

A Review Study on The Role of Artificial Intelligence and Technology in Higher Education

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Abstract—The 21st century is often looked upon as the Era of Artificial Intelligence and Technology. Today Artificial Intelligence (AI), Computer science and its applications, Machine learning, and Technology are transforming society and industries by automating tasks across the knowledge economy. From medicine development to writing and editing, AI is upsetting and transforming various traditional professions. The influence of AI in the Ed-tech market is thriving. Artificial intelligence is a field of study and the resulting innovations and developments that have culminated in computers, machines, and other artifacts having human-like intelligence characterized by cognitive abilities, learning, adaptability, and decision-making capabilities. AI initially took the form of computer and computer-related technologies, transitioning to web-based and online intelligent education systems, and ultimately with the use of embedded computer systems, together with other technologies, the use of humanoid robots and web-based chatbots to perform instructor's duties and functions independently or with instructors. The purpose of the study is to explore the role of Artificial intelligence and technology in the field of Higher education in India. The study reveals that Artificial Intelligence (AI) and technology are reshaping the knowledge economy and propelling us into a future where the possibilities seem limitless.

Index Terms—Review, Role, Artificial Intelligence (AI), Computer Science, Machine Learning, Technology, Field of Education.

I. INTRODUCTION:

The phrase “Artificial Intelligence” is still used as if it's a future technology, Whereas, the phrase "machine learning" is being debated about a lot these days. We are by now living within the Age of Artificial Intelligence.

Artificial intelligence (AI) represents to computer systems which is capable of performing complex tasks that historically only a human could do, such as reasoning, making decisions, or solving problems. AI is an umbrella term that encompasses a wide variety of technologies, including machine learning, deep learning, and natural language processing (NLP).

Artificial intelligence (AI), is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is usually applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. Since the development of the digital computer in the 1940s, it has been recognized that computers can be programmed to carry out very complex tasks such as discovering proofs for mathematical theorems or playing chess—with great proficiency.

Still, in spite of continued advances in computer processing speed and memory capacity, there are as yet no programs that can match full human flexibility over wider domains or in tasks requiring much everyday knowledge. On the other hand, some programs have attained the performance levels of human experts and professionals in performing certain specific tasks, so that artificial intelligence in this limited sense is found in applications as diverse as medical diagnosis, computer search engines, voice or handwriting recognition, and chatbots.

Artificial intelligence is changing the teaching-learning process in education. Since the origin of the establishment of education, the strategies of teaching and also the bond shared between learners and

educators have evolved considerably. Teaching strategies across the world have become additionally structured to administer higher, additional efficient results. This transformation will be majorly attributed to the continued intervention of technology.

On the rear of continuous technological advancement, we tend to square measure witnessing a paradigm shift within the teaching-learning method. the connection between educators and students is dynamical, wherever educators became additional approachable and far higher at understanding their students' views. Technology has created learning additional cooperative, for academicians and also for students. In the contemporary epoch the application, role and uses of artificial intelligence is becoming essential because it can solve complex problems with an efficient way in multiple industries, such as Healthcare, entertainment, finance, education, etc. AI is making our daily life more comfortable and faster.

II. AIMS AND OBJECTIVES OF THE STUDY:

- To discuss the meaning, definitions, and history of Artificial intelligence.
- To discuss Types of Artificial Intelligence.
- To discuss the role of artificial intelligence and technology in the field of education.
- To discuss the challenges and considerations faced by AI in the field of education.

III. MEANING AND DEFINITIONS AND HISTORY OF ARTIFICIAL INTELLIGENCE.

The concept of Artificial Intelligence is not as new as it seems to be. It has its roots in Aristotle's time (Greece, 1607 BC): 'It would be nice for humans to have intelligent machines to serve them'. Only very recently, in the last fifty years, researchers have attempted to provide formal definitions for the determination of Artificial Intelligence (AI). [S C. Shapiro] defined the term artificial intelligence as "AI is the field of science and engineering concerned with the computational understanding of what is commonly called intelligent behaviour, and with the creation of artifacts that exhibit such behaviour." Whereas [Rauch-Hindin] defined that "AI is a software that programs use to solve symbolic rather than numeric

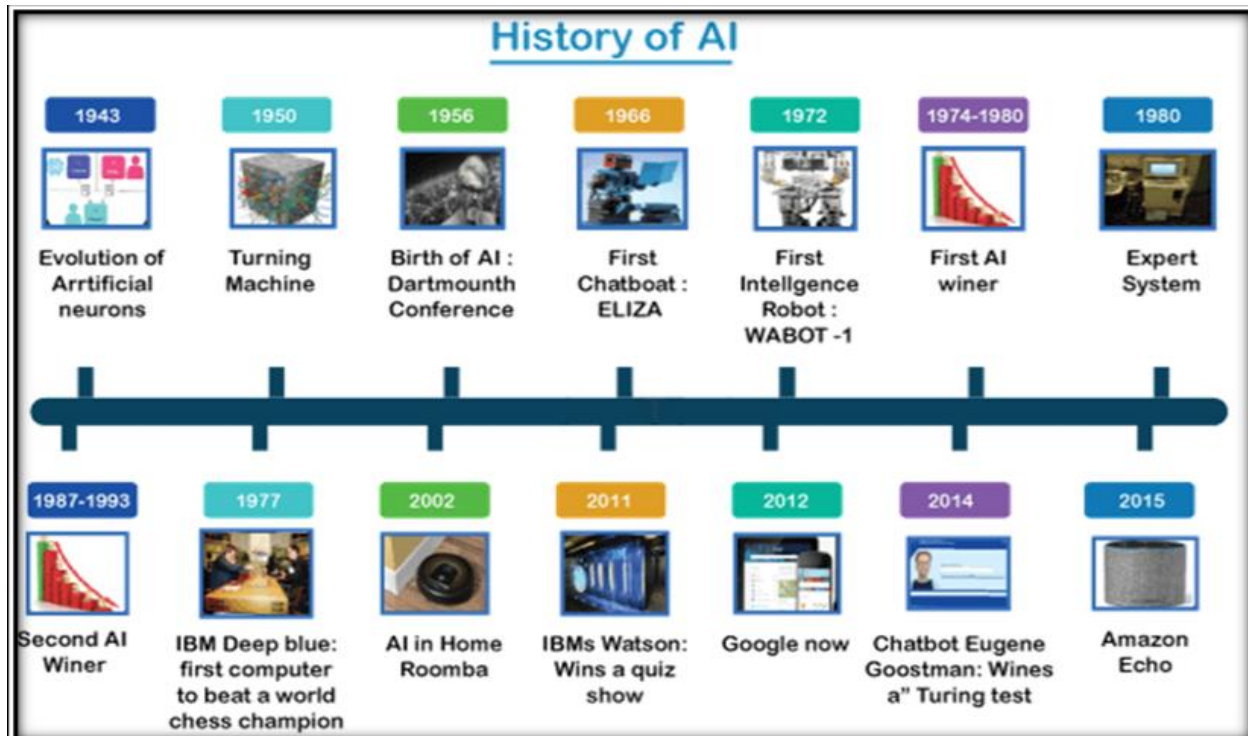
problems." [E. Rich] has well-thought-out that artificial intelligence is - "AI is the study of how to make computers do things at which, at the present, people are better." [Brady-Bobrow-Davis] orated that - "AI is the study of intelligence using the ideas and methods of computation." [Genesereth-Nilsson] has address artificial intelligence as - "AI is the study of intelligent behaviour." [Bench-Capon] stated that artificial intelligence is - "An AI system is a system which attempts to imitate natural intelligence." [N. Bourbakis] delineated that "AI is the science which studies the behaviour of intelligent systems."

Intelligent systems (or machines) are the systems designed and programmed to operate in a way analogous (not necessarily the same) to some human actions, such as sensing, searching, solving problems, learning rules, patterns and concepts, reasoning, extracting and acquiring knowledge in various forms, deciding under uncertainty, developing planning strategies, understanding and interpreting of events, etc.

Following are some milestones in the history of AI and AI technologies which defines the journey from the AI generation to till date development. Although the term artificial intelligence was formally introduced in the mid-20th century, creating intelligent systems has excited the human imagination for centuries. Since its inception in the 1950s, the field of artificial intelligence has embarked on a meteoric journey. Over the past few decades,

AI has undoubtedly made significant advances, changing how we think about the capabilities of human cognition. However, it has also yet to realize some of its grand promises. In this section, we offer you to go through the history of AI, find out its turning points and significant achievements, and how AI is changing the world.

Amidst the years 1943 - 1952, is recognized as Maturation of Artificial Intelligence. there was notable progress in the expansion of artificial intelligence (AI). Throughout this period, AI transitioned from a mere concept to tangible experiments and practical applications. Here are some key events that happened during this period: In the year 1943: The first work which is now recognized as AI was done by Warren McCulloch and Walter pits in 1943.



They proposed a model of artificial neurons. In the year 1949 Donald Hebb demonstrated an updating rule for modifying the connection strength between neurons. His rule is now called Hebbian learning. Then in the year 1950 Alan Turing who was an English mathematician and pioneered Machine learning in 1950. Alan Turing publishes "Computing Machinery and Intelligence" in which he proposed a test. The test can check the machine's ability to exhibit intelligent behaviour equivalent to human intelligence, called a Turing test. The year 1951 Marvin Minsky and Dean Edmonds created the initial artificial neural network (ANN) named SNARC. They utilized 3,000 vacuum tubes to mimic a network of 40 neurons.

Wherein from the years 1952 - 1956, marks the birth of Artificial Intelligence. AI surfaced as a unique domain of investigation. During this period, pioneers and forward-thinkers commenced the groundwork for what would ultimately transform into a revolutionary technological domain. Here are notable occurrences from this era: In the Year 1952, Arthur Samuel pioneered the creation of the Samuel Checkers-Playing Program, which marked the world's first self-learning program for playing games. Then in the Year 1955 Allen Newell and Herbert A. Simon created the "first artificial intelligence program" which was named as "Logic Theorist". This program had proved

38 of 52 Mathematics theorems, and find new and more elegant proofs for some theorems. During the Year 1956 the word "Artificial Intelligence" first adopted by American Computer scientist John McCarthy at the Dartmouth Conference. For the first time, AI coined as an academic field. At that time high-level computer languages such as FORTRAN, LISP, or COBOL were invented. And the enthusiasm for AI was very high at that time.

But the period from 1956 – 1974, which is commonly known / referred as the "Golden Age" of artificial intelligence (AI). In this timeframe, AI researchers and innovators were filled with enthusiasm and achieved remarkable advancements in the field. Here are some notable events from this era: During this period in the year 1958, Frank Rosenblatt introduced the perceptron, one of the early artificial neural networks with the ability to learn from data. This invention laid the foundation for modern neural networks. Simultaneously, John McCarthy developed the Lisp programming language, which swiftly found favor within the AI community, becoming highly popular among developers. Then in the Year 1959, Arthur Samuel is credited with introducing the phrase "machine learning" in a pivotal paper in which he proposed that computers could be programmed to surpass their creators in performance. Additionally,

Oliver Selfridge made a notable contribution to machine learning with his publication "Pandemonium: A Paradigm for Learning." This work outlined a model capable of self-improvement, enabling it to discover patterns in events more effectively. During the year 1964, at this time a doctoral candidate at MIT, Daniel Bobrow created STUDENT, one of the early programs for natural language processing (NLP), with the specific purpose of solving algebra word problems. Although in the year 1965, An initial expert system, Dendral, was devised by Edward Feigenbaum, Bruce G. Buchanan, Joshua Lederberg, and Carl Djerassi. It aided organic chemists in identifying unfamiliar organic compounds. While in the year 1966 the researchers emphasized developing algorithms that can solve mathematical problems. Joseph Weizenbaum created the first chatbot in 1966, which was named ELIZA. Furthermore, Stanford Research Institute created Shakey, the earliest mobile intelligent robot incorporating AI, computer vision, navigation, and NLP. It can be considered a precursor to today's self-driving cars and drones. Whereas in the year 1968 Terry Winograd developed SHRDLU, which was the pioneering multimodal AI capable of following user instructions to manipulate and reason within a world of blocks.

However then in the year 1969, Arthur Bryson and Yu-Chi Ho outlined a learning algorithm known as backpropagation, which enabled the development of multilayer artificial neural networks. This represented a significant advancement beyond the perceptron and laid the groundwork for deep learning. Additionally, Marvin Minsky and Seymour Papert authored the book "Perceptrons," which elucidated the constraints of basic neural networks. This publication led to a decline in neural network research and a resurgence in symbolic AI research. Then in the year 1972 the first intelligent humanoid robot was built in Japan, which was named WABOT-1. But then in the year 1973, James Lighthill published the report titled "Artificial Intelligence: A General Survey," resulting in a substantial reduction in the British government's backing for AI research.

However, the initial AI winter, which occurred in the period 1974 to 1980, is known as a tough period for artificial intelligence (AI). During this time, there was a substantial decrease in research funding, and AI faced a sense of letdown.

But the years between 1980 - 1987, marked a boom for AI. AI underwent a renaissance and newfound vitality after the challenging era of the First AI Winter. Here are notable occurrences from this timeframe: In the year 1980, AI came back with an "Expert System". Expert systems were programmed to emulate the decision-making ability of a human expert. Additionally, Symbolics Lisp machines were brought into commercial use, marking the onset of an AI resurgence. However, in subsequent years, the Lisp machine market experienced a significant downturn. However, in the year 1981 Danny Hillis created parallel computers tailored for AI and various computational functions, featuring an architecture akin to contemporary GPUs. Then in the year 1984, Marvin Minsky and Roger Schank introduced the phrase "AI winter" during a gathering of the Association for the Advancement of Artificial Intelligence. They cautioned the business world that exaggerated expectations about AI would result in disillusionment and the eventual downfall of the industry, which indeed occurred three years later and in the year 1985 Judea Pearl introduced Bayesian network causal analysis, presenting statistical methods for encoding uncertainty in computer systems.

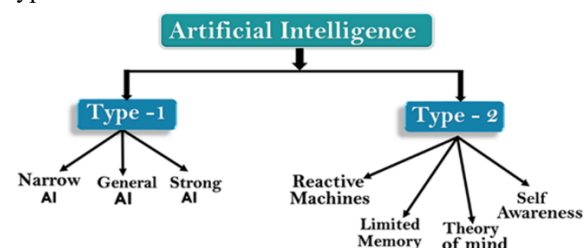
The duration between the years 1987 -1993 which was termed as the second AI Winter duration. Where again Investors and government stopped in funding for AI research as due to high cost but not efficient result. The expert system such as XCON was very cost effective. However, the period between 1993 - 2011, has been characterised as, 'The Emergence of Intelligent Agents.' there were significant leaps forward in artificial intelligence (AI), particularly in the development of intelligent computer programs. During this era, AI professionals shifted their emphasis from attempting to match human intelligence to crafting pragmatic, ingenious software tailored to specific tasks. Here are some noteworthy occurrences from this timeframe: In 1997, IBM's Deep Blue achieved a historic milestone by defeating world chess champion Gary Kasparov, marking the first time a computer triumphed over a reigning world chess champion. Moreover, Sepp Hochreiter and Jürgen Schmidhuber introduced the Long Short-Term Memory recurrent neural network, revolutionizing the capability to process entire sequences of data such as speech or video. But then in the year 2002, for the first time, AI entered the home in the form of Roomba, a vacuum

cleaner. Whereas in the year 2006, AI came into the Business world till the year 2006. Companies like Facebook, Twitter, and Netflix also started using AI. Although in the year 2009, Rajat Raina, Anand Madhavan, and Andrew Ng released the paper titled "Utilizing Graphics Processors for Extensive Deep Unsupervised Learning," introducing the concept of employing GPUs for the training of expansive neural networks. While in the year 2011, Jürgen Schmidhuber, Dan Claudiu Cire, Ueli Meier, and Jonathan Masci created the initial CNN that attained "superhuman" performance by emerging as the victor in the German Traffic Sign Recognition competition. Furthermore, Apple launched Siri, a voice-activated personal assistant capable of generating responses and executing actions in response to voice commands. Nevertheless from 2011 to the present moment, there has been significant advancements that have been unfolded within the artificial intelligence (AI) domain. These achievements can be attributed to the amalgamation of deep learning, extensive data application, and the ongoing quest for artificial general intelligence (AGI). Here are notable occurrences from this timeframe: Yet in the year 2011, IBM's Watson won Jeopardy, a quiz shows where it had to solve complex questions as well as riddles. Watson had proved that it could understand natural language and can solve tricky questions quickly. But in the year 2012, Google launched an Android app feature, "Google Now", which was able to provide information to the user as a prediction. Further, Geoffrey Hinton, Ilya Sutskever, and Alex Krizhevsky presented a deep CNN structure that emerged victorious in the ImageNet challenge, sparking the proliferation of research and application in the field of deep learning and the next year 2013, China's Tianhe-2 system achieved a remarkable feat by doubling the speed of the world's leading supercomputers to reach 33.86 petaflops. It retained its status as the world's fastest system for the third consecutive time. Furthermore, DeepMind unveiled deep reinforcement learning, a CNN that acquired skills through repetitive learning and rewards, ultimately surpassing human experts in playing games. Also, Google researcher Tomas Mikolov and his team introduced Word2vec, a tool designed to automatically discern the semantic connections among words, still in the year 2014, Chatbot "Eugene Goostman" won a competition in the infamous "Turing test." Whereas Ian Goodfellow and

his team pioneered generative adversarial networks (GANs), a type of machine learning framework employed for producing images, altering pictures, and crafting deepfakes, and Diederik Kingma and Max Welling introduced variational autoencoders (VAEs) for generating images, videos, and text. Also, Facebook engineered the Deep Face deep learning facial recognition system, capable of identifying human faces in digital images with accuracy nearly comparable to human capabilities. Where as in the year 2016 DeepMind's AlphaGo secured victory over the esteemed Go player Lee Sedol in Seoul, South Korea, prompting reminiscence of the Kasparov chess match against Deep Blue nearly two decades earlier. Whereas Uber initiated a pilot program for self-driving cars in Pittsburgh, catering to a limited group of users. During the year 2018, The "Project Debater" from IBM debated on complex topics with two master debaters and also performed extremely well. Meanwhile Google had demonstrated an AI program, "Duplex," which was a virtual assistant that had taken hairdresser appointments on call, and the lady on the other side didn't notice that she was talking with the machine. Still in the year 2021, OpenAI unveiled the Dall-E multimodal AI system, capable of producing images based on textual prompts and the next year 2022 in November, OpenAI launched ChatGPT, offering a chat-oriented interface to its GPT-3.5 LLM. At the present time AI has developed to a remarkable level. The concept of Deep learning, big data, and data science are now trending like a boom. Nowadays companies like Google, Facebook, IBM, and Amazon are working with AI and creating amazing devices. The future of Artificial Intelligence is inspiring and will come with high intelligence.

Types of Artificial Intelligence:

Artificial Intelligence can be alienated in various types, there are mainly two types of main classification that are based on capabilities and based on functionality of AI. Following is flow diagram which explain the types of AI:



Type – 1 Artificial Intelligence (AI) based on Capabilities:

Narrow AI or Weak AI: Narrow AI or weak AI is a type of AI based on capabilities:

Which is able to perform a dedicated task with intelligence. The most common and currently available AI is Narrow AI in the world of Artificial Intelligence.

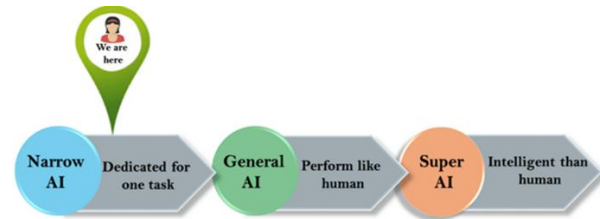
Narrow AI cannot perform beyond its field or limitations, as it is only trained for one specific task. Hence it is also termed as weak AI. Narrow AI can fail in unpredictable ways if it goes beyond its limits. Apple Siri is – is a good example of Narrow AI, but it operates with a limited pre-defined range of functions. Also, IBM's Watson supercomputer also comes under Narrow AI, as it uses an Expert system approach combined with Machine learning and natural language processing.

Some Examples of Narrow AI are playing chess, purchasing suggestions on e-commerce site, self-driving cars, speech recognition, and image recognition

General AI: General AI is a type of intelligence based on capabilities:

Which can perform any intellectual task with efficiency like a human. The idea behind the general AI to make such a system which could be smarter and think like a human by its own. Currently, there is no such system exist which could come under general AI and can perform any task as perfect as a human. The worldwide researchers are now focused on developing machines with General AI. As systems with general AI are still under research, and it will take lots of efforts and time to develop such systems.

Super AI: The Super AI is also based on Capabilities: Super AI is a level of Intelligence of Systems at which machines could surpass human intelligence, and can perform any task better than human with cognitive properties. It is an outcome of general AI. Some key characteristics of strong AI include capability include the ability to think, to reason, solve the puzzle, make judgments, plan, learn, and communicate by its own. Super AI is still a hypothetical concept of Artificial Intelligence. Development of such systems in real is still world changing task



Type – 2 Artificial Intelligence based on Functionality of AI

Reactive Machines - based on Functionality of AI:

Purely reactive machines are the most basic types of Artificial Intelligence. Such AI systems do not store memories or past experiences for future actions. These machines only focus on current scenarios and react on it as per possible best action. IBM's Deep Blue system is an example of reactive machines. Google's AlphaGo is also an example of reactive machines.

Limited Memory – based on Functionality of AI:

Limited memory machines can store past experiences or some data for a short period of time. These machines can use stored data for a limited time period only. Self-driving cars are one of the best examples of Limited Memory systems. These cars can store recent speed of nearby cars, the distance of other cars, speed limit, and other information to navigate the road.

Theory of Mind – Based on Functionality of AI:

Theory of Mind AI should understand the human emotions, people, beliefs, and be able to interact socially like humans. This type of AI machines is still not developed, but researchers are making lots of efforts and improvement for developing such AI machines.

Self-Awareness – Based on Functionality of AI:

Self-awareness AI is the future of Artificial Intelligence. These machines will be super intelligent, and will have their own consciousness, sentiments, and self-awareness.

These machines will be smarter than human mind. Self-Awareness AI does not exist in reality still and it is a hypothetical concept.

Roles of Artificial Intelligence and AI Technology in the field of education in India:

- Automated Assessment and Instant Feedback:

AI acts like a super-speedy homework checker. It looks at your assignments and tests and gives you

grades and feedback right away. This aids in gauging your progress and pinpointing areas for potential enhancement. Furthermore, it alleviates some of your teacher's grading responsibilities, allowing them to dedicate more time to teaching rather than paper evaluation. AI-driven programs can give students and educators helpful feedback AI cannot solely facilitate academics and students to craft courses that are bespoke to their wants, however it may give feedback to each concerning the success of the course as an entire. These sorts of AI systems enable students to urge the support they have and for professors to search out areas wherever they'll improve instruction.

- AI can automate basic activities in education, like grading:

While AI might not ever be ready to actually replace human grading, it's obtaining pretty shut. It's currently potential for academics to alter grading for nearly every kind of multiple alternative and fill-in-the-blank testing and automatic grading of student writing might not be so much behind.

- Accessibility and Inclusivity:

AI is breaking down barriers to education by making it more accessible and inclusive. For students with disabilities, AI can provide customised support, such as text-to-speech, speech-to-text and adaptive content. This ensures that higher education is available to a wider range of learners, regardless of their physical or cognitive abilities.

- Curriculum Enhancement through Predictive Analytics:

Predictive analytics powered by AI enables universities to analyse vast amounts of data, predict student performance and identify at-risk students. AI is also impacting curriculum development. Institutions can analyse industry trends and the job market to adjust their programmes and better-prepare students for real-world challenges. AI can predict future high-demand skills, enabling universities to tailor their curriculum accordingly and ensure that students are equipped to succeed in the job market.

- Customized Learning Routes:

AI figures out what you're good at and where you might need extra help. Then, it gives you the right stuff

to learn and the best way to learn it. This makes learning easier and more fun.

- Data powered by AI can change how schools find, teach, and support students.:

Smart data gathering, powered by intelligent computer systems, is already making changes to how colleges interact with prospective and current students. From recruiting to helping students choose the foremost effective courses, intelligent computer systems are helping make a neighbourhood of the faculty experience more closely tailored to student needs & goals.

- Education Content Creation:

AI acts as a teaching assistant for educators. It helps them make things like quizzes, lesson plans, and study materials. This makes teaching easier and better because educators have more time for students, and the materials are top-notch. It's like having a super-efficient helper who does the paperwork, leaving teachers more time to inspire students.

- Language Learning:

India is a linguistically diverse nation with multiple languages and dialects spoken across the country. AI-powered language-learning platforms are making it easier for students to acquire proficiency in different languages. English learning app Mondly is one such example that provides personalised language learning experiences. This is particularly valuable in a globalised world where multilingual proficiency can open up career opportunities and enhance cultural understanding.

- Personalized Learning:

AI is transforming Indian higher education, especially through personalised learning—adaptive learning systems tailored to each student's unique needs. While AI capabilities are new to consumers, it has been a well-established element of Ed-tech companies. Learning companies such as Pearson have been using AI for tasks ranging from English assessment to formulating specific course directives for students. Notably, Pearson has launched new generative AI beta features in select products with the intention to learn and evolve. Digital education platforms, e-learning and e-learning resources are increasingly popular in

India, with AI algorithms analysing students' interactions with content to identify areas where they may need help and offer relevant resources.

- **Research Advancement:**

In the field of research, AI has the potential to revolutionise the way projects are conducted and findings are analysed. AI-driven tools can process massive datasets, identify patterns and help researchers make sense of complex information. In India, AI is particularly valuable for scientific research in areas like healthcare, agriculture, and environmental science.

- **Students could get additional support from AI tutors:**
These programs will teach students fundamentals, however up to now aren't ideal for serving to students learn high-order thinking and creative thinking, one thing that real-world lecturers square measure still needed to facilitate. nonetheless that shouldn't rule out the likelihood of AI tutors having the ability to try to these items within the future.

- **It could change the role of teachers:**
There will always be a job for teachers in education, but what that role is and what it entails may change because of new technology within the type of intelligent computing systems. As we've already discussed, AI can take over tasks like grading, can help students improve learning, and should even be a substitute for real-world tutoring.

- **Virtual Learning Assistants:**
AI is there to answer questions, explain things, and offer help whenever students need it, day or night. This makes learning easier and more fun because students have someone to turn to whenever they're stuck. It also takes some pressure off teachers because AI can handle common questions, leaving more time for personalized teaching.

IV. CHALLENGES AND CONSIDERATION FACED BY AI AND AI TECHNOLOGIES IN THE FIELD OF HIGHER EDUCATION IN INDIA.

While AI is undoubtedly reshaping higher education in India, some challenges and considerations need to be addressed. First and foremost is the issue of data privacy and security. As AI systems collect and

analyze vast amounts of data, it is crucial to ensure that student information is protected and used responsibly. There is also the concern of AI bias. Algorithms can inherit biases from the data they are trained on, potentially perpetuating discrimination. The higher education ecosystem must be vigilant in monitoring and addressing bias in its AI systems to ensure fairness and equity. Lastly, while AI has the potential to make education more accessible, it can also exacerbate the digital divide. Not all students have access to the necessary technology and internet connectivity, and addressing this disparity is essential for ensuring that AI-driven education benefits all

V. CONCLUSIONS:

Artificial intelligence (AI) has an optimistic future, but it also faces several difficulties. AI is projected to grow increasingly with persistent in technology advancement and developments, which would be revolutionising sectors including healthcare, banking, and transportation. The work market will change as a result of AI-driven automation, necessitating new positions and skills. In the field of education, AI will likely be transformative. Students will receive educational content and trainings tailored to their specific needs. AI will also determine optimal educational strategies based on students' individual learning styles. The major role that AI could in the field of education in India would be to promote the idea of learning as learner-centred, meaning the curricular content, teaching methods would need to be adapted by the teacher to the needs and contexts of each learner, moving from the one-size fits-all approach that is dominant and expanding the limited content and pedagogy practices of most teachers. AI could do this by suggesting diverse content and pedagogy possibilities to teachers.

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