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Evaluating the Transformative Role of Artificial Intelligence Tools in Enhancing Engineering Education

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Abstract

The disclosure of Artificial Intelligence (AI), popularly referred to as AI, has created prominent challenges to various fields. It concentrated in the realms of education and offered remarkable opportunities for substantiated literacy acts through traditional methodologies. AI improves education quality by providing personalized learning experiences, offering immediate access to a wide range of study materials, and delivering targeted practice questions. Now, the real challenge is to equip educators about this practice, mainly to those in remote areas and underserved regions with the knowledge of using AI tools in classrooms. Numerous efforts have been made to introduce this system to those unfamiliar with the practice. The " AI Education Frontier Turning preceptors in Remote Areas into Agents of Change," was a holistic approach that included boot- camps, AI empowered mentoring apps and further in its structure intending to reach over 700 members in 8 months duration. Through this paper, we aim to offer useful insights into how such programs can be scaled and sustained to promote digital literacy and new educational practices around the world. This paper also delves deep into how this educational action reforms the tutoring and literacy practices in the classroom. Along with this, we will explore its wide- ranging benefits and examine the issues along with the required training to be provided to the educators in diverse fields to introduce this new technology to the broader market. Clearly, working together helps us to conclude on the relinquishment and perpetration of a promising AI period in various sectors. We aim to provide statistical analysis on the data collected through our survey.

Keywords
Artificial Intelligence, Teaching, Learning, Statistical analysis, Correlation, Covariance, Standard Deviations.

1. Introduction

Artificial Intelligence (AI) has revolutionized various sectors, including education, by providing tools like ChatGPT, enabling real-time interactions between students, teachers, and large language models (LLMs). While AI has many benefits, concerns have arisen, particularly regarding academic integrity, as students may use AI to cheat during exams. Distinguishing between human and AI-generated content has led to the development of tools like OpenAI's classifier and GPTZero. The Education Technology Lab (EDTec Lab) at the German Research Centre for AI (DFKI) emphasizes a balanced approach to AI, cautioning against overreliance on software that claims to detect

AI-generated text. Additionally, concerns about data privacy and students' trust in AI persist. Educators must emphasize that AI is a supportive tool, not the ultimate authority in learning.

1.1 Objective

The main aim of AI is to come up with new, creative content or data. But how is it different from regular AI? In general, AI covers a wide range of tasks, like analysing information, making decisions, and automating various processes. However, this specific type of AI focuses more on generating original and creative content rather than just processing or analysing what already exists. In education, AI helps improve the learning experience by understanding each student's needs and providing personalized, one-on-one guidance.

2. Literature Review

2.1 Technical Foundations

AI generates creative and up to minute content such as text, images, music and videos by examining and producing patterns from large datasets. AI is built on a combination of advanced machine learning techniques, large datasets, and powerful computational resources. Real time conversations were integrated into this by the help of Large Language Models commonly known as LLMs. It must generate texts and images for which it needs these technical foundations, diving into the depths of these technical foundations:

A) Deep Learning: Deep learning deals with the AI that drives applications and services which improve automation and performs tasks without the intervention of humans. It uses the concept of multi-layered neural networks to replicate the complex decision-making power of the human brain.

B) Natural Language Processing (NLP): Natural Language is a field of AI that involves developing algorithms and models. These models enable machines to understand, interpret, and generate human language in a way that is both meaningful and useful (Arpitha, N., & Dr. Vibha 2023).

C) Massive Datasets Training: AI models are trained on large and diverse datasets to understand a wide range of topics and generate contextually appropriate responses. These datasets often include books, articles, websites, and other forms of text.

D) Optimization Algorithms: Techniques like gradient descent are used to adjust the model's parameters during training. These algorithms help minimize the difference between the model's predictions and the actual data.

E) Large Language Models (LLMs): These prototypes are trained on vast amounts of text data. They can generate coherent and contextually appropriate text by predicting the next word or phrase in a sequence based on what they have learned from their training data. Most LLMs are based on transformer architectures, which use self-attention mechanisms to handle large amounts of textual data effectively. Examples include GPT-4 (from Open AI), BERT (from Google), and T5 (from Google). They play a huge role in Contextual Understanding.

F) Contextual Awareness: LLMs use context from previous parts of a conversation or text to generate relevant responses, making interactions more coherent and contextually appropriate.

G) Long-range Dependencies: Transformers can handle the connections between the words or phrases in text, meaning they can understand and maintain context over longer passages when compared to old models.(Meli et al. 2024, Mistretta 2023)

2.2 Applications of AI in Education Sector

Generative AI is transforming the education sector by introducing innovative solutions that improve the learning experiences, simplify administrative tasks, and give personalized support for both students and mentors (EDTEC, 2023). AI can help in the content of a topic in a unique way for each student who is facing difficulty in certain areas and gives customized problems to improve their skills where they are lagging and needs guidance. AI converts the learning in a manner which is adaptable and easy for any student by providing resources and adjusting the content feasible to the student. AI can create interactive content such as quizzes, educational games and many other alternatives to make learning easy and engaging (Doug 2023). It can also help in creating apps which has AI Assistance that helps in summarizing deep and complex topics in easy and understanding way for students. These practices not only engage students but can also create more interest in that topic. AI can act as a virtual tutor which helps in assisting the problem and gives real time assessments which can be solved by the individual that helps ion sharpening that topic (Naomi 2023). It can also clear any minute doubt in any topic given. AI can help in generating practice exercises for language learners, providing corrections and suggestions. AI can help in grading their assessments and giving instant feedback for their answers which help them to understand their mistakes quickly and AI helps to resolve the mistakes done by them previously (UNESCO 2023). AI enables students to experience historical sites, conduct virtual experiments, or interact with complex problems (Amando 2023).

Potential Risks and Drawbacks:

1. Plagiarism: (Rodriguez-Paz 2024) The assignments and projects given to students might be done using the AI tools. This misuse of AI can result into plagiarism.
2. Loss of Analytical Reasoning: Students' critical thinking abilities may deteriorate by using AI limitlessly.
3. Data Inaccuracy: (NLivari 2020): Generative AI can be helpful, but not all the time. Sometimes, the data shown may be inaccurate.
4. Technology Over-dependence: Students might become overly dependent on AI tools, thereby neglecting the traditional learning methods and human expertise.
5. Decrease of Human Jobs: (Atahar 2024) With increase in AI, many traditional human roles are being replaced by technologies. Experts are tensed that AI might take over the world, if this continues for a long period of time.

3. Methodology

Proposed methodology for client segmentation using AI.

Step 1: Data Processing: The goal is to prepare data for subsequent analysis. It normalizes data to guarantee uniformity throughout its features. Variables can be converted to numerical representations as needed. It handles missing values through suggestions or elimination.

Step 2: Describe Data Its goal is to understand the survey results. Data is described and understood using a variety of mathematical methods.

Step 3: Statistical Analysis. Its goal is to analyse the survey results. To better assess the influence of AI on education, statistical analysis is performed.

Step 4: Visualization. This step involves presenting the data in the form of graphs and charts to help visualize the statistical analysis of data and the influence of AI on education.

4.Data Collection

We included the following questions in the survey (Table 1):

Table 1. Survey Questions

Question	Option1	Option2	Option3	Option4	Option5
1.How often do you use AI in your daily life?	Almost Never	Rarely	Frequently	Always	
2. Do you find AI tools useful to learn?	Yes	No	Not Sure		
3. Which tools do you use frequently?	ChatGPT	Quill Bot	BlackBox	OpenAI	Others
4. Where do you use Ai in your daily life?	Research	Projects	Curriculum Subjects	Technical Trainings	
5.Have you Experience any drawbacks?	Yes	No	Not Sure		

5. Results and Discussion

Usage of AI tools in your daily life (Source: Survey done in Engineering colleges all over India) is presented in Figure 1, use AI to learn is presented in Figure 2.

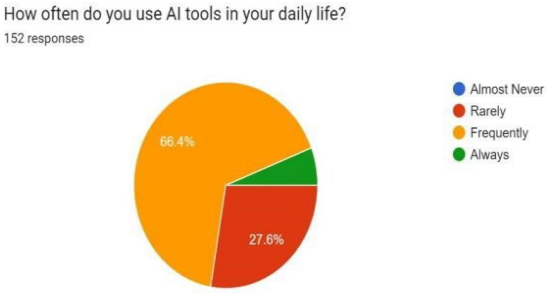
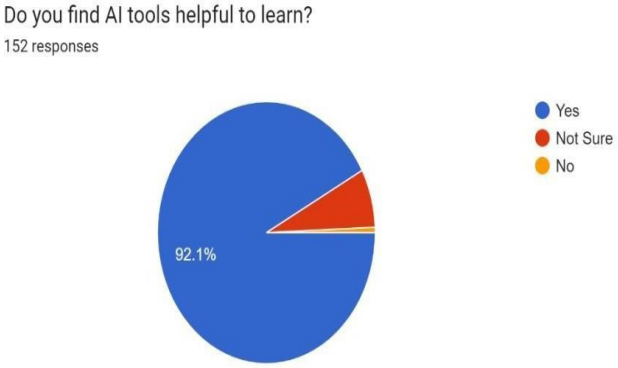


Figure 1. Usage of AI tools in your daily life (Source: Survey done in Engineering colleges all over India).

Statistical Data for Usage of AI tools in your daily life:

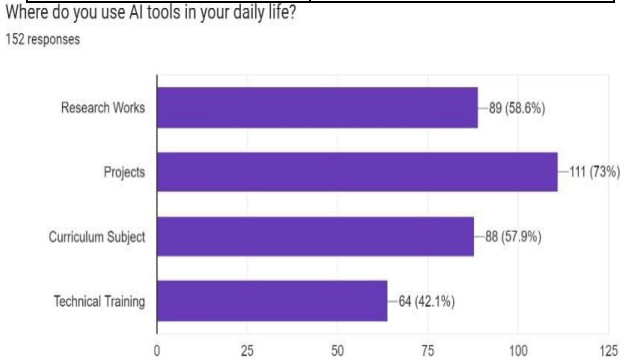


Option	Count of Responses
Yes	140
Not Sure	11
No	1

Figure 2. Do you use AI to learn? (Source: Survey done in Engineering colleges all over India).

Statistical data on whether students use AI:

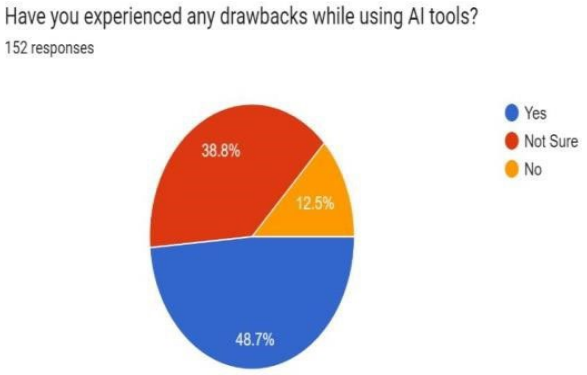
Option	Count of Responses
Research work	89
Projects	111
Curriculum Subject	88
Technical Training	64



Option	Count of Responses
Almost Never	0
Always	9
Frequently	101
Rarely	42

Figure 3: Where do you use AI tools in your daily life? (Survey done in Engineering colleges all over India)

Statistical data on where students use AI tools in your daily life:



Option	Count of Responses
Yes	74
Not Sure	59
No	19

Figure 4. Have you experienced any drawbacks while using AI tools? (Survey done in Engineering colleges over India)

Statistical data on whether students have experienced any drawbacks while using AI tools:

From this survey, we see that many students frequently use AI tools for project works. ChatGPT is the most preferred AI tool. They are apprehensive about the experience while using AI tools.

Mathematical calculations:

For the data collected from Figure 1, 2, 4; Mean, Median and Mode of the data have been calculated.

- Use of Pandas in calculating Mean, Median and Mode:

Pandas is a library in python that for data analysis and manipulation, and is convenient to calculate statistical measures like mean, median, mode, correlation, standard deviation and many more. It is efficient, convenient and works effectively with other libraries like NumPy, Matplotlib. To make it simpler for calculations, here's how we represented the options:

Q. How often do you use AI?	Q. Do you find AI tools helpful to learn?	Q. Have you experienced any drawbacks while using AI tools?
1 Always	1 Yes	1 Yes
2 Frequently	2 Not Sure	2 Not Sure
3 Rarely	3 No	3 No

1. Calculation of mean

Mean or average can be defined as the sum of all the quantities divided by total number of quantities. Mean= Sum of quantities / Total number of Quantities

```
Mean of how often do you use AI tools in your daily life? :
('1:', 1.0, '2:', 0.0891089108910891, '3:', 3.0)
Mean of do you find AI tools helpful to learn? :
('1:', 1.0, '2:', 12.727272727272727, '3:', 3.0)
Mean of have you experienced any drawbacks while using AI tools? :
('1:', 1.0, '2:', 1.2542372881355932, '3:', 3.0)
```

2. Calculation of Median:

Median represents the middle value when the dataset is arranged either in ascending or descending order.

If number of observations are odd, then. Median= Middle number

If number of observations are even, Median= Average of middle two numbers

```
Median of how often do you use AI in your daily life? : 2.0 -Frequently
Median of do you find AI tools helpful to learn? : 1.0 -Yes
Median of have you experienced any drawbacks while using AI tools? : 2.0 -Not Sure
```

3. Calculation of Mode:

Mode is the most repeated quantity in each dataset.

```
Mode for how often do you use AI in your daily life? 2 -Frequently
Mode for do you find AI tools helpful to learn? 1 -Yes
Mode for have you experienced any drawbacks while using AI tools? 1 -Yes
```

Observations: As stated from the graphs above, AI tools are used frequently, and students find them helpful to learn. Yet, students have experienced some drawbacks while using AI tools.

Various AI tools used by students:

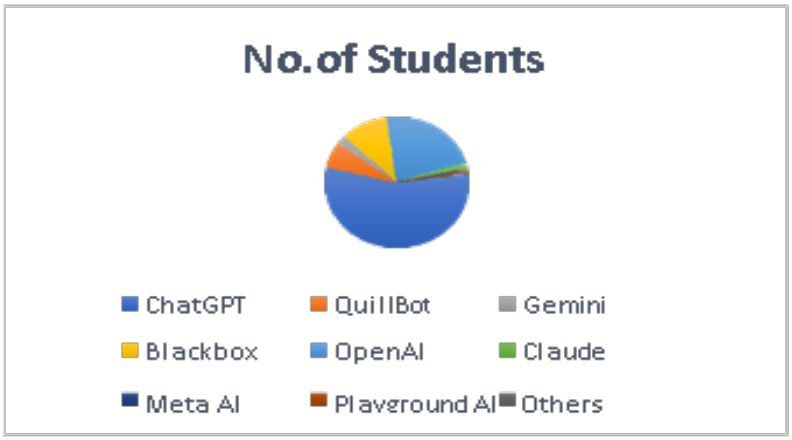


Figure 5. Usage of different AI tools by students. (Source: Survey done in engineering colleges across India)

6.Conclusion

AI is a compelling change in the education zone that opens new frontiers with solutions that are more individual, more creative and run the office more efficiently than ever. Through deep learning, transformers and large language models that power such techniques as the expanding of tailored educational experiences and interactive content on the one hand and the coming to life of real-time tutoring on the other.

The study's outputs exhibit the vital role of AI in the education sector, mostly in the lives of students and teachers. With the ongoing competition around the world, AI provides the users, students or teachers, with a simple way out. Despite its easy detection, most of the students are choosing Chat GPT as their primary tool of AI.

Nevertheless, the AI incorporation into the educational system is a task fraught with difficulties. Problems such as academic dishonesty, technology over-dependence, and the correctness of AI-generated content bring about the risks that must be dealt with. Also, the ethical concerns regarding data privacy, consent, and the likely substitution of educational roles should be handled with care.

AI will certainly be more involved in education as it goes through its development, thus opening up the prospects of bringing about innovation and improvement. Overcoming the obstacles and harnessing the unlimited capacity of the technology, the educational field is set to become a more vibrant, optimally functioning, and fair learning mode for everyone. AI helps students and teachers in various forms, and it is important for teachers to be open about using AI with students. Having these open conversations with students and each other will encourage us all to be transparent. Faculty should explicitly state in the course syllabus or assessments that AI tools can be used and even encouraged to be utilized. It is equally important to have boundaries set so that students use it in an appropriate way.

Author Contribution

Author 1 has contributed in collecting data for methodologies and writing. Author 2 has contributed for literature review and writing the literature review. Author 3 has contributed in writing Abstract, Introduction, and Result and data collection and writing. Author 4 has contributed in conducting survey on Generative AI.

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Biographies

Akshaya Dandu currently in her second year of B. Tech at BVRIT Hyderabad, College of Engineering for Women, specializing in Computer Science and Engineering with a concentration on Artificial Intelligence and Machine Learning. As an AI student, she is fascinated to learn how artificial intelligence, particularly generative AI, affects our daily life. It's interesting how often we utilize these technologies without even recognizing it, which adds to the intrigue of the issue. Writing is another of her passions, and this paper combines her love for AI with my enthusiasm for writing. Diving into the area of AI is extremely enjoyable, and she gets a lot of enjoyment from understanding its different applications and ramifications. She enjoys learning how generative AI can enhance creativity, improve efficiency, and transform industries. Through this paper, she is sharing her insights about generative AI, highlighting its practical uses as well as the potential risks involved. It's important to have conversations about the ethical considerations and challenges that come with these advancements, as we want to ensure responsible development.

Ms. R. Priyanka Completed Bachelor of Technology from Ganapathy Engineering College, Warangal and received the Master of Technology degree from Mallareddy College of Engineering and Technology, Hyderabad. Currently she is an Assistant Professor in the Department of artificial intelligence and machine learning, BVRIT Hyderabad College of Engineering for Women, Hyderabad, and Previously worked as an Assistant Professor in the Department of Computer Science and Engineering, DRK College of Engineering and Technology, Hyderabad. Her primary research interests lie at the intersection of machine learning and cybersecurity, where she focuses on developing intelligent systems to enhance digital security and mitigate cyber threats. She is particularly interested in applying advanced machine learning techniques to identify vulnerabilities, improve threat detection, and develop robust solutions for securing data and infrastructure in an increasingly connected world.

Mahima Kalidindi currently pursuing her second year of B. Tech at BVRIT Hyderabad, College of Engineering for Women, studying Computer Science and Engineering (AI&ML), and she can't help but be fascinated by the realm of artificial intelligence. Her enthusiasm for research is what inspired her to write this paper; she really believes that we must delve deeply into the potential of generative AI. This field is quite vast and has a significant impact on our daily lives. She recommends her peers to investigate it, as knowing AI is becoming increasingly important in today's environment. She is primarily interested in LLMs, NLP, and data structures. It interests her to study how LLMs can generate human-like text and how NLP helps machines understand and interact with us. She also enjoys studying data structures because they are the backbone of efficient data management, which is crucial for building effective AI applications. Through her studies and research, she hopes to deepen my knowledge in AI. She is eager to collaborate with others who share her enthusiasm and to discover the innovative possibilities that generative AI has to offer.

M. Phanindra Rushi is a third-year mechanical engineering student at B.V. Raju Institute of Technology, currently pursuing a minor in Artificial Intelligence and Machine Learning. With a strong interest in design and analysis, he is dedicated to integrating innovative technologies into engineering practices. M. Phanindra is particularly passionate about utilizing AI and ML techniques to identify defects in mechanical rotary components. He believes that these technologies can significantly improve predictive maintenance and quality assurance in the engineering field. By exploring the intersection of mechanical engineering and artificial intelligence, he aims to contribute to advancements that enhance the reliability and efficiency of mechanical systems. M. Phanindra looks forward to continuing his education and seeks opportunities that allow him to innovate and make a meaningful impact in the industry.