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The Impact of AI on Student Engagement and Learning Outcomes

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Abstract

Artificial Intelligence (AI) and Machine Learning have become essential to education in the current scenario. Perceived as the mythical Frankenstein, it has emerged as a tool to enhance the students' learning experience. This paper aims to delineate the graph of AI from its inception to its transformative potential in augmenting processes across diverse areas. Education is one of the key sectors which AI has hugely impacted. There are speculations that it could erode the critical thinking faculties of the learners and hurt ethical values, but it is now an unavoidable necessity. The paper examines how AI can be integrated into the classroom to reinforce learning, creativity, and imagination. It explores how the challenges posed by AI can be overcome, which will facilitate the planning of the classes, carrying out administrative responsibilities and developing innovative pedagogical practices. This qualitative research relies heavily on recent published literature in books, journals, and policy documents issued by Niti Aayog in India. The article deduced that technology-driven teaching is the future of education, and AI literacy and knowledge by teachers can help leverage its unprecedented potential and minimise its challenges and threats to construct a more democratic, inclusive, research and activity-based approach to education.

Keywords*— *Artificial Intelligence, Innovative Pedagogy, Ethics, Creativity, Critical Thinking

I. INTRODUCTION

The debate around Artificial Intelligence (AI) leads one to wonder whether it promises a 'brave new world' that Miranda conceived of upon first laying eyes on Ferdinand in *The Tempest* or whether it could emerge as the Frankenstein of the twenty-first century. Innovations in AI and Machine Learning are taking place at an unprecedented pace, with heavy investments in its development globally. These have emerged as transformative forces that will reshape industries, economies, societies and education worldwide. The world's five top economies, the USA, China, Japan, Germany, and India, are building extensive AI ecosystems. 'The World Economic Forum' reported, "The allocation of resources toward AI research, development and implementation varies globally, reflecting diverse strategies, priorities and visions for the future." (Chopra &Gupta 2024). There are enormous venture capital investments in AI globally, with the USA having spent 290 billion dollars in the last five years. China's investment is projected to exceed 61 billion dollars. Japan is investing heavily in AI to support its ageing population and declining workforce. Gupta remarks, "India's artificial intelligence market is projected to touch $17 billion by 2027, growing at an annualised rate of 25-35% between 2024 and 2027. An increase in enterprise tech spending drives the growth, the country's expanding AI talent pool and a rise in AI investments". (ibid.)

II. ARTIFICIAL INTELLIGENCE

In the finance budget of 2025- 2026, Finance Minister Nirmala Sitharaman announced that the Indian

Government plans to fund the integration of Artificial Intelligence (AI) in various fields. Allocations for all AI-related schemes have significantly increased since the previous Union Budget. In her 8th Budget presentation speech, the finance minister stated that the government will set up a new Centre of Excellence (CoE) in AI in the education sector, with a capital outlay of ₹500 crore. (Radhakrishnan et al.) This allocation supports healthcare, agriculture, and governance and conducts interdisciplinary research in developing advanced applications. Education is a key area where implementing AI models would lead to transformative, cutting-edge research and advancement.

This technology started being developed in the 1950s. Artur Samuel coined the term Machine Learning in 1959, which involves using algorithms to analyse data, learn from it, and derive conclusions or make predictions based on it. "Instead of hand coding software libraries with well-defined specific instructions for a particular task, the machine gets "trained" using large amounts of data and algorithms and, in turn, gains the capability to perform specific tasks" (Kant 14). Recently, Mustafa Suleyman has defined artificial intelligence as "the science of teaching machines to learn humanlike capabilities. Artificial general intelligence (AGI) is the point at which an AI can perform all human cognitive skills better than the smartest humans" (15). In his Ted Talk, he described AI as something "like a new digital species, as digital companions for humans in the future. (*What Is an AI Anyway? | Mustafa Suleyman | TED*). In the 'National Strategy for Artificial Intelligence' in Niti Ayog policy document, Kant remarks that it "is a constellation of technologies that enable machines to act with higher levels of intelligence and emulate the human capabilities of sense, comprehend and act…the explosion of powerful deep neural networks now gives AI something a mere program doesn't have: the ability to do the unexpected" (12). Andrew Ng, a computer scientist and Course Era founder, famously remarked, "AI is the new electricity" (Lynch 2017) that will transform how the world functions in different sectors.

Priten Shah (2023) defined AI as "the simulation of human intelligence by machines. These include simulations of learning (the acquisition of information and rules for using the information), reasoning (using the rules to reach approximate or definite conclusions), and self-correction (knowing when a mistake has been made and correcting it" (16). But it is a path that can lead to dark and unknown results that could defy the expected results. Suleyman warns that with AI we could create systems that are beyond our control and find ourselves at the mercy of algorithms that we don't understand". He adds that "we are faced with a choice—a choice between a future of unparalleled possibility and a future of unimaginable peril". He warns that since AI is still in its developmental stages, the framework of policies and decisions made at this juncture "will determine whether we rise to the challenge of these technologies or fall victim to their dangers" (17-18).

III. ROLE OF AI IN EDUCATION

The only certainty in this unprecedented development is that AI is here to stay and will affect our lives in more ways than we ever imagined. In such a context, we are witnessing heavy capital investments in developing cutting-edge technology. More and more AI applications are being developed and used, and education is predicted to be one sector that will use generative AI models in multiple ways. According to Niti Aayog's 'National Strategy for Artificial Intelligence' (2017), the key focus areas of AI intervention in India are healthcare, agriculture, education, smart cities and infrastructure, and smart mobility and transportation. The report states:

> Artificial Intelligence (AI) is poised to disrupt our world. With intelligent machines enabling high-level cognitive processes like thinking, perceiving, learning, problem-solving and decision-making, coupled with data collection and aggregation advances, analytics and computer processing power, AI presents opportunities to complement and supplement human intelligence and enrich how people live and work. (Kant 5)

With its plan # AI for All, India 's policy on AI seeks to leverage transformative technologies to ensure inclusive growth in different sectors. It has far-reaching implications in the education sector as well. Likewise, the National AI mission the 'INDIAai' aspires to build a comprehensive ecosystem that fosters "AI innovation by democratizing computing access, enhancing data quality, developing Indigenous AI capabilities, attracting top AI talent, enabling industry collaboration, providing startup risk capital, ensuring socially impactful AI projects, and promoting ethical AI" ("AI for Societal Transformation: India's Vision in Action").

In its recent report, Accenture predicted that AI has the potential to add US$957 billion, or 15 per cent of current gross value added, to India's economy in 2035" ("Rewire for Success Boosting India's AI Q enabling

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Strong and Inclusive Ai-Driven Economic Growth"). To avoid missing out on this opportunity, policymakers and business leaders must prepare for and work toward the AI revolution. Accenture states that the power of AI can be harnessed with a combination of people and technology working together to wield satisfactory outcomes in building nations. Consequently, globally, the investment in AI-driven technologies has grown manifold. "With the recent convergence of a transformative set of technologies, economies are entering a new era in which AI has the potential to overcome the physical limitations of capital and labour and open up new sources of value and growth." (ibid.) AI can augment productivity and innovation in three crucial ways: automation of complex and physical tasks, complementing and enhancing the skills of the existing workforce, and acting as a catalyst for boosting economic growth. Accenture states that by 2035, India's annual growth rate could increase by 1.3 percentage points by integrating AI and human resources. India is geared to develop its AIQ to leverage social development, inclusive growth, and innovation in four crucial sectors: healthcare, agriculture, the development of smart cities, transportation, and education.

Recent research reveals the far-reaching potential of artificial intelligence (AI) in enhancing teaching practices in areas such as lesson planning, personalised teacher intervention and feedback, and performance assessment (Shi et al. 1). It is transforming various dimensions of the education system, such as instructional practices, assessment strategies, and administrative processes (Almasri 977). It necessitates AI literacy, prompt engineering proficiency, and enhanced critical thinking skills. Introducing AI into education marks a significant departure from conventional teaching methods, offering personalised learning and support for diverse educational requirements, including students with special needs (Walter). Li and Peng (2022) found that AI-based platforms can effectively perform monitoring and tutoring functions to facilitate flipped class instruction. Li and Peng recommend face-to-face classroom instruction with the AI-technology-assisted online learning experience to coherently support each other. Kamalov et al. (2023) conducted a detailed study and concluded that the "only way forward is to embrace the new technology while implementing guardrails to prevent its abuse" (1). This paper examines how AI can be integrated with the current educational practices in India to strengthen the system and benefit the students and the teaching community. It seeks to locate the factors that could help to strike the delicate balance between technology and human intelligence.

IV. TECHNOLOGY-DRIVEN PEDAGOGY

Advanced artificial intelligence offers avenues for enhancing teachers' pedagogical innovation, making it possible to customise instruction, study material and feedback to individual needs. This enables immediate instructional intervention and facilitates teachers' decision-making processes (Shi et al. 1). It transforms education in the twenty-first century in various dimensions. Almasri notes that AI in education (AIEd) is an evolving interdisciplinary area incorporating technology to renovate and enhance the teaching and learning environment (977). This has a far-reaching impact on instructional practices, assessment strategies and administrative processes. Almasri conducted a study of research done in this area from 2014 to 2023 and explored how AI tools can enable the learning of science. by enhancing the learning environment, creating quizzes, assessing the students' work and predicting their academic performance. Walter (2024) points out that AI in education offers personalized learning and supports diverse requirements, which include differently abled children. However, its integration into education requires adequate teacher training and curriculum development to align with societal structures. Almasri observes:

> It enhances educational processes, developing essential skills such as computational and critical thinking, intricately linked to machine learning and educational robotics…However, integrating AI into education is not without its challenges… Beyond algorithmic thinking, AI in education demands a focus on creativity and technology fluency to foster innovation and critical thought. (2)

Chat GPT, i.e., Generative Pretrained Transformer, launched in San Francisco in November 2022, marked a new era in how learning could be approached and delivered. It has personalised education, making it inclusive and democratic by catering to the unique needs, strengths, and weaknesses of the learners. While it has made the teaching processes far more adaptable by allowing the teachers to design study material to suit the students' individual needs, it has also opened the gateway for the students to feel unhindered in their enquiry or explanation of doubts. It salvages the learner from the fear of being judged and has redeemed them

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from inhibitions. The generative AI model can simplify the content in the chosen language, allowing the learner to ask for explanations using suitable examples and illustrations. Billions of resources on a given subject are now available for the students. The erstwhile need to hunt for study material and excessive dependence on teachers and professors has been remarkably mitigated. The approach of dictating notes in the classroom, of the teachers owning the final word on the subject to be delivered, has now become passe. What is now required is the 'prompt' and the curiosity to ask the right questions, which is where the teacher remains indispensable. The teacher should be able to inspire the students to enquire and probe, to find the answers and develop the confidence to articulate or differ from them and come up with contrary opinions and innovative ideas. The personal connection of the teacher with the students, the personal charisma, inciting the students' curiosity and leading by example are traits that the instructors will have to develop and chisel consciously.

Kamaov et al. (2023) mentioned the "potential hazards of introducing autonomous systems in education", which include issues of "data privacy and security, bias and discrimination, and the teacher-student relationship" (3). There is the risk of data being misused, as some applications require the student's personal information to be shared to customize a learning plan for the individual. "Another important issue is bias and discrimination. Since AI is trained on public data, it can be exposed to biases on the internet. In addition, AI algorithms can also inadvertently learn bias on their own" (ibid.). For these reasons, policies need to be framed and implemented so that the technology can be used for the welfare of humanity and not vice versa.

Kristen DiCerbo, the chief learning officer at Khan Academy, believes that learning outcomes can be improved for all by catering to five essential policy concerns that include:

i) Promoting AI literacy by integrating AI concepts into the curriculum and motivating students to become well-informed consumers by critically evaluating AI-generated responses.
ii) Providing guidance on using AI responsibly and being mindful of its ethical implications.
iii) Building adequate capacity through teacher training to harness its potential fully
iv) Encouraging consistent innovation through funding R&D to create new applications specially tailored to meet specific needs
v) Inculcating leadership through engagement at multiple levels viz, teacher, learner and developer of AI ("Policy Ideas - Foundational Policy Ideas for AI in Education")

In an AI-driven educational environment, key emphasis will be placed on developing essential skills such as problem-solving, management, communication, team building, emotional intelligence, and empathy. Unless the students are taught to work in teams through group activities, there is the danger of increasing isolation and growing social anxiety. Educators need to underpin the idea that we are social animals, and that technology is created to enhance the human experience, not vitiate it. There is an urgent need to develop innovative learning models such as collaborative, peer group learning that involves project-based activities, problem-based learning that encourages out-of-the-box thinking and innovative solutions, flipped classroom approach and interdisciplinarity in approach.

The transformative power of AI has unquestionably revolutionized education. The change is here to stay, grow and advance into super-intelligent models. Hence, the demand of the moment is to embrace the change with preparedness. In such a scenario, it is imperative that the learners be enabled with key skills. While teaching undergraduate students Girish Karnaad's *Naag Mandala,* the researcher instructed the class to probe deeper into the role of the 'story' and the 'flames' in the prologue. As a conscious move to integrate AI into classroom teaching, it was fascinating to observe that the students became increasingly inquisitive about the suppressed voice of women and the lack of agency that disallowed women from narrating their stories. It further led to engaging discussions in the group where the female students gained the courage and freedom to express themselves more openly. Generative AI can support critical thinking by enabling students to ask thought-provoking questions. Snipes (2023) reiterates the same idea and points out that "Chat GPT can be an excellent tool for enhancing communication skills in the classroom. By providing students with opportunities to engage in written or verbal discussions with the AI, they can practice expressing their thoughts and ideas effectively" (14). Through dynamic and interactive assignments, the students can be led to develop critical thinking and problem-solving.

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Flogie and Abersek (2019) emphasized the need for teachers in the twenty-first century to be creative in delivering their lessons. They note:

> The teacher can use fresh examples…or problems or surprise students with new data…The teacher can also engage students through games and simulations that require them to apply the information in unfamiliar contexts. E-learning environments, role play, energizing online discussions, and quick, serious games can all add sensory stimuli to raise blood pressure and epinephrine levels to eliminate drowsiness, reduce restlessness, and reinforce information. (109)

In their discussion on Education 4.0, the researchers in 2019 posited whether machines could be taught morality and ethics. Generative AI is equipped to deliver answers based on what the machine has pre-learned from the available information through billions of resources. But, since it is based on the existing quantum of knowledge, there is a possibility of bias and ethical infringement.

V. CONCLUSION

The issue of plagiarism is a significant factor in academic ethics and integrity. As education becomes revolutionised, its collateral damage is the breach of ethical frameworks that discourage copying and honouring intellectual property rights. In *AI and the Future of Education* (2023), Priten Shah notes that although AI has become ubiquitous, users must consider its social and ethical implications. In education, it is paramount that the users are mindful of its ethical and judicious use. Students should be able to sieve misinformation, fake media, propaganda and manipulation. "They will also need to think through what they produce and put out into the world and its consequences for the rest of society. Finally, they will have to critically evaluate the output of AI to spot and address biases and inaccuracies" (5).

Additionally, there is also the risk of students' excessive dependence on AI. It may hamper the learner's natural curiosity to ask questions and form an overview of a subject. It will be easier for them to get the text summary, look for ready-made answers and get AI to complete assignments. It may not be suitable for certain subjects that must dwell on abstract and philosophical issues or involve creativity and expression. In such instances, the personal connection between the team and the teacher cannot be replaced. The role of a teacher in AI and technology-driven classes will become even more fundamental and challenging. She will be the pilot who can enable the learners to dive deep into subject enquiry comprehensively and encourage group participation. It is the collective responsibility of academia to harness the potential of technology even as we walk the tightrope, not to allow machines to impair human faculties of thinking, creating, and inspiring.

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