

Navigating The Impact Of AI Tools: Exploring Challenges, Opportunities, And Strategies For Maintaining Quality Education In The Case Of Engineering Universities

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Abstract

The teaching and learning practices have been transformed by the incorporation of AI tools. This paper seeks to discuss the opportunities and challenges of implementing AI tools. The study was conducted in the form of a qualitative study. The semi structured interviews were carried out on 30 university faculty members in various engineering institutions to investigate their perception regarding the role of AI in an academic culture. The results found significant tendencies emphasizing the advantages of AI tools in the improvement of the educational achievements, such issues as technical constraints, insufficient training and support, and worries about job displacement and over-reliance on AI tools undermine creativity and critical thinking abilities of the students. The paper is highlighting a need to have an emergence and development of teaching strategies by the educationalists and investment by institutions in professional development programs which builds technical skills of teachers. Policymakers should note that the universities should have the necessary infrastructure and resources to successfully adopt the use of AI tools in the learning process. These findings can be added to the highly developing structure of literature on AI-assisted learning that can provide great recommendations to instructors, scholars, and administrators who aim to leverage the power of AI without suffering the loss of quality of education and creativity.

Keywords: Artificial intelligence (AI), Generative AI in education, Engineering university pedagogy, Teacher adoption of AI, Challenges and opportunities of AI in learning

INTRODUCTION

Due to blistering development of artificial intelligence (AI), the use of AI has become extremely popular with ChatGPT, Gemini and other generative AI models taking over the world and making substantial changes in higher education, including in engineering universities (Akolekar et al., 2025). Students greatly use these tools to formulate academic content, to perform assignments and numerical tasks (Akolekar et al., 2025; Hanafi et al., 2025) Platforms that are being driven by artificial intelligence will offer instant feedback, automate the processes within the administration

and support more personalized learning accomplishing education to be more accessible and efficient (Hanafi et al., 2025).

Nevertheless, there are concerns, as well as advantages to the effect of AI on learners' innovation, the role of teachers and the general standards of schooling (Popenici & Kerr, 2017). With the increases in the sophistication and the availability of AI tools, numerous students start using them to generate content, formulate ideas, and solve problems (Pellas, 2025). Although such can be efficacious, they can also influence critical thinking and creativity as a result of students relying too much on AI generated answers rather than offender the independent reasoning (Hanafi et al., 2025; Popenici & Kerr, 2017). The change poses challenges to the teachers to integrate new methods of teaching that would allow them to create originality and an increase use of higher order thinking (Devaki, 2024). Furthermore, the existing position of an educator is becoming more than a traditional one where they should be more inventive and technologically skilled in the fields of AI use (Karataş et al., 2024). The requirements are that teachers should not cease updating their professional abilities according to the current technological developments and implement AI tools in their classes successfully (Devaki, 2024; Karataş et al., 2024).

The implementation of AI in learning comes with a number of issues despite the benefits that it could have. One of the challenges most educators face is the inability to adjust as a result of poor training, insufficient institutional support and time constraint caused by workload (Naseer et al., 2025). Moreover, the problem of ethical issues in the academic integrity, plagiarism and the responsible work with AI generated material are essential problems (Naseer et al., 2025). Universities are required to meet these issues by investing in faculty development program where educators are provided with the required technical and pedagogical skills and provide balanced and ethical learning environment (Mouta et al., 2024).

The proposed study will set out to examine the ways in which AI technologies are transforming the teaching and learning process of engineering colleges by understanding the experiences of educators regarding this issue, the problems and methods of sustaining high-quality education. In particular, the study will discuss the following questions:

RQ1: How do engineering educators perceive the advantages and issues of implementing AI?

RQ2: In what way are the educators changing their teaching methods due to the adoption of AI?

Considering the benefits and dark aspects of AI in the engineering educational process, the given study presents an exclusive perspective on the role of educator being modified in accordance with the wave of AI implementation. It is also expected to build on the existing literature by closing the gap in knowledge on the impact that the concept of AI tools integrated into the teaching methodologies and their effects on the academic integrity pedagogy.

LITERATURE REVIEW

Generative AI models have advanced in a remarkable way and demonstrated to be very versatile in areas including natural processing, image generation as well as complex problem solution (Bengesi et al., 2024). Such influential models as ChatGPT, Gemini, Claude, LLaMA and Mistral all have their own capabilities, which is constantly growing alongside technological progress (Bengesi et al., 2024). Generally, the AI workflow has three steps in the generative component. It starts with data phase that combines various input such as text images, speech, structured information as well as the 3D signals. The next stage of the foundation model is training and adapting in the fine-tuning stage. Lastly, task stage presents practical uses of AI including question answering, sentimental analysis, information extracting and image classification (Sengar et al., 2024).

These improvements have overturned the teaching and learning dynamics in case of engineering studies in the event that they come up with. AI tools are able to generate learning opportunities at

a more personalized level, increase problem solving abilities, aids research with the help of literature analysis and simulation, and cars out in administration tasks (Sengar et al., 2024). A number of studies have noted that the adoption of AI enhances student interactions in terms of adaptive learning system and virtual, and is applicable in multifaceted field such as engineering (Hagos et al., 2024). Nonetheless, in spite of such benefits, the issue of overdependence on AI technologies and their effects on the customary practice is one of the central issues of discussion (Hagos et al., 2024). Overutilization of AI might interfere with the ability of the students to master critical thinking and ability to solve their problems independently (Ali et al., 2024).

Students have access to a large amount of information instantly with the help of AI tools, which help them to come up with ideas, summarize the concepts and even a finalization of the assignment at a more convenient pace. Although such availability makes people creative, it has been found that too much reliance on AI produced materials does suppress the potential of students to think creatively and critically (Ali et al., 2024). Calculating of the process of writing and creating codes and finding solutions has brought about the question of students growing to be the passive learners as opposed to facing intellectual challenges (Bansal et al., 2024).

A number of studies support the necessity to balance active learning strategies with AI assistance. Teachers need to introduce a framework in the curriculum that promotes originality, critical thinking, and problem-solving such that students would be treated as a supporting and aiding tool to the cognitive activity instead of doing it for students. Other scientists propose the introduction of AI awareness program that will provide the students with ethical application of AI and the approach which would stimulate autonomy and creativity in an AI support-based study (Abdulrahman, 2024).

The use of AI in education poses serious problems to the instructors (Thomas, 2024). Among the major issues, it is important to mention the inadequacy of training and technical skills that can be employed to incorporate AI into the teaching strategies (Abdulrahman, 2024). Most teachers faces challenges integrating AI-tools into pedagogy because they do not have organizational support and adequate professional development courses (Abdulrahman, 2024). In addition, the menace of deskilling is another major issue among teachers as the AI systems have led to concerns regarding the future of human teachers (Thomas, 2024). However, the studies indicate that the role of educator is not supposed to be reduced. They need to change their approach towards mentoring where they make them think critically and give personal recommendations (Thomas, 2024).

Additionally, the academic integrity and plagiarism has been a significant issue that the AI has been playing an important role throughout the education system (Muazu, 2024). To address this issue, a lot of institutions are struggling on the way to control ethical usage of AI-generated contents in grading whilst being just and genuine. To promote genuine student activity, AI detection mechanism is now being investigated by universities as well as alternative assessment schemes being redefined (Muazu, 2024).

Keeping in mind the urgency of the changing role of AI in education, it is necessary to be addressed and adapted as soon as possible. In fact, teachers must improve their technical skills and imagination in order to be functional in the conditions of AI-assisted learning (Benouachane, 2024). This period makes it imperative to embrace new and practical practices that embrace the use of AI tools even though evoking human-oriented learning processes (Muazu, 2024). Institutional support has a crucial role to play in the provision of the breadth of infrastructure, resources and policies that are required to successfully implement AI in education. The fact that government and academic institutions are joining forces and offering sufficient and pertinent training is a desperate requirement of the day. Such training will lead to the establishment of AI guideline, and the development of dynamic curricula that will utilize AI potential without affecting the quality of education (Muazu, 2024).

The researcher has also indicated the positive and negative aspects of incorporation of AI-tools in schools. Research indicates that AI is a powerful useful device, and its outstanding characteristic is offering immediate solutions to any dilemma but it is also hazardous to the ingenuity and authenticity of people (Benouachane, 2024). This issue will require identifying a moderate solution involving the integration of AI -based innovation and human-centered instruction. In the future, any academic learning opportunities offered should look into the AI integration without compromising the ethical study. Encouraging innovation, preparing the trainers with the required expertise to operate the AI-mediated training efficiently (Benouachane, 2024).

The gap in the existing literature is wide and under-researched the complicated situation caused by the merging of AI and maintaining the quality of education in engineering universities specifically in the developing world i.e. Karachi, Pakistan (George & Wooden, 2023). Although the negative impact of AI in education has not attracted a significant amount of attention globally, it is clear that it is often disregarded, as the institutions also face a number of issues that are not common to every other institution of that type (Arvin et al., 2023). This paper aims at filling this gap by exploring the lived experience of the educators, the barriers posed to them by the institutes they work in as well as their pedagogical practices which utilize AI assisted learning to navigate through their learning experiences. Through unearthing grounded perspectives in the form of theses, the study will come up with actionable information that will guide policy makers and curriculum designers. Such findings, in the long run will lead towards enhancing an ethical, innovative contextually balanced introduction of AI to the higher education systems in the developing regions.

METHODOLOGY

The qualitative research strategy was used in the research methodology as depicted in figure 1. It employs semi structure questionnaire, to retrieve in depth information of the experience and the difficulties that the teachers in the engineering universities encounter, in the process of adapting the AI in the teaching process (Mateus et al., 2024). It was developed to obtain the semiautomatic nature of experiences, perceptions and plans used by teachers in reaction to the increased use of AI in learning institutions.

Research Design

The purposive sampling technique was applied, in picking 30 members of the faculty of two universities of engineering in order to represent diversity of views of different engineering subjects. The sample used in the study consisted of 30 faculty members in two engineering universities. The sample of the research population was chosen according to different fields of engineering such as mechanical, electrical, electronics, and industrial engineering and guaranteed a variety of viewpoints on the use of AI in education. The respondents were selected according to their time of working in the field of teaching, connectedness with the use of AI-based tools in education, and willingness to participate in the research.

Data Collection method

In order to gather redundant qualitative information semi-structured interviews were carried out including such data as personal or video-conferenced interviews. The interview guideline included open-ended questions aimed at learning the experience of teachers, benefits and difficulties of using AI tools, as well as strategies to efficiently implement AI tools in the teaching process.

Data Analysis trials

The data of the interviews were analyzed through the thematic analysis; whereby, the tape recordings were transcript verbatim and coded using NVivo software systematically. The codes were grouped into broad themes where it was possible to discover patterns, relationship and important insights on the effects of AI on methods of teaching.

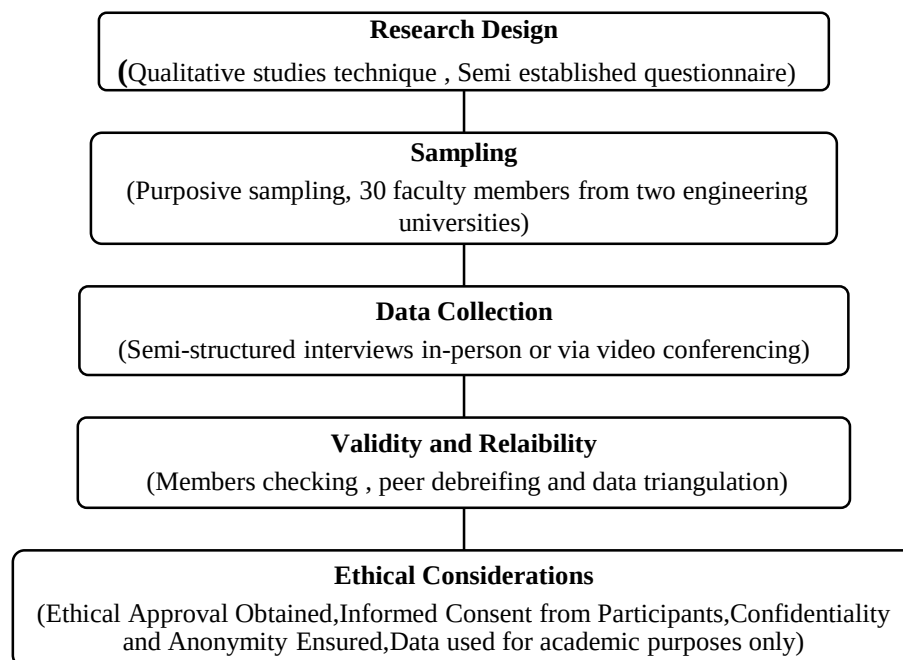
Validity and Reliability Conduct.

Various validation plans were adopted to achieve the credibility and reliability. The process involved member checking, which entailed reviewing of transcripts of interviews to ensure that there was no inaccuracy or falseness of the results. Furthermore, peer debriefing entailed frequent consultation with research fellows in order to narrow down on theme emergent during the process and interpretation. Cross-validation of the interview data with documentary evidence, including university policies and course contracts and institutional reports, was used to bring a deeper insight into the situation, hence data triangulation was employed.

Ethical considerations

Ethical issues were thoroughly followed in the study. Institutional ethical committees of the university where the researcher was based gave his approval and an informed consent was obtained on participating in the interviews with all the participants, which was volunteered toward the end of the research. All the information was vehemently kept confidential and anonymity was strictly observed and no information was utilized except in the academic purpose. These methodological implications enhanced the dependability and credibility of the results, which made sure that the research included the true picture of the experiences and problems of teachers with integrating AI-related educational technologies in engineering schools.

Fig. 1 Flowchart showing the research methodology adopted in the qualitative study



RESULTS

The results are represented in two distinct sections. The first section represents the demographic characteristics of the participants, highlighting key variables such as gender, years of experience, designation, departments and usage of different AI tools. The second section focuses on emerging themes derived from the interviews which gives insights into key trends and patterns.

Section I:

Table 1: Shows gender distribution of participants

Years of Experience	Male	Female
5 to 10	4	3
11 to 15	5	3
16 to 20	4	3
21 to 25	3	2
Above 25	2	1

Table 1 illustrates gender distribution whereby out of 30 teachers 18 were men and 12 were women who took part in the study. It also represents the gendered representation of the participants based on their experience levels. The level of experience was categorized in five levels that consisted of 5 to 10 years, 11 to 15 years, 16 to 20 years, 21 to 25 years and the last one was above 25 years. The data has been fairly balanced in the participation of diverse levels of experience where both male and female members of the faculty will be represented in each profile. Particularly, the biggest population was composed of respondents who had 11 to 15 years of experience, which was a total of 8 of 5 males and 3 females. Teachers with 5 or 10 came next representing 7 participants of 4 males and 3 females. There were 7, 5 and 3 participants in Year 16 to 20 and 21 to 25 and 25 years above respectively.

Table 2: Distribution of Participants by Department and Gender

Department	Male	Female
Mechanical Engineering	4	3
Electronics Engineering	4	3
Industrial Engineering	6	4
Electrical Engineering	4	2

Table 2 shows the population of the members of the faculty in different engineering departments. Conducting an interview with teachers in various departments would give a detailed insight about the problem leaving the way clear in tracking down areas of shared challenges thus it increases the depth to which the findings can be generalized. The respondents were 6 male and 3 female teachers in Mechanical engineering department, 3 males, 3 female residents (students) in the Electronics engineering, 5 male, 4 female residents in Industrial engineering department and 4 male, 2 female residents in electrical engineering department.

Table 3: Distribution of Participants by gender and designation

Designation	Male	Female
Lecturers	6	5
Senior Lecturers	4	3
Assistant Professor	3	2
Associate Professor	3	1
Professor	2	1

Table 3 describes the distribution of participants according to their designation. Interviewing teachers from different career stages provides a comprehensive understanding. It can help identify areas where teachers with different experience levels may need additional support, resources or trainings. It can be seen that both male and female teachers designated on diverse position from Lecturer to Professor participated in the study. This represents strong academic representation. The highest number of participants were lecturers i.e. 6 male and 5 female followed by senior lecturers that comprises of 4 male and 3 females, Assistant Professors 3 male and 2 female and Professors 2 male and 1 female participant.

Table 4: Participants designation wise distribution of AI tool usage

AI Tools	Designation				
	Lecturers	Senior Lecturers	Assistant Professor	Associate Professor	Professor
ChatGPT	11	7	4	3	1
Gemini	10	6	3	2	1
Copilot	8	6	2	0	0
Meta AI	7	5	1	0	0

Table 4 shows the distribution of AI tools usage that includes. ChatGPT, Gemini Copilot and Meta among faculty members based on their designation ranging from lecturer to Professor. The data reveals that lecturers are the most frequent users of AI tools across all 4 categories, with ChatGPT being the most commonly used by 11 participants, followed closely by Gemini used by 10 participants. Senior lecturer also showed considerable engagement, particularly with ChatGPT and Gemini used by 7 and 6 participants respectively. However, the usage of AI tools significantly declines among higher academic ranks. Assistant professors show moderate engagements particularly with ChatGPT that was 4 users while associate professors and professors shows minimal to no use, especially copilot and meta-AI which has zero users among these designations. The trend suggests a hierarchical gap in the usage of AI tools, while junior faculty are more open to explore and include AI technologies in their academic practices while senior faculty seems to stick to more conventional methods of teaching.

Section II:

The next section presents the finding from the qualitative analysis based on the experiences and challenges faced by teachers while becoming AI-savvy. Based on participants' insights, the analysis revealed four major themes. Each theme is mapped with the research question.

Table 5: Mapping of research questions with Themes derived from the interviews

RQ1: What are perceived benefits and challenges of AI integration in engineering education	Theme1: Enhancement of Educational Outcomes through AI tools Theme 2: Challenges in Integrating AI Tools
RQ2: How are educators adopting their teaching strategies in response to AI adoption?	Theme 3: Strategies for ethical usage of AI tools, while preserving the aim of quality education. Theme 4: Implications for the teacher roles and professional development

As shown in table 5, the study revealed four themes. Each theme is mapped with research question of the study. Theme 1 and 2 are aligned with research question 1, which investigated about the benefits of integrating AI tools and challenges in adopting it. Whereas, research question number 2, that inquiries about the strategies teachers needs to adopt in order to achieve effective AI implementation is being answered by theme 3 and theme 4.

Theme1: Enhancement of Educational Outcomes through AI tools

Faculty members highlighted that AI tools are the ground breaking innovation of this era, which has transformed the ideas of teaching methodologies. It has enhanced the efficiency by providing prompt solution to many problems such as it is very helpful in developing customized teaching plans and saves a lot of time in typing and editing. Teachers also emphasized on the fact that AI tools have the ability to automate assessments of the students which is an incredible feature in the context of teaching pedagogy. Additionally, most of the teachers underscores the role of AI in developing interactive platforms which makes learning more interactive and hands on. These tools use real-time feed backs and offers innovative options like chat boots, virtual labs and educational games which helps in keeping students motivated and excited to learn. The educators likewise emphasized the handy trait of AI tools of making administrative work more convenient and efficient. Many of the teacher's uses different AI tools in drafting documents and assignments and found AI tools to be efficient and accurate when it was provided right set of instructions.

Theme 2: Difficulties with the ingestion of AI Tools.

The study also throws light on the challenges in the adoption of AI tools after reminding the importance and benefits of the AI tools. The participants having different levels including 5years up to 25 years of teaching experience had varied views on the same. The teachers that had over 15 years of teaching experience showed their worries regarding the adaptation to AI-powered tools, where younger faculty members were willing to experience those. Besides, both male and female faculty members had different attitudes towards the availability and applicability of these technologies in the classroom. However, the advantages were not the only significant issue the participants raised during the conversation about implementing AI-powered tools in education, and there were also a number of obstacles that should be considered. The most reported problems were:

Technical problems and infrastructure challenges (20 out of 30): It was quite difficult to use a quality internet, old hardware, and absence of institutional support were also a major challenge.

Inadequate training and professional development (18 out of 30): A significant number of teachers stated that they required a systematic training program in order to become better AI-literate and technologically proficient.

Fears of job displacement and deskilling (15 out of 30): Part of the worries of some participants were the fact that further use of AI might cause the decline of the role of educators and the decrease in the importance of traditional teaching experience.

Issues with curriculum integration (12 of 30): Distributing the current syllabus and integrating AI-based approaches was viewed as a time-consuming and complicated task.

Theme 3: Strategies for ethical usage of AI tools, while preserving the aim of quality education.

The next theme came out to be the most concerning issue related to the ethical use of AI tools. All the participant teachers emphasized on the fact that AI is equally accessible to students as well, which poses a high risk to their creativity and learning abilities. Teachers also stressed on the fact that ensuring the authenticity of student's creativity is becoming more challenging with the rise of AI technology. Teachers show concerns about students over relying on AI instead of using conventional method of studying. One of the most senior faculty participant stated that the development in AI tools is diminishing the book reading habits. Students seem to show less interest in visiting libraries and do analytical research using different literatures as the solution to most complex problem is just a click away. Another challenge is keeping them focused on one topic as their attention span has become shorter and they want quick solutions rather than preferring long term and meaningful learning. AI tools have drastically changed the mind set of students, as completing the assignments no matter how complex the problem might be is no more a big deal to be solved. Some senior's faculties also reported that students are more proficient in using AI tools than teachers, which is making it more difficult to ensure ethical usage of it. Hence, most of the teachers agreed to the fact teachers and students both need to utilize the power and benefits of AI tools, while devising some countermeasures to ensure ethical usage that discourages the over relying and threat to the creativity of students.

Theme 4: Implications for the teacher roles and professional development

The last theme that this study underscored is the emerging role of teachers in an AI-integrated educational environment. Participants emphasized the need for educators to develop new skills and adapt their teaching approaches to remain effective. Most of the participants stated that as AI continues to advance, regular training and upgradation is the need of the time. No one can progress without equipping themselves with the latest technologies. The teachers further identified key areas of focus which included:

Teaching Proficiency: Acquiring the skills necessary to efficiently use AI-powered tools for instruction and assessment.

Pedagogical innovation: design engaging and dynamic learning environment that takes benefits from AI without diminishing human interaction.

Critical thinking and adaptability: encourage both students and teachers to approach AI-generated content with using their analytical skills and creativity.

These findings highlight the dual impact of AI-powered tools in education---while they present opportunities for enhancing teaching and learning, they also require the educator to adapt, innovate, and continuously develop their skills to ensure meaningful integration.

DISCUSSION

The issues that came up as the results of the study revealed special outcomes. It not only highlights the importance and the benefits of the use of AI tools but also emphasizes the need to master the technology of AI, so as to be able to keep abreast with the current fast paced world. This is why it is essential to implement AI mechanisms in schools to become successful in the future. The study results indicate the implication of AI, where theme 1 depicts AI as a revolutionary product of the modern world that has many advantages to the teacher. Although the theme 2 deals with the issues surrounding the integration of these tools, and it needs a strong plan to transform it into a component of a system. Particularly, theme of ethical use of AI turned out to be one of the essential factors. Not only does it create the question of how creativity of the student can be preserved, but it also opens up the danger of overuse of AI tools. The results of the following theme point to the conclusion that educators should rethink their strategies of teaching and structure of their curriculum due to the introduction of AI-tools. On the one hand, these tools will offer an opportunity to receive the learning experience in a personalized way and encourage student to be engaged in the full potential of the current learning process.

Other concerns, as understanding by the study, include the need to have some organized professional development programs within which the educators will be trained to have the technical, critical thinking and pragmatic skills required to integrate AI tools in an effective manner. Most of the teachers have shown difficulties on technical expertise, inadequate training, and deskilling. In order to counter these, the institution will have to invest into continuous professional development programs, which would consist of:

AI literacy and ethical workshop and training

Team learning communities within which teachers have an opportunity to exchange best practices and experiences.

Incorporations of AI into the curriculum to meet the learning aims and student achievement.

Also, educators will need to develop flexibility and imagination in order to stay topical in the AI-enhanced environment. The skills of creating learning experiences that enable AI improvement and retain human-oriented forms of teaching will be the keys towards the further success of the instructors.

Education policy implications:

The results of the study highlight the importance of focusing on the advancement of infrastructure and the allocation of resources to AI, as it should be of concern to policymakers and institutional leaders. The policymakers need to make sure that the educational institutions are characterized by: Smooth digital infrastructure with superfast Internet and learning management systems with artificial intelligence.

Financing of AI-based learning tools and courses

Ethical principles and models to control the responsible practices in AI use in classrooms.

The possible advantages of AI tools will be realized with no institutional backup, and it will give rise to the disparities in AI literacy among instructors.

Limitations and directions of future research:

The study has limitations even though it is of good contributions. To begin with, the number of universities sampled was quite small, with only engineering universities, which can restrict the application of the results to other universities. The study needs to be conducted using more institutions that represent a wide and a more varied spectrum in order to understand the impact of the problem in more detail in different education settings.

Second, although the focus of the study was mostly on the teachers' attitudes, the researchers did not research on the direct influence of AI power tools on students learning experiences, creativity, and academic achievements. These are some of the areas that should be examined in future studies on the evaluation of how AI-driven learning affects critical thinking, problem-solving skills, and knowledge memory in students.

Finally, more studies should be conducted to focus on long-term implications, such as ethical, psychological, and socioeconomic consequences of the large-scale AI use in education. This will then require a multi-disciplinary approach with insight to exploit pedagogy, cognitive science, and artificial intelligence to develop sustainable education models based on AI.

CONCLUSION

The introduction of AI power tools is radically changing the situation in the field of engineering universities. In spite of the large number of benefits of these tools, nevertheless, there are unnoticed problems that accompany it. The AI tool can offer the individual learning experience and more efficiency in the administrative effort. Nevertheless, some of its main concerns are the technical problems and insufficient infrastructure, insufficient training of teachers, and deskilling of the educationalist which is possible. The issue with the application of AI tools by many teachers is that they struggle to integrate them in existing curricula. This is primarily due to not being trained and not having the support of the institution.

The complex nature of AI and its opportunities necessitate a multifaceted strategy to ensure the solution gets the most benefits and the control over the challenges. In the beginning, teachers should be dynamic in changing the new pedagogical methods. This would come in handy in aiding in the penetration of the AI tools as an aid technology but not substitutes to the conventional approaches of tutors. This necessitates the change to an inquiry-based student-centered approach of learning. Second, a greater focus on the professional development programs in institutions is needed to provide teachers with the skills and knowledge that will allow them to use AI in education. The collaborative learning initiatives of a workshop, training sessions need to be adopted to guide a teacher in the AI-powered teaching environment. Furthermore, higher learning institutions have a role to re-engineer the education programs to accommodate the AI-literacy with a view to having both teaching and learning institutions ready to accept an AI-enhanced future. Thirdly, policymakers can make a significant contribution to helping to integrate AI by making education institutions access to education infrastructure, funding, ethical regulations, investment in digital facilities, cybersecurity, an AI governance framework, all-important to building a balanced, responsible, and common sustainable AI-based education system.

Since AI continues to transform education, common institutions of educators and common policymakers have to work together to utilize the potential and maintain the human essence of education and teaching. Through using a tactical and well-organized strategy, the education sector

will be able to embrace the use of AI tools in improving Learning Outcomes. At the same time, avoiding academic dishonesty, being creative and intellectually enriched.

Recommendations

Due to the results of this research, the following guidelines can be provided to educators and interventions to policymakers to further enhance the opportunities of introducing AI tools in engineering education effectively and ethically:

For Educators

Professional development that is centered around AI literacy and pedagogical innovation is one of the programs to be attended by teachers. They should acquire skills on how to apply AI tools as additional learning tools and not substitutes of conventional pedagogy. The teachers are expected to create tasks and examinations where critical thinking and creativity are promoted, so that the students do not use AI tools as a hack to study, but as a learning resource. Also, teachers ought to engage the students in free conversations regarding responsible use of AI, and should highlight the need to be original and have the ability to find a solution on their own.

For Institutions

To have a smooth integration of AI, higher institutions of education need to invest in powerful digital infrastructure, such as high-speed internet connectivity and advanced hardware to support the implementation. Universities ought to come up and set up special AI training centers or workshops where its faculty can be trained and supported in real life. Institutions are supposed to have proper policies regarding the use of AI and ethical principles that handle the issue of academic dishonesty and at the same time encourage innovative learning practices. Additionally, the establishment of strategic learning communities so that teachers could share successful experiences and best practices will contribute to businesses.

For Policymakers

The policymakers should give sufficient funding towards AI-related education programs such as infrastructure, teacher training programs, and acquisition of AI-charged studying gadgets. They need to collaborate with school organizations to put in place holistic AI governance systems that would be ethical, equitable and sustainable. Regular curriculum reviews should also be enforced by policymakers to include AI literacy as one of the main core competencies of students and teachers to prepare them to the AI-driven future.

Future Research Directions

Further researches should consider broadening the research scope to cover various education environment outside engineering universities like medical, business and social studies. The longitudinal research is significant in its own way and it is required to evaluate the long-lasting effectiveness of AI tool on students learning outcomes, complexity, and innovative capabilities. Besides, examining the opinions of students regarding the introduction of AI would offer a better comprehensive insight into the impact of AI on the learning processes. The interdisciplinary research incorporating the expertise of pedagogy, cognitive science, ethics, and artificial intelligence is needed in order to achieve sustainable and human-centered AI education models.

Lastly, comparative research in various geographical areas especially in the developing world would be used to determine the region-specific issues and opportunities in the use of AI. With such recommendations in place, the education sector will be in a position to embrace the transformative power of AI and still maintain the core values of creativity, critical thinking and academic integrity.

REFERENCES

- Abdulrahman M, A.-Z. (2024). Balancing act: Exploring the interplay between human judgment and artificial intelligence in problem-solving, creativity, and decision-making. *IgMin Research*, 2(3), 145–158. <https://doi.org/10.61927/igmin158>
- Akolekar, H., et al. (2025). The role of generative AI tools in shaping mechanical engineering education from an undergraduate perspective. 1–14.
- Ali, O., Murray, P. A., Momin, M., Dwivedi, Y. K., & Malik, T. (2024). The effects of artificial intelligence applications in educational settings: Challenges and strategies. *Technology Forecasting and Social Change*, 199, 123076. <https://doi.org/10.1016/j.techfore.2023.123076>
- Arvin, N., Hoseinabady, M., Bayat, B., & Zahmatkesh, E. (2023). Teacher experiences with AI-based educational tools. *AI Tech Behavioral and Social Sciences*, 1(2), 26–32. <https://doi.org/10.61838/kman.aitech.1.2.5>
- Bansal, G., Nawal, A., Chamola, V., & Herencsar, N. (2024). Revolutionizing visuals: The role of generative AI in modern image generation. *ACM Transactions on Multimedia Computing, Communications, and Applications*, 20(11). <https://doi.org/10.1145/3689641>
- Benges, S., El-Sayed, H., Sarker, M. K., Houkpati, Y., Irungu, J., & Oladunni, T. (2024). Advancements in generative AI: A comprehensive review of GANs, GPT, autoencoders, diffusion model, and transformers. *IEEE Access*, 12, 69812–69837. <https://doi.org/10.1109/ACCESS.2024.3397775>
- Benouachane, H. (2024). AI in higher education: Balancing pedagogical benefits and ethical challenges. *Scientific Step Journal*, 2(5). <https://doi.org/10.6084/m9.figshare.26349289>
- Devaki, V. (2025). Academic integrity and human cognitive development of learners: Is artificial intelligence replacing the human brain? 195–197. <https://doi.org/10.4018/979-8-3693-5443-8.ch007>
- George, B., & Wooden, O. (2023). Managing the strategic transformation of higher education through artificial intelligence. *Administrative Sciences*, 13(9). <https://doi.org/10.3390/admsci13090196>
- Hagos, D. H., Battle, R., Rawat, D. B., & Member, S. Recent advances in generative AI and large language models: Current status, challenges, and perspectives. 1–21.
- Hanafi, A. M., Ahmed, M. S., Al-mansi, M. M., & Al-sharif, O. A. (2025). Generative AI in academia: A comprehensive review of applications and implications for the research process. *Generative AI: Historical development*, 1, 91–110.
- Karataş, F., Eriçok, B., & Tanrikulu, L. (2024). Reshaping curriculum adaptation in the age of artificial intelligence: Mapping teachers' AI-driven curriculum adaptation patterns. *British Educational Research Journal*, 154–180. <https://doi.org/10.1002/berj.4068>

- Mateus, J. C., Lugo, N., Cappello, G., & Guerrero-Pico, M. (2024). Communication educators facing the arrival of generative artificial intelligence: Exploration in Mexico, Peru, and Spain. *Digital Education Review*, 45, 106–114. <https://doi.org/10.1344/der.2024.45.106-114>
- Mouta, A., Torrecilla-Sánchez, E. M., & Pinto-Llorente, A. M. (2024). Comprehensive professional learning for teacher agency in addressing ethical challenges of AIED: Insights from educational design research, 30(3). <https://doi.org/10.1007/s10639-024-12946-y>
- Muazu, M. (2024). AI and ethics, academic integrity and the future of quality assurance in higher education. *Handbook on AI and quality higher education in honour of Prof Abubakar Adamu Rasheed*, 0–1143.
- Naseer, M. A., Saeed, S., Afzal, A., Ali, S., & Malik, M. G. R. (2025). Navigating the integration of artificial intelligence in the medical education curriculum: A mixed-methods study exploring the perspectives of medical students and faculty in Pakistan. *BMC Medical Education*, 25(1). <https://doi.org/10.1186/s12909-024-06552-2>
- Pellas, N. (2025). The impact of AI-generated instructional videos on problem-based learning in science teacher education. *Education Sciences*, 15(1). <https://doi.org/10.3390/educsci15010102>
- Popenici, S. A. D., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education, 12(1). <https://doi.org/10.1186/s41039-017-0062-8>
- Sengar, S. S., Bin Hasan, A., Kumar, S., & Carroll, F. (2024). Generative artificial intelligence: A systematic review and applications. *Multimedia Tools and Applications*. <https://doi.org/10.1007/s11042-024-20016-1>
- Thomas, A. P. (2024). Balancing innovation and integrity: Addressing concerns of AI in classroom environments [Unpublished manuscript]. ScholarWorks @ GVSU.