

Application of Generative Artificial Intelligence (AI) on Teaching-Learning Process in Higher Education

Dr. Laxmi Jaiswal^{1*}

^{1*}Assistant Professor, Department of Education, Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur, UttarPradesh-273009
Email ID(s): laxmi.jaiswal01@gmail.com; laxmi.edu@ddugu.ac.in

Abstract

This paper focuses on the various tools available in open AI platforms that are extensively used by the students, teachers and academic community and it is increasing day by day. With the review of available literature, it is attempted to explore the various AI platforms that are extensively used in higher education and its impact on the quality improvement of teaching learning process and overall satisfactory experience of the learner as an aid in learning given the diverse background. This paper has dealt at large with ChatGPT and Bud-D AI tools that can be helpful in a variety of ways for the learners customised learning, self-paced assessment and reducing the cultural and language gap. Small discussion on interaction of AI with virtual reality, augmented reality, mixed reality and extended reality technologies with its application for the users is also being discussed.

Key Words: AI; ChatGPT, Bud-D; Augmented Reality; Virtual Reality; Extended Reality; Mixed Reality; Teaching and Learning Process.

Introduction

Emerging technologies such as virtual reality, mixed reality, cloud computing, augmented reality, digital twin, block chain, virtual assistant, Internet of Things, Natural Language Processing and Artificial Intelligence are dominating almost every sector of the services and education can't remain in absolute status (Sharma, 2021). Among these, Artificial Intelligence is influencing every sphere of life from devices to humans. According to UNESCO, "artificial intelligence in education is expected to be worth USD 6 billion by 2024 and is a great tool to accelerate SDG 4 that is quality of education." (p.). Deep learning, Machine Learning and Neural Networks are embedded parts of Artificial Intelligence.

Artificial Intelligence (AI) is concerned with the development of intelligent computer systems mimicking the execution of tasks that require human intelligence. "Machines capable of imitating certain functionalities of human intelligence, including such features as perception, learning, reasoning, problem-solving, language interaction and even producing creative work" (UNESCO, 2019b, p.24). AI has two types, the first one is Artificial Narrow Intelligence (ANI) that is widely used and applied with the help of machine learning. The second one is Artificial General Intelligence (AGI) that is mostly seen in theoretical form and would be comparable with human intelligence

when it comes into application. Bostrom (2014) defined the third category of AI as Artificial Super Intelligence (ASI) that may super exceed the cognitive capabilities of humans in all spheres of life. Professor John McCarthy from Stanford University (USA) is considered as one of the AI founders and this term was coined by him. He defines AI as "the science and engineering of making intelligent machines, especially intelligent computer programs" (Stanford University, para2). Another definition of AI includes a more technical explanation "AI systems are software (and possibly also hardware) systems designed by humans that, given a complex goal. Act in physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured and unstructured data, reasoning on the knowledge, or processing the information derived from this data and deciding the best actions to take to achieve the given goal" (Delipetrev, Tsinaraki and Kostic, 2020, p.5). AI can be classified as generative AI and predictive AI. Generative AI produces or creates new content by using neural networks whereas predictive AI makes predictions for the future on the basis of the data stored in the past using statistical algorithms. General Adversarial Networks (GANs) train two neural networks at a time, a generator network that creates new content and a discriminator network that evaluates the content and provides feedback to the generator (Aydin and Karaarslan, 2023).

Examples from day to day life can be seen such as Alexa, Siri, self-driving automobiles, chatbots and Robo-advisors (Stanford Encyclopaedia of Philosophy, 2020). AI is becoming prominent in every sphere of life including various aspects of education particularly the teaching learning process. Various AI systems present in various walks of life, however, an open AI system in the form of chat generative pre-trained transformer ChatGPT came into public domain. "A deep neural network architecture with multiple layers is used to implement ChatGPT. These layers are transformers created to analyse sequential data, like text written in natural languages and produce output that resembles human speech. In order to train ChatGPT, a lot of text data is put into the model. This enables it to recognize relationships and patterns between words, phrases, sentences, and typing errors. The model gets better as additional data is fed into the model throughout the iterative training process. Once taught, ChatGPT can be tailored for particular activities or applications, such as content creation or language translation" (Gaayathri et al., 2023, p. 51). Other types of AI systems released namely Mid journey, Microsoft's Bing AI chat, Google chatbot BARD and Dall-E made remarkable impact on higher education. Other generative AI tools that have made an impact on higher education are Synthesia, a video generative tool, and Amper music, a cloud-based platform that generates soundtracks for films and digital games. The recent developments such as the prominence of virtual learning after 2020 and use of open AI ChatGPT has brought about rapid changing technological landscape in the teaching and learning processes of higher education. Thus, it is of paramount importance to study how to implement AI effectively (Crawford et al., 2023; McGrath et al., 2023).

Application of AI Tools in Teaching and Learning

Ability of AI to positively influence student's creativity by inclusive curriculum, personalised learning, tailor-made courses for maximising learning experiences (Wang, Sun & Chen, 2023). Study conducted on students from vulnerable groups with learning disabilities believed that AI could assist in better ways to overcome issues of disabled for learning in optimum way [McGrath et al. (2023)]. Generative AI is being used for creating new content, automated assessment feedback and facilitating rudimentary support services (Pelletier et al., 2023). Predictive AI can be and be applied in personalised learning platforms, managing student enrolment promoting student success and aiding student advice. Duolingo is such an app that assists in learning a new language. Adaptive learning algorithms along with machines create a learning path that becomes

highly individualised. Knewton is used by the teachers to teach Mathematics, Chemistry and other subjects. Task automation such as answer script evaluation, attendance handling, time-schedule preparation and inventory management is done by the help of AI.

With the help of location-based technologies and sensors students may be located for letting their access for educational facilities (Sharma, 2021). Image recognition and processing is another application of AI for data and image manipulation. Chatbots such as ChatSim and SOCRATES enable students to interact with each other using Avatar in a virtual learning environment. Affectiva and Mind Lab are used for the behaviour analysis of the students in the classroom for looking at the emotional dynamics that is not possible for a teacher to do in real classroom situations for all the students. Iowa and Querium are such applications that help students to assess learning capabilities and identify struggling students in academic discourse. Speech recognition, self-regulated learning tools such as Flora and Internet of Behaviour (IoB) studies the behaviour that are very effective tools for counselling of the students and for the creation of better products for the system.

Nowadays the concept of Metaverse is gaining value. This is a virtual environment where interaction is possible in digital space giving experience in the deepest manner. This concept was limited to gaming and science fiction in the early developmental period, however, now it is expanding towards finance, health, education and other services (Huynh-The et al. 2022). AI can be a reforming tool for Metaverse by incorporating personalised experiences and intelligent virtual assistants. Metaverse may become more accessible to the persons with any sort of disability with the characteristics of enhanced security and maintaining the privacy of the users (*ibid*). Supervised learning can be developed with the help of AI. Few examples are K-Nearest Neighbour (KNN), Linear Classifiers, Decision Trees, Random Forests, Support Vector Machines (SVMs), Artificial Neural Networks (ANNs) and Random Forests (Kotsiantis et al., 2007). Machine learning technology includes three types of strategies: supervised learning, unsupervised learning and reinforcement learning (Hu et al., 2015).

Big data-analysis is proved to be more efficient with ChatGPT as a tool in time-saving tools. AI provides personalised and adaptive learning opportunities to the students by customised contents, language translation services, writing and revision assistants for feedback to

improve concerned skills (Wang et al., 2023). AI can be used in education in creating adaptive learning systems, intelligent tutoring systems, learning analytics and educational data mining. An AI subfield is computer vision that acts on the inputs in the form of visuals, video inputs, and extract information from these inputs through decision-making. Here AI gives power to reason and accordingly computer vision extracts the given visuals..Semantic segmentation involves classifying the image into distinctive colours based on the pixel-level information (Lin et al., 2021). In computer vision semantic segmentation is a very important aspect for fast and efficient classification of pixels on the information base present. Examples can be taken to classify the group of people providing distinctive colour with the background of the image. This can be an effective tool in scientific research for providing different characteristics to different elements. Another important aspect of computer vision is object detection and localisation which detect, recognise and localise objects of image and can be applicable to Metaverse applications (Hbali et al. 2016). Another important application of computer vision is face detection and recognition.

NLP enables more involved and deep conversation experience in the Metaverse by analysing multilingual data, textual data, social media posts and reviews to identify set patterns of behaviour. Machine translation, chat bot, sentiment analysis, audio processing, information extraction are few more applications of NLP (Chenget al., 2022). Text to image and image to text conversion implies the identification of specific characteristics from the object and translating or creating the image or text by generating the target object with consistency and realistic manner. GANs are used for text to image generation such as GAN-INT-CLS (Reed et al., 2016). One type of machine learning is self-supervised learning where eliminating the need of additional labelled data, the utilisation of unlabelled data to utilise the learning efficiency of the model. This helps the discriminate or to provide more images thus stimulating the generator by supplying more images.

Multimodal data processing uses a single AI model that can analyse audio, images and texts. The data2vec model can identify speech from an audio sample, can classify objects from an image, capable of analysing the tone and emotions of the writing and can check the Grammar (Baevskiet al., 2022).Transformer that is a deep learning architecture is used for multimodal data processing that predicts sentiment by using different modalities (Kim and Park, 2023). Large Language Models (LLMs) are nowadays used for text-based systems dealing with large amounts of data in textual form.

GPT-3 has 175 billion machine learning parameters including language translation, question answering and text summarisation (Leippold, 2022). ChatGPT is a variant of GPT-3 that generates responses on written queries using human inputs and reinforcement learning algorithms. Megatron-Turing NLG produced by NVIDIA and PaLM introduced by Google are other examples of Large Language Models (Chowdhery, 2022).

Virtual reality is the conversion of the real world into a 3D replicated environment for a fully immersive experience. 3D scenes, 3D virtual objects and avatars give real world experiences and give experience in the classroom for various experimentation, communication and conversation. Integration of AI with virtual reality gives more realistic experiences to the users. Augmented reality combined with AI enables more natural, intuitive and fluid interaction with virtual objects and environments. Combining AI with the Internet of Things (IoT) may provide more immersive and lifelike experiences to the users. With the help of IoT devices connecting virtual and real-world environments, AI algorithms can analyse large amounts of data from real time producing adaptive and immersive experiences. A lot of intelligent tasks such as language interpretation and speech recognition are anticipated by simulated intelligence without human intervention (Kuzlu et al., 2022). Utilising blockchain technology combining this with AI detection and prevention of fraudulent activity such as identity theft and double spending attacks can be prevented (Matthieu et al., 2021).

Generating secure digital identity, innovative use cases, enhanced privacy, trust and transparency for the student services, increased blockchain network speed and its transaction by combining AI with blockchain technology. Blockchain technology along with AI enhances the potential of adaptable and flexible data management. Representation of physical objects in the virtual world by synchronising assets, operations, processes and systems to create something that is called digital twins. With the use of AI, these tasks can be remotely analysed (Rathore et al., 2021).

Integration of AI with digital twin technology provides realistic simulation with high accuracy, personalisation by enhancing customized services, predictive analytics for better prediction of future trends and scenarios, autonomous decision-making where real world characteristics, processes and components are required to be managed in the digital world. Creation of Avatars and digital scenes presents virtual fields such as virtual campus, museum, communication with digital world and Avatars. Facebook

has recently launched Horizon Workrooms, a meeting platform that equips users to connect and work in the virtual world using virtual reality devices. AI Avatars can be used as virtual assistants during classroom interactions, in laboratories with human-like interaction effects.

For NLP tools, the main task is voice processing, automatic speech recognition, conversion of text to speech to understand the message and purpose of others to give real life experiences. It is stated that 'VR users frequently receive responses from non-player characters or artificial humans in the form of speech bubbles. These interactions would be elevated to a whole new level by NLP, which would enable the production of audio answers with voice modulation and subtle grammatical variation.

Interactive learning environment platforms such as AI-assisted ACTIVE Math, MATHia and Why2Atlas have applied for the management of learning achievements, individual performance, teaching tools improvement, effective communication and feedback loop between educators and learners in higher education. Apart from that, Grammarly, Ecree and PaperRater offer plagiarism detection (Chassignol et al., 2018; Johnson et al., 2010).

Learner-centred AI applications such as Deep Tutor and Auto Tutor produce custom and personalized content based on ability and requirements of students for successful learning outcomes. Chinese college students' learning capabilities were examined through the intervention of Google translate that resulted in reducing spelling mistakes and grammatical errors (Tsai, 2019). Additionally, gamification with 3D technologies assisted instructions impacted the quality of teaching. Applications such as Knewton, Cerego, CALL and Immersive reader provide real-time suggestions based on machine learning algorithms for individualised content and materials for the students corresponding to their needs. For those students not good enough in English writing and communication, AI-powered translators and writing tools such as ProWritingAid, QuillBot and Ginger have become popular as an aid. Adding into this ELIZA and ALICE chatbots; Andy and Mondly, Duolingo and RosettaStone have become helpful to the students for complex sentence framing, enriching language input for those students facing difficulties in discussion, lower listening capacities and difficulties in understanding accents.

Adaptive testing might help educators to adjust nature and difficulty such as complexity of the question according to the learner's disciplinary background, culture for accurate

assessment. In the same manner predictive analytics may identify those students struggling in their advancement at any domain well in advance so that timely help and targeted support might be provided to the students. Students with diverse demographic conditions, cultural settings, academic level and level of generation of learners in the family make the education inaccessible even getting access in the higher education institutions. AI tools such as Chatbot may become effective for such students to understand the topic or assignment as a complementary resource to get acquainted with what is asked for. AI tools such as accessibility tools such as sensory support, chatbots, virtual assistants and personalised recommendations, text to speech, image recognition, voice activated interfaces, electronic Braille displays; automatic translations may support students with visual impairments.

According to Wang and Siau (2017), AI will impact the prospective labour market of required skills. Explaining further it is argued that larger firms nowadays use algorithms to select candidates with an Applicant Tracking System (ATS). Using computer driven visual interviews services AI analysed facial expression and language pattern for selecting the candidates. In the form of the creation of an application namely Bud-D that stands as the sound-based counterpart to ChatGPT. Beyond giving inputs as text and prompts, the interaction through voice enables users to communicate naturally. ChatGPT uses GPT 3.5 that uses LLM to process crores of data, understand it and give the desired output in the form of text. Likewise, Bud-D uses natural language processing to sound too similar to human beings. By understanding linguistic links and patterns the LLM responds that encourages users to generate the responses, a kind of reinforcement learning from users feedback generated to further the conversation. Bud-D uses an open AI API. This converts user voice input to text and passes text through the API using Python programming and its available libraries. Converting user voice input into text queries by speech recognition package and placed before API that generates response which is transformed into voice by gTTS and played using OS (**Figure 1**).

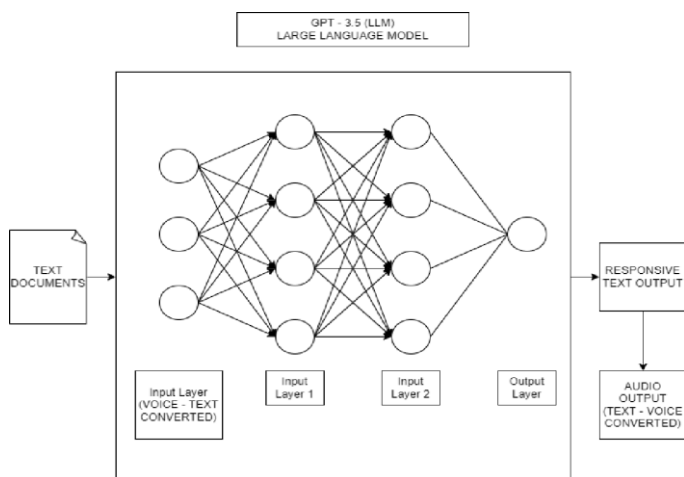


Figure1: How does ChatGPT work? (Source: Gaayathri et al., 2023.p.52)

Bud-D proved to be helpful for the visually impaired people that provide auditory output in any language. Finally, it can be stated that these open AIs provide promising tools in the hands of users to overcome their difficulties in learning, understanding the language of different regions across the world and an effective tool in the hands of educators by automating several routine tasks that consume time.

Conclusion

AI performs domain specific and fixed tasks with unlimited speed, unlimited computing capacity and extensive data. Integrating AI with other technologies such as virtual reality, augmented reality etc. allows user interaction more individualized, lifelike and safety of the privacy of users. Utilising a variety of tools and techniques digital avatars, 3D virtual items can add as an additional feature for the students as users adding on their understanding of various issues faced during the learning process. New researches and innovations create new

fieldsofapplicationstoenhancetheusersexperiencesinacomprehensivemanner. AI integrating with machine learning and

deep learning structures is largely used in different sectors of research and teaching learning processes. Supervised, unsupervised, semi- supervised and reinforcement learning have applied on classification and regression models for language processing applications such as voice recognition, physical activity recognition by collecting sensor signals received from day to day using devices.

Open AI ChatGPT is a remarkable development in transformative technology which offers a platform that

harnesses the power of AI and Machine Learning. Integration of AI in the education sector is an evolving field that gives promising advancements in learning efficiency, customised learning support and opportunity to enhance learning experiences with self-supportive systems with all categories of students. As virtual reality experiences are becoming more advanced, the integration of AI with technologies such as IoT, blockchain, virtual reality, augmented reality, mixed reality and extended reality are going to be the ambassador of further development. The purpose of AI in educational institutions enhanced functioning by incorporating machine building that comprehends natural language, process and interpret data to give it a meaning to extract out the meaning as to function like humans. The virtual environment and avatars will be a fantastic tool for the stakeholders of education and the people engaged in dealing with the technologies. The governance of higher education institutions may benefit with the AI tools by a large pool of data and aligning processes and procedures of administration and management with requirements of teaching and learning by the students and faculty. IT services that arch the student's admission data, students' services, library and marketing and branding of the institution may get advancements with the help of AI tools. Conclusively, it can be stated that AI is a great tool in the hands of each and every stakeholder of the education system; however it's utility with all wisdom requires safety of the data and its utility in an ethical and responsible manner.

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