Artificial Intelligence tools: Boon to Engineering Education or a threat?

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Abstract

In the summer of 2022, there was significant media buzz surrounding the unveiling of the latest iteration of an AI-powered tool known as ChatGPT (short for Chat Generative Pretrained Transformer) chatbot. Basically, a chatbot is a computer program that simulates and processes human conversation (either written or spoken), allowing humans to interact with digital devices as if they were communicating with a real person. Even though the launch of ChatGPT was not felt by the common public, the technical circle knew about its inauguration, and the media space was flooded with shocked reactions.

Anyone can open the ChatGPT program and type in the word or phrase about something he/she wants to know, then the ChatGPT is going to spit out a short or long essay or summary of what is being asked. Suppose a student is asked to submit a report or an essay on a particular topic for a class, then the ChatGPT can be used to write that essay or report.

This paper is going to discuss the details of the impact on Engineering Education by ChatGPT and other AI tools. Some people argue that AI and ChatGPT are going to bring down traditional education style and a new way of disseminating the subject knowledge may be introduced. Some educators think that the teachers may lose their jobs. Many people started to test the limits of the released software. The tool is able to produce high-quality texts of various focuses even with the ability to respond in various languages (internally, they are machine-translated into English similarly to "Google Translate"). Another strength of ChatGPT is contextual querying, where ChatGPT remembers previous queries and creates new results based on an earlier conversation. This paper is going to talk about the pros and cons of using ChatGPT and AI tools in Engineering Education.

Introduction

The Oxford Dictionary defines the "Artificial Intelligence" as "The study and development of computer systems that can copy intelligent human behavior." AI can be expanded to explain the theory and development of computer systems able to perform certain activities that normally require human intelligence. Human intelligence includes seeing and perceiving, reasoning, recognizing speech, decision-making, and language translation between languages. (Oxford, 2023)

AI is also defined as the ability of a computer or robot to execute commands that are usually related to daily human actions. After the advent of the digital computer, mankind witnessed the fast development of associated technologies in different fields. In the late 20th century, the use of digital computers became widespread among the common public and it is proved that the computers can be programmed to perform complicated calculations and tasks.

Early Developments of AI

In 1951 a "Checkers" program was developed by the Programming Research Group at the University of Oxford. By the summer of 1952 this program could play a complete game of checkers at a reasonable speed. In 1952, Arthur Samuel from United States wrote a checkers program for the protype of the IBM 701. In 1955 he added certain features that enabled the program to learn from experience. He included mechanisms for both rote learning and generalization and eventually his machine won one game against a former Connecticut checkers champion.

An important aspect of intelligence is the ability to reason logically, and it has always been a major focus of AI development. In 1955-56, Allen Newell and Herbert Simon wrote a "theorem-proving program" that portrayed the reasoning aspect of AI. At some point, a proof written by the theorem-proving program was more elegant than the proof given in the books.

In 1969, man landed on the moon surface because of the calculations made by series of computers that were used in the space programs. In the year 1997, IBM 's Deep Blue computer made history when it became the first digital computer to win a Chess Grandmaster in a chess game. In 2022, the language model ChatGPT is making headlines ushering in a new era in computing. Now ChatGPT is one of the computer programs that can write essays, develop literature work, make reports, and it can write songs also.

The most important different AI tools developed so far

There are many AI tools that are available in the market now and some of the important ones are listed here.

ChatGPT (Developed by a company called "Open AI")

ChatGPT standing for "Chat Generative Pre-training Transformer" is the latest useful tool available to public currently. This program can help write business reports, write essays for school going students, higher education artwork, creating fine arts, and also it acts as a semi search engine.

Dall E-2

Dall E-2 is another program which works with ChatGPT to generate computer graphics such as drawings, paintings, images, photos, but it cannot create construction plans or drawings because it needs more input and thinking to create. Often it produces stunning images of nature, human beings, and inert objects.

Stable Diffusion 2

This program is available for download, and it can be installed on anyone's computer to run as a stand-alone program. This is also another application that can create images from texts, and it is available to the public.

Lumen 5

Lumen 5 is a video making tool with an AI-powered module that can be used by anyone who wants to make marketing, or business, education related videos using a drag-and-drop-interface.

Soundraw

Soundraw is an automated innovative music-making program that utilizes AI technology to generate royalty-free music. With Soundraw, users can easily create custom music tracks by simply providing instructions such as the type of music they want to produce, whether it's country or pop music. Additionally, users can choose the musical instruments to be used, the mood they want to create, and the desired length of the music track.

Looka

Looka is a marketing tool that can be used for any business that wants to flourish. It can create special and unique logos that portray the style and uniqueness of a company. Even if one does not have any design skills, by using this Looka program he/she can produce very beautiful and creative logos or pictures that can be used to market the products manufactured by a company.

Podcastle

It is an audio recording and editing program with AI tools integrated. Podcastle is one of the AI tools that helps one produce clear, crisp, very smooth recordings that sound as though they were edited professionally with the feature of filtering noise and generating transcripts.

Gen-1

Gen-1 was developed by the creators of Stable Diffusion (Stable Diffusion is a generative AI model that translates text into vivid images). Gen-1 is a text-to-video model based on a cloud-based program that produces new videos from the ones that are uploaded, using text prompts. Also, text prompts are used to apply the edits and effects that one desires or create animations from storyboard mock-ups.

Lalal.ai

The operation of audio source separation is automated using this tool Lalal.ai. It is a neural network system called Phoenix and it involves extracting elements such as speeches, music, or even specific instrumental tracks like drumbeats or basslines from any audio or video content.

Deep Nostalgia

It is one of the special, and unique tools that can make static pictures act in motion. The historic family photographs of relatives, friends or ancestors can be used in this tool to see them as though they are all moving in real time. This innovative tool lets you animate the faces in family photos so you can see them smile, blink, and laugh, just as if you had recorded a video of them back in the day.

Murf

Vocal recordings are created using this AI based software in 15 different languages from a choice of over 100 voices and dialects. The output from this program can be easily integrated into automated marketing or video content, robotization of the process of creating narration and voiceovers.

Legal Robot

Legal Robot is an AI tool that is designed to translate complex and confusing "Bureaucratic language" into straightforward language that can be understood by everyone. This tool is very useful for both legal personnel and common man that it ensures that the contracts and documents are written in terms that anyone can understand.

Cleanup-Pictures

This AI tool helps retouch pictures and images by deleting the unwanted objects, defects, or even objects and people using a process known as "inpainting" to help produce the great image.

<u>Fireflies</u>

The most popular video conferencing tools such as Zoom, Teams or Webex use Krisp as a plug-in software and automate the process of notes taking and transcript production. Conversations can also be analyzed to provide insights into the dynamics and decision-making that are part of conversations.

<u>Krisp</u>

This one is also another video-conferencing program that uses algorithms to delete unwanted noises, echo, and other distracting elements in real-time.

AI Tools in Education

Artificial intelligence has indeed made significant progress in the field of computing, and OpenAI's ChatGPT is a recent noteworthy development. OpenAI is widely regarded as one of the leading organizations in artificial intelligence research. The ChatGPT system is built on the architecture of GPT (Generative Pretrained Transformer), which was first introduced by OpenAI in 2018. This language model has the potential to revolutionize the education sector.

It is crucial to adhere to moral principles and responsibility when implementing ChatGPT in educational institutions ranging from kindergarten to college level. ChatGPT is the most advanced and flexible chatbot ever created, capable of producing exceptional text in a matter of seconds. However, it has generated an atmosphere of excitement, activity, and significant concerns, including Armageddon predictions regarding student assessment in higher education and other issues (Rudolph et al., 2023).

Impact of AI tools on Dental Education

Thurzo et al. have done a great job in summarizing the recent changes and breakthroughs in the application of AI in dentistry education since 2020. Their research paper has been published in the journal of Dental Education. They have also presented a manual for an updated dental curriculum that can be used for both undergraduate and postgraduate education.

Thurzo et al. have highlighted that the manual they presented was written in the context of the developments in AI applications and the influence these developments have had on dentistry. It is not surprising that the majority of dental educators have little knowledge and skills to evaluate AI applications since they were not taught to do so. Furthermore, they noted that recent years have seen exponential growth in the development of AI technologies. They also pointed out that recent advancements in AI language models will cause a shift in how dentists communicate with their patients. They also highlighted that the recent advancements in AI language models would require modification in the fundamentals of dental education, such as the writing of essays, theses, or scientific papers.

They have also identified factual reliability and the opportunities presented by OpenAI Inc.'s ChatGPT as crucial turning moments in the era of generative artificial intelligence (AI). They also pointed out that as advanced deep-learning algorithms take over the clinical fields of dentistry and redefine diagnosis, treatment planning, management, and telemedicine screening, it is inevitable that dental institution curricula will need to be updated (Thurzo et al. 2023).

Impact of AI tools on Pharmacy Education

There is a well-known proverb that says "We do not learn from experience. we learn from reflecting on experience" that depicts the foundational work on teaching and learning. Critical self-reflection has been

increasingly identified as pivotal to the development of independent, self-regulated learning, as stated in various educational research studies. Reflective writing is one of the most common approaches used for critical self-reflection in education. However, teaching, learning, and grading reflective writing presents challenges, as it is often an unfamiliar style for both students and teachers (Dewey, 1933).

The evaluation of student reflective writing is usually done manually in different educational institutions across the nation. In the pharmacy program curriculum, the evaluation of student reflective writing is often done through manual content-analysis methods employed by researchers to assess student reflective writings, and through grading against a rubric by educators. This process can be quite labor-intensive, and that is where automated approaches can potentially play a role." (Krippendorff, K 2004).

Natural language processing (NLP) has the potential to be very useful in the education sector, particularly when it comes to analyzing and coding student texts. By automatically classifying these texts according to a predetermined scheme, NLP tools can provide teachers with valuable insights into their students' learning progress and areas of improvement. Additionally, in a learning context, NLP can be used to generate personalized and helpful feedback for each student, allowing them to better understand their strengths and weaknesses and ultimately improve their overall performance.

Academic Writing Analytics (AWA) is a software platform that is open-source and geared towards providing actionable feedback to support academic writing, with a focus on analytical and reflective writing.

The researchers, Gibson et al., employed the concept matching rhetorical analysis framework to detect sentences that indicate three reflective rhetorical moves: Context, Challenge, and Change. Context refers to the initial thoughts and feelings about a significant experience, Challenge pertains to the challenge of encountering new, unfamiliar ideas, problems, or learning experiences, while Change involves potential solutions and learning opportunities. [Gibson, 2017]

Impact of AI tools on Engineering Education

One of the important AI tools that can be used in the engineering field and engineering education is the ChatGPT developed by the OpenAI Corporation. Engineering education is a constantly changing field that strives to sustain the latest technological advancements and meet the changing needs of the engineering industry. One exciting development in the field of engineering education is the use of generative artificial intelligence technology, such as ChatGPT. This conversational agent has the potential to provide students with personalized and effective learning experiences by offering customized feedback and explanations. Additionally, ChatGPT can create realistic virtual simulations that enable hands-on learning. Such a combination of personalized feedback and hands-on learning can help students gain a deeper understanding of engineering concepts and prepare them for success in the industry.

ChatGPT can be used for solving math problems, answering conceptual questions, and software code generation. It is an NLP model that can generate text like how humans do write essays or reports. It is not supposed to be used for copying material from others and submitting as though it is the original. In other words, plagiarism should not be practiced using ChatGPT for writing essays, poems, or technical reports, etc. Students can constructively use ChatGPT to generate ideas and sentence structures to write their home works or assignments. Students can definitely benefit from using AI-powered tools for various tasks such as translation and literature search. However, it's important to note that relying solely on these tools for writing essays or reports may not be the best approach. It's always better to use them as a supplement and not as a substitute for one's own writing skills and critical thinking abilities.

Asking good questions is an important skill in the era of ChatGPT and other artificial intelligence (AI) tools. Asking thought-provoking questions can be incredibly beneficial as it enables us to gain a better understanding of a subject, recognize any knowledge gaps, and discover new information. It encourages us to think more critically about a topic and to explore various perspectives and approaches to problem-solving. With the advent of ChatGPT and other AI tools, it might seem convenient to depend on these resources to answer our questions. However, it's essential to keep in mind that these tools are only as reliable as the data and algorithms they rely on. Despite the availability of AI-powered tools, asking insightful questions and engaging in critical thinking and problem-solving remains an indispensable skill for personal and professional development. It allows us to expand our knowledge, challenge our assumptions, and approach new situations with confidence.

It is crucial to acknowledge the limitations of AI technology, including ChatGPT and other generative AI systems. While these tools can be helpful, they are only as reliable as their training data and may inadvertently perpetuate biases or even generate and spread misinformation. It is therefore important to approach these tools with a critical inspection and to use them in conjunction with other sources of information.

It is essential for engineering educators to recognize the implications of generative AI technology and study how to adapt the engineering education ecosystem accordingly. By doing so, we can ensure that the next generation of engineers is equipped to leverage the benefits of generative AI while minimizing any negative consequences. This includes understanding the ethical considerations surrounding AI and teaching students how to use these tools responsibly (Qadir, 2023).

ChatGPT can be used in construction engineering education. For example, if project input parameters along with expectations are given to the tool, then it can produce required documentation for various aspects of construction. It will be a great AI tool to use for teaching construction engineering because it can act like a "Construction Management Software Program". It can help with iterative procedures to improve the analysis and design of various structures to be built for different projects. Particularly to make construction reports, it will help on the writing part. ChatGPT can be an excellent platform for students to gain constructive benefits. It provides a unique opportunity to interact with like-minded people, share knowledge, and learn from each other's experiences. With its AI-powered assistance, ChatGPT can also help students find the right resources and guidance to achieve their academic goals. It can serve as a virtual reviewer by reviewing the design documents and giving feedback to the students. At the same it should not replace the expertise and experience of qualified construction engineers (Aluga, 2023).

Some examples of what ChatGPT can do are shown below in figures 1 and 2.

R   solve simultaneous equations 2x + 3y = 10 and -2x +6y = 8

To solve the simultaneous equations:

1. 2x + 3y = 10
2. -2x + 6y = 8

You can use the method of elimination. Add the two equations together to eliminate the x variable:

(2x + 3y) + (-2x + 6y) = 10 + 8

This simplifies to:

2x + 3y - 2x + 6y = 18

Now, combine like terms:

(2x - 2x) + (3y + 6y) = 18

This further simplifies to:

0 + 9y = 18

Now, isolate the y variable by dividing both sides of the equation by 9:

9y/9 = 18/9

y = 2

Now that you have found the value of y, you can substitute it back into either of the original equations to solve for x. Let's use the first equation:

2x + 3(2) = 10

Now, solve for x:

2x + 6 = 10

Subtract 6 from both sides:

2x = 10 - 6

2x = 4

Finally, divide both sides by 2 to isolate x:

2x/2 = 4/2

x = 2

So, the solution to the simultaneous equations is:

x = 2
y = 2

↻ Regenerate

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Figure 1. Solving simultaneous equations

R how to write a laboratory report

Writing a laboratory report is an important part of scientific research and experimentation. It allows you to communicate your findings, methods, and conclusions to others in a clear and structured way. Here's a step-by-step guide on how to write a laboratory report:

1. Title and Cover Page:
   - Start with a clear and informative title that reflects the content of your experiment.
   - Include your name, your lab partner's name (if applicable), the date, and the name of your instructor or supervisor on a cover page.
2. Abstract:
   - Write a concise summary of the entire report, typically around 150-250 words.
   - Include the purpose of the experiment, the methods used, key results, and major conclusions.
3. Introduction:
   - Provide background information about the topic or problem you're investigating.
   - Clearly state the objective or purpose of the experiment.
   - Include any relevant theories or hypotheses that the experiment is testing.
4. Materials and Methods:
   - Detail the materials and equipment used in the experiment.
   - Describe the experimental procedure step by step so that someone else could replicate it.
   - Mention any specific techniques or methods employed.
5. Results:
   - Present your data in an organized manner, typically using tables, graphs, and figu
   - Include all relevant observations and measurements.

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   - Include all relevant observations and measurements.
   - Provide appropriate units and labels for all data.
   - Summarize the data and highlight any trends or patterns.
6. Discussion:
   - Interpret the results and explain their significance.
   - Discuss any unexpected findings and potential sources of error.
   - Compare your results to any relevant theories or hypotheses.
   - Consider the broader implications of your findings.
7. Conclusion:
   - Summarize the main findings of the experiment.
   - Restate the objectives and whether they were achieved.
   - Offer insights into the significance of the results.
   - Suggest possible areas for further research.
8. References:
   - Cite any sources, such as textbooks or scientific papers, that you referenced in your report.
   - Follow a citation style (e.g., APA, MLA, or a style recommended by your instructor).
9. Appendices (if necessary):
   - Include any additional information, such as raw data, calculations, or detailed procedures, in appendices.
10. Proofread and Format:
    - Carefully proofread your report for grammatical, spelling, and formatting errors.
    - Follow any specific formatting guidelines provided by your instructor or institution.
11. Submission:
    - Submit your laboratory report according to your instructor's instructions, which include a printed copy, digital submission, or both.

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Figure 2. Lab report

Advantages and Disadvantages of AI tools and ChatGPT

The advantages and disadvantages of AI tools are described in the table below.

No.	Advantages	Disadvantages
Artificial Intelligence		
1	Can provide writing assistance	Plagiarism
2	Do mathematical calculations	Over-dependence
3	Compose music	Wrong information
4	Write computer programs, and codes	Ethical Concerns
5	Lesson planning	Security Concerns
6	Problem solving	Privacy issues
7	Feedback to students and educators	Jobs taken away
8	Tutoring one on one basis	Joblessness
9	Adaptive learning to the needs of the students	Crime spike

Conclusions

It seems that AI tools like ChatGPT are going to become increasingly important in the future. As they continue to improve, they will offer numerous advantages by functioning seamlessly without making humans feel inadequate.

It could be argued that the true impact of AI tools, whether positive or negative, may not be fully realized until 5 to 10 years from now. Only time will tell how these tools will shape our future.

At present, it appears that AI tools can be useful for specific tasks within engineering and engineering education. However, it does not seem to pose a threat to either the field of engineering or engineering education.

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