P-ISSN: 2798-1088 | E-ISSN: 2776-4060 | DOI: 10.52562/jdle.2026.1908

Journal of Digital Learning and Education

http://journal.moripublishing.com/index.php/jdle

AI-Assisted Learning in Engineering Education: An Analysis of Usage Patterns, Academic Impact, and Ethical Challenges

Mohan Bandaru[1,2]*, B. R. Doraswamy Naick[2]

[1]*Central Library, GITAM Dental College Hospital, Visakhapatnam - 530045, A.P., India*

[2]*Department of Library and Information Science, University College of Engineering Kakinada, JNT University Kakinada, Kakinada - 533003, A.P., India*

[*]*Corresponding author: bmohanleo@gmail.com*

Received: 03 January 2026; Accepted: 10 March 2026; Published: 17 March 2026

Abstract: The rapid growth of generative artificial intelligence (AI) tools has transformed academic work in higher education. This study examines the patterns of AI tool usage, perceived impact, challenges, and ethical concerns in an academic engineering-related context. A descriptive, exploratory cross-sectional survey was administered through Google Forms to 159 undergraduate engineering students at a state technological university in Andhra Pradesh, India, and the responses were analyzed with descriptive statistics and reliability analysis in jamovi. The results indicate that ChatGPT is the most widely used AI tool for academic purposes. Participants reported frequent use of AI tools and generally positive perceptions of their impact, particularly in terms of time management and problem-solving skills. However, concerns related to the accuracy of AI-generated content, ethical issues, and understanding of AI-generated solutions were also reported. The findings highlight that while generative AI tools offer significant benefits for academic work, their effective use requires clear institutional policies, ethical guidance, and AI literacy training.

Keywords: generative artificial intelligence; ChatGPT; higher education; engineering education; AI ethics

INTRODUCTION

Artificial intelligence (AI) has become an important part of higher education in recent years. The rapid development of generative AI tools, such as ChatGPT and similar systems, has changed how academic tasks are performed. These tools are now commonly used for information searching, content drafting, problem solving, and managing academic work. As a result, AI is increasingly integrated into daily academic and professional activities (Alkabaa & Alamri, 2025; Pham et al., 2023).

In engineering and higher education contexts, AI tools are often viewed as supportive technologies that can improve efficiency and learning outcomes. Previous studies have reported that generative AI tools help users understand complex concepts, generate ideas, and complete tasks more quickly (Alkabaa & Alamri, 2025; Munaye et al., 2025). However, researchers have also raised concerns about the accuracy of AI-generated outputs and the risk of over-reliance on these tools (Qadir, 2023; Yang et al., 2025).

Recent research highlights that although AI adoption is increasing, users differ in their confidence levels, verification practices, and understanding of AI limitations (Ravšelj et al., 2025). Ethical issues such as academic integrity, misuse of AI-generated content, and lack of transparency are frequently discussed in the literature (Kasneci et al., 2023; Đerić et al., 2025). These concerns suggest that AI use in higher education requires careful evaluation and responsible implementation.

© 2026 The Author(s). Published by MO.RI Publishing. This is an open access article under the CC BY-SA 4.0 license (https://creativecommons.org/licenses/by-sa/4.0/). The authors retain copyright and grant the journal the right of first publication.

While several studies have examined AI adoption among students and educators, fewer studies focus on practical usage patterns, such as how often AI tools are used, how users verify AI-generated information, and how AI affects problem-solving and time management in everyday academic work. Moreover, limited empirical evidence is available in engineering-related academic contexts, particularly from developing or regional higher education settings (Al Naqbi et al., 2025; Perante et al., 2025).

Therefore, the present study aims to examine AI tool usage patterns, perceived impact, ethical concerns, and challenges in an academic engineering context. By using a structured questionnaire and descriptive analysis, this study provides empirical evidence that can support institutional decision-making, training initiatives, and the development of responsible AI use guidelines in higher education.

Review of Literature

AI and Generative AI in Higher Education

The use of AI in higher education has expanded significantly over the past decade. Early applications focused on intelligent tutoring systems and learning analytics, while recent developments emphasize generative AI tools capable of producing human-like text and explanations (Williamson & Eynon, 2020; Kung et al., 2023). Systematic reviews indicate that AI applications in engineering education support personalized learning, improve engagement, and assist with complex problem-solving tasks (Pham et al., 2023; Munaye et al., 2025; Liu et al., 2025).

Generative AI tools such as ChatGPT are widely accessible and easy to use, which contributes to their rapid adoption in academic settings. Studies report that users value these tools for quick access to explanations and support with assignments and projects (Alkabaa & Alamri, 2025; Kasneci et al., 2023). However, widespread access also increases the need for guidance on responsible use.

Adoption and Usage of AI Tools in Academic Contexts

Empirical studies consistently report high levels of AI adoption in higher education, particularly among students in technical and engineering disciplines. Adoption is often influenced by perceived usefulness, ease of use, and performance benefits (Alkabaa & Alamri, 2025; Munaye et al., 2025). Research grounded in technology acceptance models suggests that positive attitudes toward AI tools significantly predict usage behavior (Choi et al., 2023; Lin, 2024; Merhej Sayegh et al., 2025).

However, frequent use does not always indicate effective or critical use. Some studies show that users rely on AI-generated content without fully evaluating its accuracy, which may affect learning quality and academic integrity (Kasneci et al., 2023; Cotton et al., 2024; Moya et al., 2023). This highlights the importance of examining not only adoption but also how AI tools are actually used in practice.

Perceived Benefits of AI Use

Several studies emphasize the positive effects of AI tools on productivity and time management. Generative AI tools have been shown to reduce task completion time and support problem-solving processes, especially in engineering education contexts (Pham et al., 2023; Alkabaa & Alamri, 2025). Users often report that AI tools are most effective when used as supportive aids rather than replacements for independent thinking (Yang et al., 2025).

AI-generated explanations also help users understand complex topics by presenting information in simplified formats. This benefit is particularly relevant in engineering disciplines, where conceptual difficulty is often high (Munaye et al., 2025; Vieriu & Petrea, 2025).

Ethical Concerns and Verification Practices

Despite reported benefits, ethical concerns remain central in the literature. Researchers frequently highlight issues related to academic integrity, plagiarism, bias, and the reliability of AI-

generated outputs (Kasneci et al., 2023; Đerić et al., 2025; Fosso Wamba et al., 2025). Many users express uncertainty about whether AI-generated information can be trusted without verification.

Verification practices vary widely. Some users actively cross-check AI outputs with credible sources, while others accept responses without validation, raising concerns about misinformation and over-reliance (Pham et al., 2023). These findings suggest that verification skills are critical for responsible AI use.

Challenges and Institutional Readiness

Common challenges associated with AI use include lack of formal training, unclear institutional policies, and limited awareness of AI limitations. Several studies report that institutions are still developing guidelines for AI use, leaving users unsure about acceptable practices (Alkabaa & Alamri, 2025; Dwivedi et al., 2023; Vincent-Lancrin & Van der Vlies, 2020; UNESCO, 2025).

The literature emphasizes that effective AI integration requires not only access to technology but also institutional support, ethical guidance, and structured training programs (Fan & Irawan, 2025; Vieriu & Petrea, 2025) . Without these measures, AI adoption may lead to inconsistent and potentially problematic practices.

Research Gap

Although existing studies provide valuable insights into AI adoption and perceptions in higher education, there is limited descriptive research focusing on actual usage patterns, perceived academic impact, verification behavior, ethical concerns, and challenges, particularly within engineering-related academic contexts. This study addresses this gap by presenting empirical evidence based on users' reported experiences, thereby contributing to a clearer understanding of AI use in everyday academic practice.

Research Objectives

1. To examine the usage patterns of AI tools among engineering students for academic purposes.
2. To identify the primary academic tasks and AI tools used in engineering coursework.
3. To evaluate the impact of AI-assisted learning on academic performance, problem-solving skills, and time management.
4. To assess students' confidence, awareness of limitations, and verification practices when using AI tools.
5. To explore ethical concerns, challenges, and faculty influence related to AI tool usage in engineering education.

METHOD

Research Design

The study adopted a descriptive and exploratory survey design to examine the use of artificial intelligence (AI) tools, perceived impact, and challenges among professionals in academic settings. A web-based survey approach was employed, as it is considered effective for reaching geographically dispersed professional populations and facilitating efficient data collection (Callegaro et al., 2015; Sue & Ritter, 2012).

Population and Sampling

The target population of the study consisted of engineering students enrolled in engineering colleges affiliated with a state technological university in Andhra Pradesh, India. A convenience sampling technique was used due to the wide geographical distribution of institutions and the online mode of data collection.

The online survey link was disseminated through professional contacts, including librarians and academic staff, who assisted in circulating the questionnaire among eligible student participants. Participation was voluntary, and respondents self-selected to take part in the study (Alessi & Martin, 2010; Callegaro et al., 2015).

Instrument Development

Data were collected using a structured questionnaire developed based on relevant literature on AI adoption, technology use in higher education, and professional practices in academic environments. The questionnaire comprised multiple sections covering demographic information, AI tools used, challenges encountered, and perceptions regarding the impact of AI on professional and academic activities. Perception-related items were measured using a five-point Likert scale, ranging from 1 (very low/never) to 5 (very high/always).

Data Collection Procedure

The questionnaire was designed and administered using Google Forms, an online survey platform that enables automated data capture and minimizes manual data entry errors. The online survey link was initially shared with professional librarians and subsequently circulated among eligible participants within their professional networks. This snowball-like dissemination facilitated broader reach within the target population.

The survey was conducted over a defined period, and responses were recorded automatically through the online platform, ensuring accuracy and completeness of the collected data. The use of online survey tools is widely recognized as an efficient and reliable method for collecting data from professional respondents (Sue & Ritter, 2012; Callegaro et al., 2015).

Data Preparation and Cleaning

Following data collection, responses were exported from Google Forms and subjected to a data cleaning procedure using Microsoft Excel. The dataset was examined for completeness, duplicate entries, and consistency of responses. Incomplete or invalid responses were screened and removed where necessary.

Likert-scale responses were coded numerically from 1 to 5, while multiple-response items were coded using binary values (1 = selected, 0 = not selected). Cleaned and coded data were then imported into jamovi (version 2.7.15) for statistical analysis.

Data Analysis

Data analysis was carried out using jamovi statistical software (version 2.7.15) (The jamovi project, 2025). A descriptive and exploratory analytical approach was followed:

1. Frequencies and percentages were used to summarize demographic characteristics, AI tools used, and challenges faced.
2. Means and standard deviations were computed for Likert-scale items assessing AI usage and perceived impact.
3. Reliability analysis was conducted using Cronbach's alpha to assess the internal consistency of the perception and impact items (Cronbach, 1951).

Given the exploratory nature of the study, a Cronbach's alpha value of 0.60 or above was considered acceptable for internal consistency (Hair et al., 2019). Inferential statistical tests were not applied, as the primary objective was to describe usage patterns and perceptions rather than to test hypotheses.

RESULTS

Table 1 presents the demographic profile of the respondents. A total of 159 engineering students participated in the study.The mean age of the respondents was 19.06 years (*SD* = 1.52), with ages ranging from 18 to 24 years. The sample comprised 77 male students (48.4%) and 82 female students (51.6%). Participants represented a diverse range of engineering disciplines, with the largest proportion from Computer Science Engineering (33.3%), followed by Data Science (18.9%) and Electronics and Communication Engineering (17.6%). In terms of academic level, most respondents were in their fourth year (37.1%) and second year (36.5%).

Table 1. Demographic profile of respondents *(N = 159)*

Variable	Category	Frequency	Percentage (%)
Gender	Male	77	48.4
	Female	82	51.6
Year	1st Year	3	1.9
	2nd Year	58	36.5
	3rd Year	39	24.5
	4th Year	59	37.1
Branch	Chemical Engineering	4	2.5
	Civil Engineering	7	4.4
	Computer Science Engineering	53	33.3
	Data Science	30	18.9
	Electronics & Communication Engineering	28	17.6
	Electrical Engineering	6	3.8
	Mechanical Engineering	18	11.3
	Machine Learning	9	5.7
	Robotics	4	2.5
Age (years)	Mean ± SD	19.06 ± 1.52	—
	Range	18–24	—

Table 2 presents the distribution of AI tools used by engineering students for academic purposes. ChatGPT was the most widely used AI tool, reported by 95.6% of respondents. A substantial proportion of students also reported using Google Bard (38.4%). Other tools such as MATLAB AI tools (11.9%), AutoCAD AI features (11.3%), and Wolfram Alpha (6.3%) were used by a smaller proportion of respondents. Additionally, 21.4% of students indicated the use of other AI tools. As multiple responses were permitted, the percentages do not sum to 100%.

Table 2. AI tools used for engineering coursework *(N = 159; multiple responses allowed)*

AI Tool	Frequency	Percentage (%)
ChatGPT	152	95.6
Google Bard	61	38.4
Wolfram Alpha	10	6.3
MATLAB AI tools	19	11.9
AutoCAD AI features	18	11.3
Other AI tools	34	21.4

Table 3 presents the challenges encountered by engineering students when using AI tools for academic purposes. The most frequently reported challenge was the accuracy of AI-generated results (59.1%), followed by difficulties in understanding AI-generated solutions (54.7%). Approximately one-third of respondents reported challenges related to integration with existing software (31.4%), ethical considerations (30.8%), and time management (30.8%). Only a small proportion of students (3.1%) indicated other challenges.

Table 3. Challenges faced while using AI tools for engineering coursework (N = 159; multiple responses allowed)

Challenge	Frequency	Percentage (%)
Accuracy of results	94	59.1
Understanding AI-generated solutions	87	54.7
Integration with existing software	50	31.4
Ethical considerations	49	30.8
Time management	49	30.8
Other challenges	5	3.1

Table 4 presents the descriptive statistics of AI usage and its perceived impact on academic activities. Respondents reported frequent use of AI tools for academic purposes (M = 4.16, SD = 0.97). AI usage was perceived to have a positive impact on time management (M = 4.26, SD = 0.81) and problem-solving skills in engineering (M = 4.04, SD = 0.93). Participants also demonstrated a good level of understanding of the limitations of AI tools (M = 3.79, SD = 0.92)

and reported regularly verifying information generated by AI tools (M = 3.72, SD = 1.07). Ethical concerns were encountered at a moderate level (M = 3.53, SD = 0.97). Confidence in using AI tools effectively showed a comparatively lower mean score (M = 3.23, SD = 0.95), indicating scope for further skill development.

Table 4. Descriptive statistics of AI usage and perceived impact (N = 159)

Item	*M*	*SD*	Min	Max
Frequency of AI tool use for academic purposes (Q1)	4.16	0.97	1	5
Confidence in using AI tools effectively (Q4)	3.23	0.95	1	5
Verification of information provided by AI tools (Q6)	3.72	1.07	1	5
Encountering ethical concerns when using AI (Q7)	3.53	0.97	1	5
Impact of AI usage on problem-solving skills (Q9)	4.04	0.93	1	5
Understanding limitations of AI tools (Q11)	3.79	0.92	1	5
Collaboration with peers using AI tools (Q12)	3.62	1.23	1	5
Impact of AI usage on time management (Q14)	4.26	0.81	1	5

Likert scale: 1 = Very low / Never, 5 = Very high / Always; values reported as M, SD, minimum and maximum

Table 5. Reliability analysis of the AI usage and impact scale

Scale	Number of items	Cronbach's α
AI usage and perceived impact	9	0.680

The internal consistency of the AI usage and perceived impact scale was assessed using Cronbach's alpha. The nine-item scale demonstrated acceptable reliability with a Cronbach's alpha value of 0.680, indicating satisfactory internal consistency for exploratory research.

DISCUSSION

This study examined the use of AI tools, their perceived impact, associated challenges, and ethical concerns within an engineering education context. The following discussion interprets the key findings from the results (Tables 2–5) in relation to existing literature on generative AI use in higher education.

AI Tools Used for Academic Purposes

The findings in Table 2 show that ChatGPT was the most widely used AI tool, reported by 95.6% of respondents. This result is consistent with recent studies that highlight ChatGPT as the most popular generative AI tool in higher education due to its ease of access, conversational interface, and ability to support a wide range of academic tasks (Alkabaa & Alamri, 2025; Munaye et al., 2025). Similar high adoption rates of ChatGPT have been reported among students and academic professionals across different disciplines (Lo, 2023; Ravšelj et al., 2025).

Other AI tools, such as Google Bard, MATLAB AI tools, and AutoCAD AI features, were used by a smaller proportion of respondents. This pattern aligns with previous research suggesting that while domain-specific AI tools are valuable, their use is often limited to specific academic needs, whereas general-purpose generative AI tools are adopted more broadly (Pham et al., 2023). The presence of multiple tool usage also reflects a growing tendency among users to combine different AI tools based on task requirements.

Challenges Faced While Using AI Tools

As shown in Table 3, the most frequently reported challenge was accuracy of AI-generated results, followed by difficulty in understanding AI-generated solutions. These findings strongly align with existing literature, which consistently reports concerns about the reliability and correctness of generative AI outputs (Kasneci et al., 2023; Baig & Yadegaridehkordi, 2024). Although AI tools can generate fluent and convincing responses, they may also produce incorrect or misleading information, making accuracy a critical concern.

Ethical considerations and time management challenges were reported by nearly one-third of respondents. Prior studies have similarly highlighted ethical uncertainty, particularly related to

academic integrity, responsible use, and unclear institutional policies (Alkabaa & Alamri, 2025; Pham et al., 2023). The relatively lower reporting of "other challenges" suggests that most concerns are concentrated around well-documented issues already identified in the literature.

Perceived Usage and Impact of AI Tools

The descriptive statistics presented in Table 4 indicate frequent use of AI tools for academic purposes and a generally positive perception of their impact. Respondents reported that AI tools had a strong positive effect on time management and problem-solving skills, with mean values above 4.0. These findings support earlier studies showing that generative AI tools can enhance efficiency and reduce the time required to complete academic tasks (Pham et al., 2023; Munaye et al., 2025).

Participants also demonstrated a moderate to high level of verification of AI-generated information and understanding of AI limitations. This suggests that users are not entirely passive consumers of AI outputs, which is consistent with research indicating growing awareness of the need for critical evaluation of AI-generated content (Kasneci et al., 2023). However, the comparatively lower mean score for confidence in using AI tools effectively suggests that while usage is high, users may still feel uncertain about optimal and responsible use.

Ethical Concerns and Verification Practices

Ethical concerns emerged as an important theme across both Tables 3 and 4. Respondents reported moderate levels of ethical concern and relatively frequent verification practices. These findings are in line with previous research emphasizing that ethical awareness is increasing alongside AI adoption in higher education (Đerić et al., 2025). However, the presence of ethical concerns also indicates a lack of clear institutional guidance, which has been widely discussed in the literature (Moya et al., 2023; UNESCO, 2025).

The combination of high usage and moderate ethical concern highlights a key tension identified in prior studies: users recognize the benefits of AI tools but remain uncertain about boundaries and acceptable practices (Alkabaa & Alamri, 2025). This reinforces calls for clearer policies, training programs, and ethical frameworks to guide AI use in academic settings.

Reliability of the AI Usage and Impact Measures

The reliability analysis presented in Table 5 shows that the AI usage and perceived impact items achieved an acceptable level of internal consistency for an exploratory study. Although the Cronbach's alpha value was slightly below the conventional 0.70 threshold, this level of reliability is considered acceptable in exploratory research involving new or evolving constructs, such as generative AI use in higher education (Kasneci et al., 2023). Similar reliability values have been reported in recent AI adoption studies, reflecting the complexity and multidimensional nature of AI-related perceptions.

Implications of the Findings

Overall, the findings suggest that AI tools, particularly generative AI systems, are widely used and perceived as beneficial for academic work, especially in terms of time management and problem-solving. At the same time, concerns related to accuracy, ethics, and confidence highlight the need for institutional support mechanisms, including training on AI literacy, verification practices, and ethical use guidelines. These implications are consistent with existing recommendations in the literature for responsible and structured AI integration in higher education (Pham et al., 2023; Đerić et al., 2025; Saxena & Rishi, 2025).

CONCLUSION

This study examined the use of AI tools, perceived impact, challenges, and ethical concerns in an academic engineering-related context. The findings show that generative AI tools, particularly ChatGPT, are widely used for academic purposes. Respondents reported frequent use of AI tools and generally positive perceptions regarding their impact on academic work, especially in terms of time management and problem-solving skills. However, the study also identified important

concerns. Accuracy of AI-generated content and ethical issues were among the most commonly reported challenges. Although respondents indicated that they verify AI-generated information to some extent, uncertainty regarding responsible and acceptable use remains. These findings suggest that while AI tools offer clear benefits, their use must be accompanied by awareness of limitations and ethical considerations. Overall, the study contributes empirical evidence on current AI usage practices in academic settings. The findings highlight the need for balanced and responsible integration of AI tools to ensure that their benefits are realized without compromising academic quality and integrity.

Recommendations

Based on the findings of this study, the following recommendations are proposed.

1. *Development of institutional AI policies:* Higher education institutions should develop clear guidelines outlining acceptable and ethical use of AI tools in academic work. Clear policies can reduce uncertainty and promote responsible use.
2. *AI literacy and training programs:* Training programs should be introduced to improve users' understanding of AI tools, including their limitations, accuracy issues, and appropriate verification practices.
3. *Promotion of critical AI use:* Users should be encouraged to treat AI tools as supportive aids rather than replacements for independent thinking. Emphasis should be placed on critical evaluation of AI-generated outputs.
4. *Support for ethical awareness:* Institutions should incorporate ethical discussions related to AI use, academic integrity, and data responsibility into academic training and orientation programs.
5. *Ongoing monitoring and evaluation:* Regular assessment of AI usage patterns and challenges can help institutions update policies and training programs in response to evolving AI technologies.

DECLARATIONS

Author Contributions. Conceptualization, B.M. and B.R.D.N.; methodology, B.M. and B.R.D.N.; investigation, B.M.; formal analysis, B.R.D.N.; data curation, B.R.D.N.; writing—original draft, B.M.; writing—review and editing, B.R.D.N.; supervision, B.M.

Funding. This research received no external funding.

Ethical Clearance and Informed Consent. The study was approved by the research ethics committee of the authors' university. Participation was voluntary and anonymous, and informed consent was obtained from all participants before they answered the questionnaire.

Conflict of Interest. The authors declare no conflict of interest.

Data Availability Statement. The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declaration of AI Use. The authors did not use generative AI or AI-assisted tools in the preparation of this manuscript.

ACKNOWLEDGEMENT

The authors thank the students who participated in the study, and the librarians and academic staff who assisted in circulating the questionnaire.

REFERENCES

Alessi, E. J., & Martin, J. I. (2010). Conducting an internet-based survey: Benefits, pitfalls, and lessons learned. *Social Work Research, 34*(2), 122–128. https://doi.org/10.1093/swr/34.2.122

Al Naqbi, H., Bahroun, Z., & Ahmed, V. (2025). Generative AI integration: Key drivers and factors enhancing productivity of engineering faculty and students for sustainable education. *Sustainability, 17*(21), Article 9914. https://doi.org/10.3390/su17219914

Alkabaa, A. S., & Alamri, N. M. (2025). Exploring the effectiveness of generative AI as a learning tool in engineering education: An analysis of student experiences and perceptions. *Computer Applications in Engineering Education, 33*(6), Article e70110. https://doi.org/10.1002/cae.70110

Baig, M. I., & Yadegaridehkordi, E. (2024). ChatGPT in the higher education: A systematic literature review and research challenges. *International Journal of Educational Research, 127*, Article 102411. https://doi.org/10.1016/j.ijer.2024.102411

Callegaro, M., Manfreda, K. L., & Vehovar, V. (2015). *Web survey methodology*. SAGE Publications. https://doi.org/10.4135/9781529799651

Choi, S., Jang, Y., & Kim, H. (2023). Influence of pedagogical beliefs and perceived trust on teachers' acceptance of educational artificial intelligence tools. *International Journal of Human–Computer Interaction, 39*(4), 910–922. https://doi.org/10.1080/10447318.2022.2049145

Cotton, D. R. E., Cotton, P. A., & Shipway, J. R. (2024). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International, 61*(2), 228–239. https://doi.org/10.1080/14703297.2023.2190148

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3), 297–334. https://doi.org/10.1007/bf02310555

erić, E., Frank, D., & Vuković, D. (2025). Exploring the ethical implications of using generative AI tools in higher education. *Informatics, 12*(2), Article 36. https://doi.org/10.3390/informatics12020036

Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., Baabdullah, A. M., Koohang, A., Raghavan, V., Ahuja, M., Albanna, H., Albashrawi, M. A., Al-Busaidi, A. S., Balakrishnan, J., Barlette, Y., Basu, S., Bose, I., Brooks, L., Buhalis, D., … Wright, R. (2023). Opinion paper: "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management, 71*, Article 102642. https://doi.org/10.1016/j.ijinfomgt.2023.102642

Fan, M., & Irawan, N. (2025). [Review of the book *Generative AI in higher education: The ChatGPT effect*, by C. K. Y. Chan & T. Colloton]. *AI & Society, 40*(6), 5041–5042. https://doi.org/10.1007/s00146-025-02246-5

Fosso Wamba, S., Queiroz, M. M., Randhawa, K., & Gupta, G. (2025). Generative artificial intelligence and the challenges to adding value ethically. *Technovation, 144*, Article 103235. https://doi.org/10.1016/j.technovation.2025.103235

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage.

Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günnemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., … Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences, 103*, Article 102274. https://doi.org/10.1016/j.lindif.2023.102274

Kung, T. H., Cheatham, M., Medenilla, A., Sillos, C., De Leon, L., Elepaño, C., Madriaga, M., Aggabao, R., Diaz-Candido, G., Maningo, J., & Tseng, V. (2023). Performance of ChatGPT on USMLE: Potential for AI-assisted medical education using large language models. *PLOS Digital Health, 2*(2), Article e0000198. https://doi.org/10.1371/journal.pdig.0000198

Lin, X. (2024). Factors influencing college students' use of AI chatbots for learning: Empirical study based on TAM extended model. In *2024 5th International Conference on Artificial Intelligence and Electromechanical Automation (AIEA)* (pp. 151–159). IEEE. https://doi.org/10.1109/AIEA62095.2024.10692550

Liu, C., Wang, G.-C., & Wang, H.-F. (2025). The application of artificial intelligence in engineering education: A systematic review. *IEEE Access, 13*, 17895–17910. https://doi.org/10.1109/ACCESS.2025.3532595

Lo, C. K. (2023). What is the impact of ChatGPT on education? A rapid review of the literature. *Education Sciences, 13*(4), Article 410. https://doi.org/10.3390/educsci13040410

Merhej Sayegh, M., Rouhana, R., Osta, A., & Haddad, Z. (2025). Exploring student intentions to use generative AI in Lebanese higher education: An EVT and TPB perspective. *Cogent Education, 12*(1), Article 2541082. https://doi.org/10.1080/2331186x.2025.2541082

Moya, B., Eaton, S. E., Pethrick, H., Hayden, K. A., Brennan, R., Wiens, J., McDermott, B., & Lesage, J. (2023). Academic integrity and artificial intelligence in higher education contexts: A rapid scoping review protocol. *Canadian Perspectives on Academic Integrity, 5*(2), 59–75. https://doi.org/10.55016/ojs/cpai.v5i2.75990

Munaye, Y. Y., Admass, W., Belayneh, Y., Molla, A., & Asmare, M. (2025). ChatGPT in education: A systematic review on opportunities, challenges, and future directions. *Algorithms, 18*(6), Article 352. https://doi.org/10.3390/a18060352

Perante, W. C., Oquino, V. H., Cidro, M. K. T., Perante, W. A., Barquin, G. M., & Gomba, F. E. (2025). Utilization of artificial intelligence tools in engineering education among HEIs in Eastern Visayas, Philippines. *International Journal of Learning, Teaching and Educational Research, 24*(12), 758–775. https://doi.org/10.26803/ijlter.24.12.32

Pham, T., Nguyen, T. B., Ha, S., & Nguyen Ngoc, N. T. (2023). Digital transformation in engineering education: Exploring the potential of AI-assisted learning. *Australasian Journal of Educational Technology, 39*(5), 1–19. https://doi.org/10.14742/ajet.8825

Qadir, J. (2023). Engineering education in the era of ChatGPT: Promise and pitfalls of generative AI for education. In *2023 IEEE Global Engineering Education Conference (EDUCON)* (pp. 1–9). IEEE. https://doi.org/10.1109/EDUCON54358.2023.10125121

Ravšelj, D., Keržič, D., Tomaževič, N., Umek, L., Brezovar, N., Iahad, N. A., Abdulla, A. A., Akopyan, A., Aldana Segura, M. W., AlHumaid, J., Allam, M. F., Alló, M., Andoh, R. P. K., Andronic, O., Arthur, Y. D., Aydın, F., Badran, A., Balbontín-Alvarado, R., Ben Saad, H., … Umek, L. (2025). Higher education students' perceptions of ChatGPT: A global study of early reactions. *PLOS ONE, 20*(2), Article e0315011. https://doi.org/10.1371/journal.pone.0315011

Saxena, A., & Rishi, B. (2025). Advancing Sustainable Development Goal 4: A comparative analysis of large language models. *International Journal of Educational Management, 39*(7), 1774–1791. https://doi.org/10.1108/ijem-12-2024-0837

Sue, V. M., & Ritter, L. A. (2012). *Conducting online surveys* (2nd ed.). SAGE Publications. https://doi.org/10.4135/9781506335186

The jamovi project. (2025). *jamovi* (Version 2.7) [Computer software]. https://www.jamovi.org

UNESCO. (2025, April 14). *Guidance for generative AI in education and research*. https://www.unesco.org/en/articles/guidance-generative-ai-education-and-research

Vieriu, A. M., & Petrea, G. (2025). The impact of artificial intelligence (AI) on students' academic development. *Education Sciences, 15*(3), Article 343. https://doi.org/10.3390/educsci15030343

Vincent-Lancrin, S., & Van der Vlies, R. (2020). *Trustworthy artificial intelligence (AI) in education: Promises and challenges* (OECD Education Working Paper). OECD Publishing. https://doi.org/10.1787/a6c90fa9-en

Williamson, B., & Eynon, R. (2020). Historical threads, missing links, and future directions in AI in education. *Learning, Media and Technology, 45*(3), 223–235. https://doi.org/10.1080/17439884.2020.1798995

Yang, W., Lu, Z., Li, Z., Cui, Y., Dai, L., Li, Y., Ma, X., & Zhu, H. (2025). The impact of human–AIGC tools collaboration on the learning effect of college students: A key factor for future education? *Kybernetes, 54*(15), 7746–7763. https://doi.org/10.1108/k-03-2024-0613