tools in their coursework, prompting growing concern over academic authenticity and potential misuse [10].

The impact of generative AI on learning is nuanced. On the one hand, these technologies offer powerful support tools; on the other, they can introduce bias, misinformation, or over-dependence if not used critically [11–13]. Institutional responses vary, while some universities restrict AI use, others advocate for embedding AI literacy into the curriculum to teach responsible use, citation practices, and critical evaluation of AI outputs [14, 15]. This evolving landscape requires educators, policymakers, and researchers to work collaboratively to develop balanced approaches that maximize benefits while minimizing risks. Despite increasing attention, there remains a gap in empirical research exploring how generative AI affects students across disciplines, particularly at the undergraduate level and across entire academic programs. Understanding students' experiences and attitudes toward these tools is essential to inform teaching practices, assessment methods, and academic policies that align with the ethical and educational challenges posed by AI.

Research Question: How do undergraduate students perceive the impact of generative AI tools on their academic performance and ethical awareness?

II. Literature Review

ChatGPT, Deepseek, Claude and Gemini have gained a lot of attention due to their fast development among higher education specialists. These new resources include academic support, summary, instant feedback and visual explainer which have improved how students deal with educational content [16]. Some studies have verified that they can make learning more tailored, boost academic achievement and simplify the process of understanding hard topics [17] Even so, this potential raises issues related to ethics and the way kids are taught. Specialists warn that overusing AI may limit students' ability to think on their own, raise the amount of cheating and make students declare work from AI programs as their own [2]. When students are not capable of properly reviewing data, chances for misuse of generative systems grow due to fake information and "hallucinations" [18, 19].

A study by Qawqzeh [13] followed up on the debate by doing an in-depth study using 515 participants that investigated how ChatGPT affects cognitive and learning skills. The research indicated that critical thinking, creativity

and learning were influenced in different ways among students, with some saying they improved their problem-solving skills and others reporting small improvements. It is important that the findings highlighted how using AI must be guided by teachers and used wisely alongside other teaching activities. Although exciting, these results suggest that educational institutions should carefully use AI when student skills and ability to use technology differ a lot. Therefore, in-depth studies are needed to discuss the use of AI technologies in educational settings on a large scale in different educational environments. Because the United Arab Emirates (UAE) prioritizes developing AI while updating its education, understanding students' opinions and actions is essential for making policy and curriculum reforms. This study fills this gap by exploring the views and use of generative AI by undergraduate students in academic settings.

Additional studies have also examined the multi-cultural and pedagogical dynamics that shaped generative AI integration in higher educational settings. A survey, 1200 participants, showed a widespread awareness about generative AI usage among undergraduate students [20]. In addition, the Unified Theory of Acceptance and Use of Technology (UTAUT) framework has been applied by another study [21] found that the intentions of students in using generative AI was mainly to increase their academic performance. Furthermore, nuanced and context-dependent outcomes were found in empirical education studies [22]. Such findings indicate the need for a unified yet flexible educational framework that encourages generative AI adoption with a controlled educational setting.

Building on this growing body of work, recent studies have confirmed both the promise and complexity of integrating generative AI tools like ChatGPT into educational practice. Meta-analyses have demonstrated that these tools can significantly enhance learning performance and foster higher-order thinking when guided by structured educational models [23]. However, findings also point to a variety of influencing factors, such as course type, instructional model, and usage duration, that shape the effectiveness of AI-enhanced learning. Other experimental studies, including those in underrepresented regions, have highlighted strong improvements in student achievement while emphasizing the need for careful implementation irrespective of demographics like age or prior experience [24]. Meanwhile, mixed-method investigations have called attention to the double-edged nature of AI in classrooms, where benefits like personalization and engagement may come at the cost of critical thinking, ethical lapses, or cognitive overdependence [25, 26]. Collectively, this literature underlines the urgency of establishing structured, pedagogically aligned, and ethically guided frameworks to maximize the academic value of generative AI while safeguarding against its potential risks. This study aims to contribute to that effort by offering an evidence-based exploration grounded in the lived experiences of UAE undergraduate students.

III. Materials and Methods

This study adopted a convergent parallel mixed-methods approach to explore how generative AI tools are influencing the academic performance and experiences of undergraduate students across different programs. By collecting and analyzing both quantitative and qualitative data concurrently, the study aimed to present a more complete picture of students' interactions with AI in their academic journeys. As illustrated in Fig. 1, the methodology began with the development and piloting of a tailored survey instrument, followed by data collection, statistical analysis, and qualitative theme identification. The quantitative and qualitative data were initially analyzed separately and then integrated during the interpretation phase to enable triangulation of findings. This approach enriched the understanding of statistical patterns with students' personal insights, providing a comprehensive view of how generative AI impacts academic experiences. The convergent parallel design was selected for its ability to combine the breadth of quantitative data with the depth of qualitative perspectives effectively.

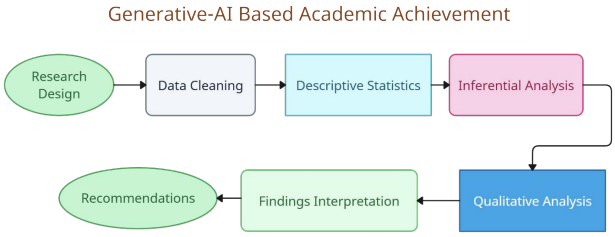

Fig. 1. Research methodology framework.

To better understand how generative AI is shaping students' academic experiences, the researchers developed a customized instrument, the Generative AI Academic Impact Scale (GAI-AIS). This tool was carefully designed to capture not only how students use AI, but also how they feel about its role in their learning. The survey began by gathering basic demographic information such as age, gender, year of study, and CGPA, with a particular focus on final-year students whose recent academic performance may have been significantly influenced by the rapid rise of generative AI between 2023 and 2025. It then explored students' patterns of AI usage, how often they used AI tools, what they used them for (like writing help, preparing for exams, or analyzing data), and their own sense of proficiency. Next, students were asked to reflect on whether these tools genuinely helped them, whether AI made it easier to grasp new concepts, study more effectively, or complete assignments. The survey also included a section on ethics, inviting students to share their concerns about content accuracy, potential misuse, and academic dishonesty, as well as ideas on how AI could be used more responsibly. Finally, students were given space to express their personal stories and thoughts, offering a richer, more personal glimpse into how they perceive AI's growing presence in education. The participant profiles are analyzed and shown in Fig. 2.

Before distributing the survey on a wider scale, a pilot study was conducted with a small group of undergraduate students. This helped ensure that the questions were clear, relevant, and easy to understand. To assess the reliability of the scale items, internal consistency was evaluated using Cronbach's Alpha, all subscales showed strong results ($\alpha > 0.80$), confirming that the items worked well together. An Exploratory Factor Analysis (EFA) was also performed to explore possible patterns in how students answered, but the

results didn't support a clear theoretical model and were excluded from the final report. A future study might apply Confirmatory Factor Analysis (CFA) using a more structured, theory-based approach.

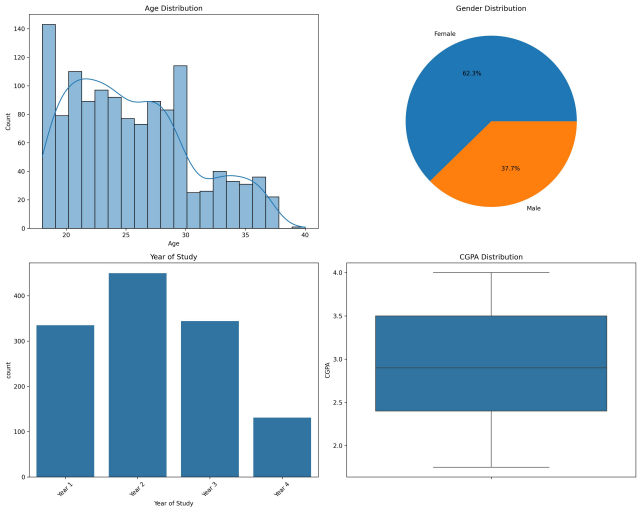

Fig. 2. Demographic characteristics of the surveyed students, including age distribution, gender breakdown, year of study distribution, and CGPA variability.

For the main study, participants were recruited using a convenience sampling method, targeting students from a variety of academic programs across multiple higher education institutions in the United Arab Emirates. The survey was shared electronically and remained open long enough to gather input from students at different points in their studies, from first-year to final-year. Participants included undergraduate students across all academic levels, from first-year to final-year. Although final-year students may have completed a portion of their academic coursework before the widespread adoption of generative AI tools (e.g., post-2022), they were not analyzed separately. Instead, the study focused on capturing students' current perceptions and experiences with AI use during the period when such tools were actively integrated into their learning routines. This approach ensured a balanced and representative sample reflecting diverse levels of exposure and engagement with generative AI technologies across different stages of undergraduate study. Descriptive statistics helped summarize the dataset (e.g., age, gender, year of study, and CGPA, as shown in Fig. 2), while more advanced statistical tests were applied to explore deeper patterns. Descriptive statistics helped summarize the dataset (e.g., age, gender, year of study, and CGPA, as shown in Fig. 2), while more advanced statistical tests were applied to explore deeper patterns. These included Analysis of Variance (ANOVA) and Tukey's Honest Significant Difference (HSD) to compare academic benefit scores between different levels of AI usage, Pearson's correlation to explore the link between CGPA and perceived AI support, and multiple linear regression to test how AI usage frequency, self-rated proficiency, and perceived usefulness predicted academic performance. Thematic analysis was also used to explore open-ended student responses. Two researchers reviewed and coded the feedback independently, then collaborated to identify recurring themes, ensuring consistency and adding rich, qualitative insight into students' personal views, ethical concerns, and ideas for integrating AI into future learning. While the study has limitations, including self-reported data and non-random sampling, it still offers a valuable window into how students across disciplines are experiencing and responding to generative AI in their academic lives.

IV. Result and Discussion

This section presents the key findings drawn from both quantitative data and qualitative responses, revealing important patterns in how undergraduate students use generative AI tools and how this usage relates to their academic success and learning perceptions. These insights offer valuable implications for educators and policymakers aiming to harness AI's benefits while addressing its challenges in higher education settings [3, 6, 7, 20]. Through detailed visualizations and statistical analysis, we explore the educational potential and complexities of AI-assisted learning. Fig. 3 demonstrates a clear link between students' AI-tool usage frequency and their GPA. Our one way ANOVA confirmed a significant difference among the four groups, daily, weekly, monthly, and rare users, $F(3, 1256) = 10.29$, $p < 0.001$. While the data slightly challenged assumptions of normality and equal variances, the substantial sample size lends confidence to our conclusions. Tukey's post hoc comparisons revealed that students who engaged with AI tools on a daily or weekly basis achieved higher GPAs than those who used them infrequently. These findings echo the work of [17] and [23], who also observed that regular AI interaction supports academic performance. In essence, weaving AI into one's study routine, whether every day or every week, appears to confer meaningful benefits. The analysis revealed a statistically significant difference across groups, $F(3, 1256) = 10.29$, $p < 0.001$. Although the Shapiro-Wilk and Levene's tests indicated deviations from normality and homogeneity of variance, ANOVA was considered appropriate due to the large sample size and its robustness against such violations. Post hoc results suggest that students who used AI tools daily or weekly had significantly higher CGPAs compared to those who rarely used them. This pattern indicates that consistent, though not necessarily daily, AI engagement may contribute to improved academic outcomes.

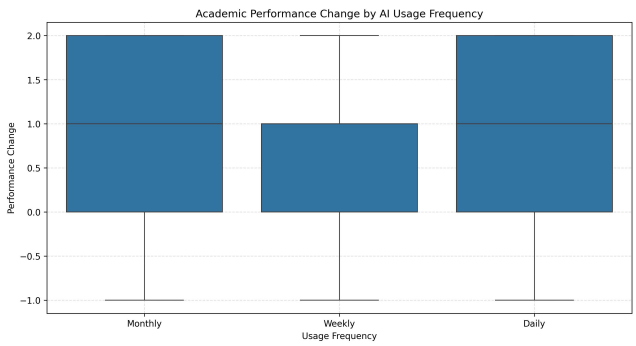

Fig. 3. Impact of AI usage frequency on academic performance.

In addition, Fig. 4 depicts how students' self-rated proficiency with AI tools relates to their perceived improvement in understanding academic material. Those who rated themselves as advanced users generally reported the greatest gains in comprehension, suggesting a strong positive link between skill level and perceived benefit. Intermediate users displayed a wider range of experiences,

indicating varied outcomes, while even beginners often noted substantial improvements, albeit with some variability. Overall, the data points to a generally positive association between AI proficiency and academic understanding.

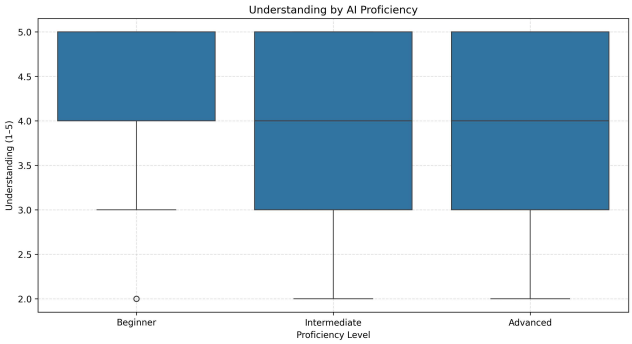

Fig. 4. Relationship between AI proficiency and academic understanding.

Fig. 5 plots each student's CGPA against their self-reported benefit from AI tools, revealing a weak but statistically significant positive correlation (r = 0.136, $p < 0.001$). Although the overall trend suggests that higher-performing students tend to perceive greater value in AI assistance, the wide scatter of points reminds us that individual experiences vary substantially. Such variability may reflect differences in learning styles, disciplinary backgrounds, or personal attitudes toward technology, a phenomenon similarly noted by [1] when examining how students across fields engage with generative AI. In other words, while AI can offer advantages, its impact is far from uniform and depends heavily on each learner's context and approach.

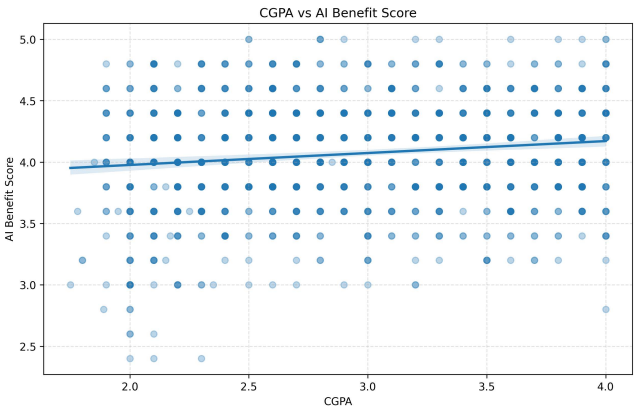

Fig. 5. Scatter plot showing the relationship between CGPA and perceived AI benefit score among students.

Moreover, Fig. 6's word cloud provides a vivid snapshot of how students are putting AI tools to work. Prominent words such as "essays," "reports," and "grammar" highlight that many learners rely on AI for writing and language support, a trend documented by [4] and [9], who both identify writing assistance as a key strength of generative AI in educational settings. At the same time, terms like "research," "exam preparation," and "flashcards" remind us that students also turn to AI for organizing studies, deepening understanding, and reviewing material. In short, while language-related tasks dominate, AI's academic applications clearly extend across the full spectrum of learning activities.

To complement this visualization, thematic analysis of open-ended responses revealed three core themes:

1) Academic Efficiency and Timesaving: Many students emphasized that AI tools helped streamline their workflow. As one student noted, "It saves me time drafting reports so I can focus more on studying".
2) Learning Enhancement: Students described using AI as a learning aid. For example, "When I don't understand something, I ask the AI to explain it differently, like a tutor".
3) Ethical Uncertainty: A smaller but important group raised concerns about integrity, with comments like "Sometimes I wonder if using AI for rewriting is actually cheating, even if I change the words".

Fig. 6. Word cloud of most common academic uses of AI tools.

These insights provide a more nuanced understanding of how students are integrating AI into their academic routines, balancing perceived benefits with ethical reflection.

These themes reveal that students are not only using AI tools for surface-level convenience but are actively shaping strategies to integrate AI into their academic routines. The emphasis on efficiency suggests that students value AI as a means to manage time-intensive academic tasks, particularly writing. Several comments reflected a deliberate approach, with one student noting, "I use AI to organize my study notes and create flashcards; it's like having a personal assistant". At the same time, concerns around academic ethics emerged with nuance, indicating students are aware of gray areas. For instance, a respondent shared, "Even if the AI gives good answers, I feel unsure whether it's still my work". These insights suggest a tension between the practical benefits and the perceived ethical risks of AI use, underlining the importance of institutional guidance and clearer policies.

To further explore these relationships, a multiple linear regression was conducted. The model explained about 28% of the variation in students' CGPA based on AI usage frequency, self-rated proficiency, and perceived understanding. It was statistically significant, indicating these factors collectively influence academic performance. Frequent AI use stood out as a strong positive predictor, and better conceptual understanding also contributed positively, though more modestly. Interestingly, higher self-rated proficiency correlated negatively with CGPA, suggesting that feeling highly skilled with AI does not necessarily translate to better academic results, perhaps reflecting overconfidence or other factors. The negative correlation between self-rated AI proficiency and CGPA may reflect an overestimation of one's digital capabilities or a reliance on automation at the expense of critical engagement, an issue echoed in recent studies that caution against superficial uses of generative AI in educational contexts [6, 13]. This highlights the importance of fostering digital literacy and

critical thinking skills alongside technical proficiency, ensuring students engage meaningfully with these tools. Table 1 summarizes regression results, and Table 2 shows regression coefficients and their statistical significance.

Table 1. Summary of OLS regression model for predicting CGPA

Variable	Value
Dep. Variable	CGPA
Model	OLS
Method	Least Squares
No. Observations	1260
Df. Residuals	1256
Df Model	3
Covariance Type	nonrobust
R-squared	0.284
Adj. R-squared	0.282
F-Statistics	166.2
AIC	1953
BIC	1973

Table 2. Regression coefficients and statistical significance of predictors of CGPA

Variable	coef	std err	t	P>|t|	[0.25	0.975]
const	1.5511	0.098	15.840	0.000	1.359	1.743
ai_freq	0.4130	0.019	21.850	0.000	0.376	0.450
ai_prof	−0.1099	0.024	−4.511	0.000	−0.158	−0.062
ai_understand	0.0521	0.018	2.955	0.003	0.018	0.087
Omnibus		20.995	Durbin-Watson		1.898	
Prop(omnibus)		0.000	Jarque-Bera (JB)		12.342	
Skew		0.033	Prob(JB)		0.00209	
Kurtosis		2.520	Cond. No		38.9	

Table 1's regression analysis revealed that AI usage frequency, self-rated proficiency, and perceived understanding together accounted for 28 percent of the variation in CGPA. Of these predictors, more frequent AI use and greater perceived understanding were associated with higher GPAs, whereas higher self-rated proficiency surprisingly corresponded with lower GPAs. This counterintuitive finding mirrors warnings in the literature that overconfidence in one's AI skills can foster shallow engagement or excessive reliance on the tools [6, 13, 24]. In practice, the negative coefficient for self-rated proficiency may signal that students who feel most adept at using AI sometimes substitute automation for deeper thinking, an issue highlighted by [13] and [16] as a potential pitfall of uncritical AI adoption.

Supporting these results, a Pearson correlation showed a small but statistically significant positive link between CGPA and perceived AI benefits. Diagnostic tests indicated that the regression model was sound, with no major issues such as autocorrelation or multicollinearity. The surprising negative correlation between self-rated AI proficiency and academic performance may point to overconfidence or a disconnect between perceived and actual skills, emphasizing the nuanced challenges of integrating AI tools effectively in academic settings. Given that this study was conducted in the UAE, the findings should be interpreted with attention to the local educational context. The UAE's strong emphasis on digital transformation in education, supported by national strategies and institutional investments, may contribute to higher levels of AI adoption among students. At the same time, cultural and curricular priorities, such as structured academic integrity policies and centralized curricula, may shape students' perceptions of responsible AI use. These contextual factors are important for understanding both the opportunities and challenges faced by students in integrating generative AI into their learning practices. While the results offer valuable insights, their applicability to other settings may depend on similar institutional readiness and cultural attitudes toward AI in education.

Together, these quantitative and qualitative findings provide a nuanced understanding of how generative AI tools influence undergraduate learning [27, 28]. While consistent AI use and conceptual understanding appear to support academic success, the complex relationship with self-assessed proficiency underscores the need for careful guidance and education on effective AI use. These insights can help educators and institutions develop strategies to maximize AI's benefits while addressing its potential pitfalls in higher education [29, 30].

The findings of this study support the claims of [31, 32] that ChatGPT plays a valuable role in enhancing students' academic progress. Frequent and high-quality use of ChatGPT significantly improves students' cognitive skills and career-relevant knowledge. These results suggest that, when thoughtfully integrated, AI tools like ChatGPT can meaningfully contribute to learning outcomes and overall academic success.

V. Conclusion and Recommendations

This study investigated how undergraduate students perceive and use generative AI tools such as ChatGPT, and how these tools influence their academic performance. Drawing from both quantitative and qualitative data, the research revealed that generative AI has become deeply embedded in students' academic routines, particularly in areas like writing assistance, exam preparation, and conceptual learning. Students who use these tools more frequently, and those who report gaining deeper conceptual understanding through AI assistance, tend to demonstrate higher academic performance. Interestingly, however, the findings also revealed a negative correlation between students' self-rated AI proficiency and their CGPA, suggesting a potential mismatch between perceived skill and actual academic outcomes. These insights highlight a nuanced reality: while generative AI tools can support academic success, their impact depends heavily on how they are used. Responsible and effective engagement, rooted in understanding, not just convenience, is critical. Merely having access to AI or feeling confident in its use does not guarantee improved outcomes. The key lies in how thoughtfully these tools are applied to learning tasks.

Based on these findings, this study recommends that academic institutions take a more active role in guiding students' use of AI technologies. Structured training programs should be introduced to build AI literacy, helping students understand not only how to use these tools, but also how to interpret and critically evaluate their outputs. Educators should foster learning environments that prioritize deep comprehension over superficial usage, ensuring AI is used to complement, not replace, cognitive effort. To operationalize this vision, the study proposes the development of a dedicated AI-Based Academic Support System (AI-BASS). This institutional platform would offer

students secure, curriculum-integrated access to generative AI tools, supported by built-in ethical safeguards, personalized tutoring capabilities, and faculty oversight. Such a system would help bridge the gap between perceived and actual proficiency, promoting responsible AI engagement while minimizing risks such as misinformation, plagiarism, and overreliance. In conclusion, while generative AI offers promising benefits for academic development, its integration into higher education must be thoughtful, guided, and pedagogically grounded. Universities that institutionalize the responsible use of AI will be better positioned to equip students with not only academic skills, but also the critical thinking and ethical awareness needed for the future. Future studies should explore the long-term effects of structured AI platforms on diverse learning outcomes and student readiness for the evolving demands of the workforce.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Yousef Qawqzeh led the conceptualization, analysis, and overall development of the manuscript. Hajar Mohammad contributed to the data collection and assisted in the writing process. All authors reviewed and approved the final version.

References

[1] Y. Qu, M. X. Y. Tan, and J. Wang, "Disciplinary differences in undergraduate students' engagement with generative artificial intelligence," *Smart Learn. Environ.*, vol. 11, p. 51, 2024. doi: 10.1186/s40561-024-00341-6

[2] D. R. E. Cotton, P. A. Cotton, and J. R. Shipway, "Chatting and cheating: Ensuring academic integrity in the era of ChatGPT," *Innovations in Education and Teaching International*, vol. 61, no. 2, pp. 228–239, 2023. doi: 10.1080/14703297.2023.2190148

[3] Y. K. Dwivedi *et al*., "So what if ChatGPT wrote it? Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy," *Int. J. Inf. Manag*., vol. 71, 102642, 2023. doi: 10.1016/j.ijinfomgt.2023.102642

[4] M. Farrokhnia, S. K. Banihashem, O. Noroozi, and A. Wals, "A SWOT analysis of ChatGPT: Implications for educational practice and research," *Innovations in Education and Teaching International*, vol. 61, no. 3, pp. 460–474, 2023. doi: 10.1080/14703297.2023.2195846

[5] J. G. Meyer *et al*., "ChatGPT and large language models in academia: Opportunities and challenges," *BioData Min*., vol. 16, no. 1, p. 20, 2023. doi: 10.1186/s13040-023-00339-9

[6] E. Kasneci *et al*., "ChatGPT for good? On opportunities and challenges of large language models for education," *Learning and Individual Differences*, vol. 103, 2023. doi: 10.1016/j.lindif.2023.102274

[7] C. K. Lo, "What is the impact of ChatGPT on education? A rapid review of the literature," *Educ. Sci.*, vol. 13, no. 4, 410, 2023. doi: 10.3390/educsci13040410

[8] B. Lund and T. Wang, "Chatting about ChatGPT: How may AI and GPT impact academia and libraries?" *Library Hi Tech News*, vol. 40, 2023. doi: 10.1108/LHTN-01-2023-0009

[9] K. Bittle and O. El-Gayar, "Generative AI and academic integrity in higher education: A systematic review and research agenda," *Information*, vol. 16, no. 4, 296, 2025. doi: 10.3390/info16040296

[10] J. Wang and W. Fan, "The effect of ChatGPT on students' learning performance, learning perception, and higher-order thinking: Insights from a meta-analysis," *Humanit. Soc. Sci. Commun.*, vol. 12, p. 621, 2025. doi: 10.1057/s41599-025-04787-y

[11] D. Ali, Y. Fatemi, E. Boskabadi, M. Nikfar, J. Ugwuoke, and H. Ali, "ChatGPT in teaching and learning: A systematic review," *Educ. Sci*., vol. 14, no. 6, 643, 2024. doi: 10.3390/educsci14060643

[12] M. Zhu and C. Wang, "A systematic review of research on AI in language education: Current status and future implications," *Lang. Learn. Technol*., vol. 29, pp. 1–29, 2025.

[13] Y. Qawqzeh, "Exploring the influence of student interaction with ChatGPT on critical thinking, problem solving, and creativity," *Int. J. Inf. Educ. Technol.*, vol. 14, no. 4, pp. 596–601, 2024. doi: 10.18178/ijiet.2024.14.4.2082

[14] Y. Qawqzeh, M. B. I. Reaz, O. Maskon, K. Chellappan, and M. A. M. Ali, "Photoplethysmogram reflection index and aging," in *Proc. Int. Conf. Graphic Image Process (ICGIP 2011)*, Cairo, Egypt, Oct. 1–3, 2011, vol. 8285.

[15] N. J. Francis, S. Jones, and D. P. Smith, "Generative AI in higher education: Balancing innovation and integrity," *Br. J. Biomed. Sci*., vol. 81, 2025. doi: 10.3389/bjbs.2024.14048

[16] S. Grassini, "Shaping the future of education: Exploring the potential and consequences of AI and ChatGPT in educational settings," *Educ. Sci.*, vol. 13, no. 7, p. 692, 2023. doi: 10.3390/educsci13070692

[17] M. A. Ashraf, J. Alam, and U. Kalim, "Effects of ChatGPT on students' academic performance in Pakistan higher education classrooms," *Sci. Rep*., vol. 15, 16434, 2025. doi: 10.1038/s41598-025-92625-1

[18] M. Turmuzi, G. P. Suharta, W. P. Astawa, and N. Suparta, "Perceptions of primary school teacher education students to the use of ChatGPT to support learning in the digital era," *Int. J. Inf. Educ. Technol*., vol. 14, no. 5, pp. 721–732, 2024.

[19] F. A. Khan, A. Rahman, M. Alharbi, and others, "Awareness and willingness to use PHR: A roadmap towards cloud-dew architecture based PHR framework," *Multimed. Tools Appl*., vol. 79, pp. 8399–8413, 2020.

[20] A. Yusuf, N. Pervin, and M. Román-González, "Generative AI and the future of higher education: A threat to academic integrity or reformation? Evidence from multicultural perspectives," *Int. J. Educ. Technol. High Educ*., vol. 21, p. 21, 2024. doi: 10.1186/s41239-024-00453-6

[21] D. Sun, A. Boudouaia, C. Zhu *et al.*, "Would ChatGPT-facilitated programming mode impact college students' programming behaviors, performances, and perceptions? An empirical study," *Int. J. Educ. Technol. High Educ*., vol. 21, p. 14, 2024. doi: 10.1186/s41239-024-00446-5

[22] A. Strzelecki and S. ElArabawy, "Investigation of the moderation effect of gender and study level on the acceptance and use of generative AI by higher education students: Comparative evidence from Poland and Egypt," *Br. J. Educ. Technol*., vol. 55, pp. 1209–1230, 2024. doi: 10.1111/bjet.13425

[23] J. Wang and W. Fan, "The effect of ChatGPT on students' learning performance, learning perception, and higher-order thinking: Insights from a meta-analysis," *Humanit. Soc. Sci. Commun*., vol. 12, p. 621, 2025. doi: 10.1057/s41599-025-04787-y

[24] I. A. Mohammed, A. Bello, and B. Ayuba, "Effect of large language models artificial intelligence ChatGPT chatbot on achievement of computer education students," *Educ. Inf. Technol*., 2025. doi: 10.1007/s10639-024-13293-8

[25] A. M. Vieriu and G. Petrea, "The impact of Artificial Intelligence (AI) on students' academic development," *Educ. Sci*., vol. 15, no. 3, 343, 2025. doi: 10.3390/educsci15030343

[26] M. M. Otoom, M. Jemmali, Y. Qawqzeh, K. N. Sa, and F. Al Fay, "Comparative analysis of different machine learning models for estimating the population growth rate in data-limited area," *Int. J. Comput. Sci. Netw. Secur*., vol. 19, no. 12, pp. 96–102, 2019.

[27] H. Altarawneh, "ChatGPT impact on student educational performance: A conceptual analysis," *EAI Endorsed Trans. e-Learn*., vol. 9, Dec. 2023. doi: 10.4108/eetel.4574

[28] Z. Liu, H. Zuo, and Y. Lu, "The impact of ChatGPT on students' academic achievement: A meta-analysis," *J. Comput. Assist. Learn.*, vol. 41, no. 4, p. e70096, 2025. doi: 10.1111/jcal.70096

[29] Y. K. Qawqzeh, M. B. I. Reaz, and M. A. M. Ali, "The analysis of PPG contour in the assessment of cardiovascular disease," *WSEAS Trans. Biol. Biomed.*, vol. 7, no. 3, pp. 179–188, 2010.

[30] O. Boubker, H. Ben-Saghroune, J. El Bourassi, M. Abdessadek, and R. Sabbahi, "Examining the impact of OpenAI's ChatGPT on PhD student achievement," *Int. J. Inf. Educ. Technol*., vol. 14, no. 3, pp. 443–451, 2024. doi: 10.18178/ijiet.2024.14.3.2065

[31] N. A. Dahri, N. Yahaya, and W. M. Al-Rahmi, "Exploring the influence of ChatGPT on student academic success and career readiness," *Educ. Inf. Technol*., vol. 30, pp. 8877–8921, 2025. doi: 10.1007/s10639-024-13148-2

[32] T. Al Shloul *et al.*, "Role of activity-based learning and ChatGPT on students' performance in education," *Comput. Educ.: Artif. Intell.*, vol. 6, 100219, 2024. doi: 10.1016/j.caeai.2024.100219

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