Exploring the Impact of Artificial Intelligence on Learning and Decision-Making in Engineering Students

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Abstract— Artificial intelligence (AI) adoption is rapidly increasing in several domains, and education is not an exception. One important breakthrough is the application of AI tools to teaching and learning activities that has shown great promise. They can serve as resources for students to use for a variety of academic purposes and decisions. As AI software, such as intelligent tutoring systems, chatbots, and learning boards driven by data, becomes pervasive within schools and universities, students are being given a more individualized, flexible, and responsive learning experience. The use of AI in engineering programs has its own advantages and disadvantages. Artificial intelligence technologies meet numerous roles in education. The growing use of AI in education and research has also led to ethical debate and ways to address it. The AI systems in this study are in dialogue with students and monitor student interactions, and collect such monitoring data. The findings reveal that users find AI useful for the understanding of new concepts, user-adaptive learning, and assistance in decision-making, but challenges regarding dependence, privacy, memory, and ethics persist. These potential negatives just highlight the need for moderation in terms of ethics, some teacher oversight on these types of programs, and keeping tabs on them. This study contributes to our understanding of how students use AI, giving important indications on what we should aim for in promoting responsible and effective use of AI in engineering education.

Keywords- Artificial Intelligence, Education, Decision Making, Engineering Students, Learning

I. INTRODUCTION

The speedy progression of Artificial Intelligence (AI) technologies has brought transformative changes to each and every sector, including education. In education, particularly in engineering disciplines, AI tools have emerged as a significant influencing factor in reshaping teaching, learning, and decision-making processes of students. AI technologies such as adaptive learning platforms, virtual assistants, and intelligent tutoring systems have rapidly made their way into academic environments. They also provide personalized learning options as well as learning experiences that help students with other duties, such as course planning, problem-solving, and making informed decisions for the future. And those technologies have been proven to enhance student engagement and academic performance. Engineering students, in particular, are very frequently using AI tools to stay ahead of the curve with innovations. This makes them a good distribution group for the scientists to investigate the effects of AI on learning behaviour and decision-making. The benefits of AI now are also its consequences; more access to facts, real-time feedback, targeting, etc, are the boons or sins of our AI transformation. Some of which include risks of over-dependence, ethical

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misuse, and potential reductions in critical thinking and memory skills. The goal of the study is to know how AI tools influence the academic learning and behavioural aspects of engineering students' academic journeys, while also acknowledging the associated challenges. By analysing the data collected from students through a structured questionnaire, the research provides insights into both the positive impacts and the potential concerns/ risks of AI dependency. The findings focus on the importance of responsible AI usage and highlight the need for ethical guidelines, continuous monitoring, and human oversight in academic settings.

II. REVIEW OF LITERATURE

The application of AI in the education field has attracted significant interest from researchers and practitioners alike, especially in technical domains such as engineering. The researchers have reviewed the research papers from quality publications like Scopus, Web of Science, etc. The summary of the review of the literature is as follows:

AI in Educational Environments: (Okonkwo, 2021, January) The article describes the increased application of AI in education and a highly personalized experience for the learners. It has facilitated the development of smart tutoring systems, adaptive learning platforms, and AI-powered assistants that provide guidance as per learners' requirements. These tools offer students the ability to engage with content in a manner tailored to their individual learning styles, thereby improving academic performance and conceptual understanding.

Personalized and Adaptive Learning: The article (Kumar A. , 2023, September) Emphasizes that AI-powered systems are central to enabling personalized and adaptive learning environments, where instructional content and pace are dynamically adjusted to suit individual learners. Using advanced algorithms can help in enhancing the engagement of the students by offering them flexible pathways for knowledge acquisition and conceptual mastery. Collectively, the research positions AI not merely as an instructional aide but as an active participant in tailoring education to diverse learner profiles, thereby fostering more meaningful and effective learning outcomes.

The research paper (Reiss M. , 2021) highlights the multifaceted role of AI in education, illustrating how AI extends beyond simple automation to actively enhance learning processes and support informed decision-making among students. AI is capable of personalizing instructional content by integrating intelligence analytics. It can also assist learners in evaluating academic pathways and selecting options best aligned with their abilities and goals. This perspective positions AI as both a cognitive partner in knowledge acquisition and a strategic guide in educational planning, reflecting its broader impact on shaping learner autonomy and academic success.

While recognizing the huge advantages in integrating AI into higher education, the paper by Sayed (2023) also humbly concedes certain limitations. The work concerns AI-based applications varying from intelligent tutoring systems to automatic evaluations. They spice up learning, add a bit of fun, and help create a learning culture. Yet, these gains come with challenges, including ethical issues, concerns over data privacy, algorithmic biases, and the possibility of overdependence on technology over human judgment. This dual focus highlights the need for a careful, well-regulated approach to adopting AI within education to fulfil its potential to support teaching and learning while upholding academic integrity and equity. Ethical and Thinking Skills: Kooli (2023) illustrates the ethical and cognitive effects that AI entry in education can have, contending that technological advances must be synchronized with responsible usage. The findings underline concerns regarding data privacy, informed consent, algorithmic transparency, and the possible erosion of human judgment in educational contexts. It also guarantees that AI-based education effectively improves learning and protects students' rights, privacy, autonomy, and cognitive development by conceptualizing AI as a pedagogical technological innovation. It has even posited this as a moral question that underlines the urgency in the requirement for governance principles and value-centered design practices.

Wang (2023) focuses on the influence of AI on students' academic decision-making, examining both the positive and negative sides of AI. The study shows that AI-based tools, such as predictive analytics algorithms and recommendation systems, could help students select courses, programs, or career paths that are the best fit for their talents and aspirations. Also, the author cautions on the increased integrations and reliance on algorithmic advice that may impede students' critical thinking skills, and reiterates the issues around transparency, bias, and over-automation in choice-based educational systems. This double perspective frames AI as both an enabler and a possible trap of dependency and thus suggests a more responsible blending of the technology.

The study showcases the consensus on the changing scope of AI in engineering education and academic decision-making to improve learning efficiency. However, it also chalks out the significant challenges.

III. OBJECTIVES

1. To study and understand the AI interaction and usage amongst engineering students for academic learning processes.
2. To evaluate the effect of AI tools on the understanding of core engineering concepts and the academic performance of students.
3. To identify the major usage of AI and apprehensions due to the integration of AI tools in engineering education.
4. To recommend strategies for AI responsible use in academic environments.

IV. RESEARCH METHODOLOGY

Research Design: The researchers have adopted a Quantitative approach for this study. A Descriptive and analytical research design is applied to know more about the impact of AI tools on the learning and decision-making processes of engineering students.

Population**:** The study targets undergraduate engineering students enrolled in deemed universities within the Pune Region of Maharashtra, India. Due to the substantial number of

deemed universities and the considerable student population in this area, the study considers an extensive or infinite population.
Sampling of the Study**:** To define an appropriate sample size for the study, especially given a large or undefined population, the researchers considered multiple methods. They referred to the Krejcie and Morgan table, along with statistical formulas designed for infinite populations. Based on these approaches, a sample size of 384 was identified as suitable, ensuring a 5% margin of error and a 95% confidence level. Furthermore, Cochran's formula and a Z-score–based formula were also applied to support this calculation.
A sample size of three hundred and eighty-four would be justifiable for an infinite population size. As a result, the researchers distributed questionnaires to 539 individuals to cover a larger sample base. After excluding 16 incomplete responses and 10 non-responses, data from 513 participants were retained for analysis. Thus, 26 individuals were excluded from the final sample due to ineligibility. Non-probability sampling techniques, specifically convenience sampling, were applied for the collection of data.
Primary Data**:** To gather primary data, the researchers designed a structured questionnaire, which was distributed to undergraduate students studying at engineering colleges affiliated with deemed universities in the Pune region. A pilot study involving 90 students from these institutions was carried out, during which informal interactions took place to gather participant feedback. This input was used to improve and refine the questionnaire. To make sure about the instrument's reliability, Cronbach's alpha was computed, and content validity was assessed to confirm its appropriateness and effectiveness. A collection of Secondary data was done from a diverse range of sources, comprising research papers, articles, academic journals, online resources, and newspapers.

Data Analysis**:** The researchers employed both **SPSS and MS Excel** to analyse data. **Chi-square test** was applied to hypothesis testing, and findings were presented through frequency tables and descriptive statistics. **Cronbach's alpha was applied for reliability testing**. The computed Cronbach's alpha value was 0.768 for standardized items, indicating high reliability. According to **Cortina (1993)**, a Cronbach's alpha value above 0.70 is deemed acceptable, confirming that the questionnaire responses were reliable. The initial summary of case processing showed that **513 valid responses** from undergraduate students were included, and the total sample siz**e of 513** remained consistent for all subsequent data analysis procedures.

Case Processing Summary

		N	%
Cases	Valid	513	100.0
	Excluded[a]	0	.0
	Total	513	100.0

a. Listwise deletion based on all variables in the procedure.

Case Processing Summary

		N	%
Cases	Valid	513	100.0
	Excluded[a]	0	.0
	Total	513	100.0

Reliability Statistics

Cronbach's Alpha	N of Items
.768	30

Demographic Profile**-**This analysis aims to understand the demographic profile of engineering students using AI tools in a deemed university in the Pune region.

TABLE I
DEMOGRAPHIC PROFILE

Gender	**Frequency**	**Percent (%)**	**Valid Percent (%)**	**Cumulative Percent (%)**
Male	265	52%	52%	52
Female	248	48%	48%	100
Region				
Rural	30	6%	6%	6%
Semi Urban	105	20%	20%	20%
Urban	378	74%	74%	100%
Family Annual Income				
Less than 5 Lac	35	7%	7%	7%
5L-10 L	210	41%	41%	41%
10 L-15 L	189	37%	37%	37%
15 L and above	79	15%	15%	100%
Age				
24 and above	14	3%	3%	3%
21-24	189	37%	37%	37%
18-21	310	60%	60%	100%

The data shows a nearly equal gender split among engineering students, with **52% male** and **48% female**. A majority (**74%**) come from **urban areas**, reflecting strong access to technology. Most students (**60%**) are aged **18–21**, suggesting they are early in their academic journey. More than half belong to families earning **₹5 lakh to 15 lakh annually**. Overall, the student base is young, urban, and diverse, making them well-positioned for AI adoption in education.

TABLE II
AI INTERACTION AND USAGE

AI interaction and usage	Frequency	Percent	Valid Percent	Cumulative Percent
1 (No)	49	9.55	9.55	9.55
2(Yes)	464	90.45	90.45	100.00

The data shows that a vast majority of engineering students (**90.45%)** actively **interact with and use AI tools**, **indicating** widespread adoption in their academic activities. Only **9.55%** reported not using AI.

Purpose/Objectives of AI Usage -To assess the purpose/objectives to explore how AI supports key academic areas. Key variables identified are **research topics**, writing **assignments, concept learning, decision-making,** and enhancing **critical thinking, problem-solving,** and **personalized learning** experiences.

TABLE III
PURPOSE/OBJECTIVES OF AI USAGE

Purpose/Objectives	Description	Frequency	Percentage
Researching Topics	Using AI to explore and gather information on various subjects.	217	42.3001949
Writing Assignments	Getting assistance in drafting, editing, or improving written work.	496	96.6861598
Learning Concepts	Understanding academic or complex concepts through explanations.	489	95.3216374
Decision-Making Support	Seeking advice or structured thinking for academic or personal decisions.	289	56.3352827
Boost Critical thinking	Prompt students to think more analytically	49	9.55165692
Problem solving	Tackle complex engineering problems	320	62.3781676
Personalized learning	content based on a student's pace and understanding	389	75.82846

Writing Assignments are the most common use, with **96.7%** of students using AI for drafting or improving their work**. Learning Concepts** is the second important reason, with **95.3%** using AI to understand complex topics**. Decision-Making Support** is used by **56.3%,** showing moderate reliance on AI for academic or personal choices. **Researching Topics** is the least common, with **42.3%** using AI to gather information on various subjects. Personalized **Learning (75.8%)** students prefer the use of AI for tailored content that matches their learning speed and needs. 62.4%rely on AI to help solve complex engineering problems efficiently. 9.6% students use AI to enhance analytical thinking, indicating a limited perceived impact in this area.

V. MAJOR CONCERNS/ CHALLENGES IN USING AI

The identified variables include over-dependence on the tool, memory retention, difficulty understanding responses, adverse impact on decision-making, inaccurate information, privacy concerns, lack of domain-specific accuracy, reduced creativity, ethical concerns (e.g., plagiarism or misuse), and technical issues (e.g., access, cost, or tool limitations)**.**

The table highlights major concerns students face when using AI in education. The top concerns include **overdependence on AI (95.91%), reduced memory retention (93.18%), and ethical issues such as plagiarism (91.42%), indicating that students worry about long-term learning and potential** misuse. **Adverse impacts on decision-making (90.06%)** and **reduced creativity (89.08%)** are also significant. While concerns like **inaccurate information**, **privacy**, and **technical issues** affect over half the students, challenges in **understanding AI responses** are relatively lower but still notable (52.63%).

Hypothesis Testing

H_0: Students **do not** use AI frequently for academic purposes.

H_1: Students **do** use AI frequently for academic purposes.

TABLE IV
MAJOR CONCERNS/ CHALLENGES IN USING AI
CASE PROCESSING SUMMARY

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
AI interaction * AI is often used for academic purposes	513	100.0%	0	.0%	513	100.0%

AI interaction * AI is often used for academic purposes. Cross tabulation

		AI is often used for academic purposes					Total
		1	2	3	4	5	
AI interaction	1	225	134	46	53	6	464
	2	33	16	0	0	0	49
Total		258	150	46	53	6	513

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.437[a]	4	.006
Likelihood Ratio	24.153	4	.000
Linear-by-Linear Association	12.593	1	.000
N of Valid Cases	513		

The **Pearson Chi-Square p-value is 0.006**, which **is less than 0.05.** There is **statistically significant evidence** that students' interaction with AI is **associated with** how frequently they use AI for academic purposes. **Therefore, the null hypothesis ("students do not use AI frequently") is rejected. Students were asked questions about frequency, like daily, weekly, fortnightly, monthly, and rarely.**

Hypothesis -2

H_0: There is no significant association between students' AI interaction and their level of dependence on AI.

TABLE V
MAJOR CONCERNS FACED BY STUDENTS WHILE USING AI IN EDUCATION

Major Concerns/ Challenges in Using AI	**Description**	**Estimated Number of Students**	**Percentage (%)**
Over-dependence on the tool	Relying too much on AI, reducing self-learning and problem-solving skills	492	95.91%
Memory Retention	**The ability of students to retain and recall information** over time after exposure to AI	478	93.18%
Difficulty understanding the responses	Responses may be too complex or unclear for some users	270	52.63%
Adverse impact on decision-making	Students may follow AI suggestions without critical evaluation	462	90.06%
Inaccurate information	AI might provide wrong or misleading data	310	60.43%
Privacy concerns	Data sharing and security risks	378	73.68%
Lack of domain-specific accuracy	AI might not give precise answers for specialized engineering topics	310	60.43%
Reduced creativity	Heavy AI use may limit original thinking or innovative ideas	457	89.08%
Ethical concerns (e.g., plagiarism or misuse)	Students may use AI unethically in assignments or exams	469	91.42%
Technical issues (e.g., access, cost, or tool limitations)	Inconsistent access to tools or platform limitations	343	66.86%

H_2: There is a significant association between students' AI interaction and their level of dependence on AI.

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
AI interaction * excessive dependence on AI	513	100.0%	0	.0%	513	100.0%

AI interaction * excessive dependence AI Cross tabulation

		Excessive dependence on AI					Total
		1	2	3	4	5	
AI interaction	1	50	145	171	74	24	464
	2	0	24	0	25	0	49
Total		50	169	171	99	24	513

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	58.351[a]	4	.000
Likelihood Ratio	73.317	4	.000
Linear-by-Linear Association	3.457	1	.063
N of Valid Cases	513		

a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 2.29.

The **calculated Pearson Chi-Square value of 58.351,** along with a **p-value of 0.000**, indicates a **statistically significant association** between students' interaction with AI and their level of excessive dependence. This means the association between **AI interaction** and **excessive dependence on AI** is **statistically significant.** So, the null hypothesis is rejected. Responses to questions about AI interaction were Yes or No, while dependency on AI was assessed using a five-point scale: Highly Dependent, Dependent, Neutral, Not Dependent, and Not Highly Dependent.

Hypothesis -3

H_0: AI **usage does not positively enhance critical thinking in students (i.e., there is no significant association between AI interaction and students' levels of critical thinking).**

H3: AI usage does positively enhance critical thinking (i.e., there **is a significant association** between AI interaction and critical thinking levels).

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
AI interaction * Critical thinking	513	100.0%	0	.0%	513	100.0%

AI interaction * Critical thinking Cross tabulation

		Critical thinking			Total
		1	2	3	
AI interaction	1	88	337	39	464
	2	6	38	5	49
Total		94	375	44	513

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.407[a]	2	.495
Likelihood Ratio	1.526	2	.466
Linear-by-Linear Association	1.237	1	.266
N of Valid Cases	513		

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 4.20.

Since the p-value is high (0.495), we fail to reject the null hypothesis. There is no significant evidence to support the claim that AI usage positively enhances students' critical thinking. **Questions about AI usage were answered with 'Yes' or 'No', while questions regarding its positive impact on critical thinking included response options: 'Yes', 'No', and 'Not Sure'."** AI appears to have little to no positive impact on fostering critical thinking among students, as observed.

VI. MAJOR FINDINGS AND OBSERVATIONS:

1. Utilization of AI tools in academic learning processes and decision making by engineering students: It is observed from the data analysis that the majority of students frequently used AI tools for tasks like assignment completion, coding support, exam preparation, and report writing. AI tools were most commonly used for enhancing productivity, improving language quality, and receiving instant explanations for complex technical concepts.
2. Most common tools used are ChatGPT, Gemini, open AI. AI-driven educational platforms were among the most widely used by students for learning support and productivity enhancement.
3. AI tools are capable of providing a customized, flexible, and responsive understanding of the perception of the students.
4. Whether to enhance learning outcomes or support students in making informed decisions, AI tools can be trusted. The

study findings show that AI is positively influencing decision-making processes.

5. The information in the AI algorithms can then regulate the content delivered in real time based on student behaviors and learning data. It is also engaging and improves learning retention. It is a landmark in engineering education where issues are often blurry for students.
6. Not only in technology, but also in the field of education, AI can support in performing multiple operations such as personalized content advice, automation of assessment, and real-time checks of feedback. And AI-based analytics can also keep tabs on how students are pacing, matching their learning to career goals to improve strategies on what decisions are ultimately made.
7. There are ways in which AI shapes students' educational decisions, such as choice of courses, type of research project, and career plans. The research highlights that AI applications assist in decision-making with data-driven information.

VII. CHALLENGES IN USING AI IN ENGINEERING EDUCATION

Let's take a closer look at some of the challenges that come with creativity and critical thinking in education.

1. An overreliance on AI tools can impede students' critical thinking, memory, and creativity. Such an excessive dependence may stunt their acquisition of the necessary engineering skills, such as creativity, analytical thinking, and problem-solving.
2. Then there's the matter of privacy and ethics around the data. But though AI systems are adept at promoting personalized learning through the analysis of data, this can raise questions of transparency and can result in the misuse of sensitive information, and students' privacy can be at risk.
3. If AI systems give biased or discriminatory feedback, or if they affect how admissions processes are carried out, it's possible to generate unfairness for individuals from underrepresented student groups. Those systems could inadvertently perpetuate biases in the training data, or mirror the biases of their creators.
4. ChatGPT-like AI systems and automatic code generators may assist students in the completion of assignments without any academic or authentic effort. Such a process undermines genuineness and academic integrity, further devaluing educational credentials earned by the student.
5. Generally, the human connection between educators and students is diminished when they over-rely on the AI software. It cuts down the opportunities of peer learning for them, which might lead to isolation and a lack of support from the educators. In the long run, it can affect their mental health and emotional well-being.
6. Another challenge in the debarment of human instructors in the presence of AI and automation that is capable of performing tasks like grading, content delivery, and tutoring. It may further affect employment and the mentorship led by educators to fulfill students' professional ethics and values.

VIII. STRATEGIES FOR RESPONSIBLE APPLICATION OF AI IN ACADEMIC ENVIRONMENTS

1. Collaboration between Human and AI: AI should be suggested as a supportive tool, not a replacement. Educators should use AI to enhance teaching, not to fully automate it. It can preserve the human element of education while increasing efficiency.
2. Ethics Education and Digital Literacy: Incorporate AI ethics, responsible use, and digital literacy into engineering curricula. It will empower students to evaluate AI tools and apply them responsibly.
3. Transparency in data usage: Institutions must clearly inform students about details of data collected, its usage, and its accessibility. It builds trust and ensures compliance with data protection
4. Inclusive Design: Regular audit of AI systems for bias and include diverse perspectives during development to reduce bias and discriminatory outcomes, and ensure fair treatment for all learners.
5. Assessment Reforms: Educators should develop creative assessments that test critical thinking, practical application, and originality of the students. It will reduce the excessive and misuse of AI and ensure genuine learning.
6. Faculty Training and Support: Provide training for educators to integrate AI effectively and ethically in their teaching practices. It will encourage informed, responsible use and maximize AI's benefits in pedagogy.

IX. FURTHER SCOPE OF STUDY

As a scope for further study, the research can be extended by applying multivariate analysis techniques such as regression or factor analysis to uncover deeper patterns and relationships between variables. This would provide a more comprehensive understanding beyond descriptive and bivariate analysis, thereby enhancing the robustness and generalizability of the findings.

CONCLUSION

While AI offers transformative potential in engineering education—from personalized learning to smart tutoring—over-reliance poses ethical risks that could affect the quality, fairness, and integrity of academic processes. A balanced, transparent, and human-oriented attitude is essential to make sure that AI empowers education without compromising its core values.

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