TO STUDY THE USE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN SECONDARY EDUCATION

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ABSTRACT :

In the present era, technological development has brought about sweeping changes in the field of education. Incorporating new technologies has become necessary to make teaching and learning processes more effective, accessible and engaging, especially in secondary education. Modern technologies like Artificial Intelligence (AI) and Machine Learning (ML) have given rise to many possibilities in the field of pedagogy. These technologies are not only modernizing the teaching methods but also providing learning experiences tailored to the individual needs of the learners. This paper comprehensively studies the use of

artificial intelligence and machine learning in secondary education. The research analyzes how AI and ML-based educational tools and platforms are helping secondary level students learn. Under this, aspects like personalized learning, intelligent tutor system, innovation in assessment and evaluation system and improvement in quality of education have been discussed. At the same time, challenges in the application of these technologies such as lack of technical framework, data privacy issues, and technical training of teachers have also been considered. The main objective of the research is to evaluate the effects of AI and ML in secondary education and to elucidate the possibilities of their practical application. The study provides guidance to teachers, students and education policy makers towards the effective use of AI and ML in the field of secondary education in the digital age.

KEYWORDS : *Secondary Education, Artificial Intelligence, Machine Learning, Digital Education, Personalized Learning, Educational Innovation, Educational Technology.*

INTRODUCTION

Artificial Intelligence (AI) is a branch of computer science that aims to equip machines with human-like thinking, understanding, and decision-making abilities. This technology enables machines to make human-like decisions, solve problems and understand language. Machine learning (ML) is a part of AI, in which machines are given the ability to learn from data and draw conclusions based on experiences. The use of AI and ML in the education sector is growing rapidly. These techniques help in customizing the learning content as per individual needs, analyzing the progress of students, automating the process of assessment, and helping teachers make data-based decisions. Features like AI based Intelligent Tutor System (ITS) chatbots, virtual classrooms and data analytics are making teaching and learning processes more impactful. The major objective of this research is to study the impact and use of artificial intelligence and machine learning in secondary education. At present,

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technology-based solutions are essential to empower the secondary education system in terms of quality, access and outcomes. Technologies such as AI and ML have the potential to make teaching methodologies more effective, engaging and personalized. This study is also needed because there is a lack of clear guidelines and policy framework regarding the use of AI and ML in secondary education. It is essential for teachers and learners to use these techniques intuitively and assess their effectiveness.Further, in developing countries like India, the need of the hour is to analyse the practical side of these, keeping in mind the availability of technological resources, data privacy and ethical questions.

Educational Perspective of Artificial Intelligence and Machine Learning

Today's era is an era of technological advancement, where the need and utility of innovations in the education sector is also increasing. Technological interventions, especially in secondary education, are proving to be helpful in enhancing the quality and effectiveness of education. Cutting-edge technologies such as Artificial Intelligence (AI) and Machine Learning (ML) have radically transformed the traditional processes of teaching and learning. Artificial intelligence (AI) is a technology that enables computers and other machines to think, make decisions, and solve problems in ways similar to the human brain. It gives machines the intelligence to behave like humans. Machine learning (ML) is a subset of AI, in which machines are given the ability to learn from data themselves. Using algorithms in machine learning, machines make decisions based on prior experiences and continuously improve. Both these technologies are being incorporated in the education sector to make the teaching methods automated, customizable and effective. In education, AI and ML in the form of intelligent tutor systems, adaptive learning platforms, automated assessment systems, data analytics based personal optimization of learning and interactive learning tools are prominent.These techniques not only reduce the workload of teachers, but also provide students with the opportunity to learn according to their individual needs.

AI and ML are being used in secondary education especially keeping in mind the diverse needs of students. At this stage, the difference in the learning behaviour of the students is evident. AI based platforms provide personalized learning experience to students by analyzing their learning speed, their difficulties and interests. This has not only brought efficiency in the teaching process but has also seen an increase in the achievements of the students. The use of AI and ML is also proving effective in making assessment processes transparent and quick in secondary education. AI-based virtual classrooms and chatbots provide instant solutions to students' doubts, thereby keeping the learning process continuous. Additionally, significant contribution is being made towards inclusive education by making available customized content for students with special needs.

The use of AI and ML globally is witnessing revolutionary changes in the education sector. AI-based adaptive learning systems, personalised learning platforms and virtual teaching assistants are being successfully used in countries like the US, China, Finland and South Korea. Platforms like IBM Watson Education in the US and Squirrel AI in China are revolutionising secondary education. In India too, AI and ML technologies are increasingly being incorporated in the educational sector. The Government of India's "National Education Policy 2020" lays special emphasis on digital and technical education. Many private institutions and startups, such as BYJU'S, Vedantu, and Toppr, are developing AI-based learning platforms. Along with this, the state and central boards are trying to include AI and ML in the secondary education curriculum. However, challenges such as lack of technical infrastructure and training of teachers still exist. AI and ML-based innovations are playing a key role towards making secondary education in India more effective, inclusive and quality-driven. Widespread and planned use of these technologies is creating new possibilities of innovation and progress in the education sector of India.

Major Applications of AI and ML in Secondary Education

The increasing influence of technological innovations has drastically changed the traditional pattern of teaching and learning in the field of secondary education. Artificial Intelligence (AI) and

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Machine Learning (ML), in particular, have introduced many applications in the education system through which the learning process has become more personalized, adaptive and effective. Key applications of AI and ML in secondary education include personalized learning, intelligent tutor systems, adaptive learning platforms, examination and assessment systems, and educational data analysis and feedback systems. Personalized learning is an extremely effective application of AI in secondary education. This technology provides specific educational content and resources to each student, taking into account their learning needs, interests, abilities and pace of learning. AI based systems continuously analyze the performance of the students and make necessary changes in the teaching strategies on that basis. It makes the learning process more effective by providing tailored support to the students according to their difficulties. Intelligent Tutoring Systems is a technology in secondary education that provides students with guidance similar to that of a human tutor. This system evaluates the answers of the students and gives immediate feedback to improve their learning. Additionally, it provides alternative solutions by analyzing the student's mistakes, thereby deepening the student's understanding. The intelligent tutor system promotes self-sufficient learning of students and continuous improvement in their performance. Adaptive learning platforms are also important applications of AI and ML in secondary education. These platforms customize the learning content according to the learning style and progress of the students. For example, if a student is having difficulty in a particular subject, the platform provides him with additional practice material or simple explanations. Adaptive learning platforms provide educational resources tailored to each individual's needs while understanding the diversity in students' abilities.

The use of AI in the examination and evaluation system is also a major area of quality improvement in education. Traditional assessment system requires more time and sometimes lack of objectivity is seen. The AI based assessment system not only ensures quick and fair assessment but also clarifies the learning needs of the students by analysing the answers. Through this, automatic evaluation of both objective and subjective types of examinations has become possible. Useful information is made available to both teachers and learners by analyzing the performance of students through educational data analysis and feedback system. AI and ML techniques collect data on the progress of students and based on that make appropriate suggestions to improve learning. This mechanism not only empowers the decision making process of the teachers but also provides guidance to the students to overcome their weaknesses by making them aware of them.

Improving the learning process in secondary education by AI and ML

Artificial Intelligence (AI) and Machine Learning (ML) have significantly changed the traditional methods of teaching and learning in secondary education. Through these technologies, the learning process is being made more personal, flexible and inclusive. To improve the learning process in the field of secondary education, AI and ML based applications are providing customized experiences to the students by understanding their needs, abilities and preferences. Personal optimization in learning speed and methods is the most important aspect of AI and ML techniques. Each student's learning speed and style is different. Some students learn faster while others require more time and effort. AI-based platforms, such as adaptive learning systems, analyze learning trends of students and optimize learning content based on their performance. This adaptation provides students with appropriate learning resources and practices to enable them to learn at their own level. For example, platforms such as BYJU'S and Vedantu have created personalized learning content using AI, which is customized according to the students' competencies and weaknesses. The increase in the interest and motivation of students to learn has also been made possible by the influence of AI and ML technologies. In AI based learning system, gamification, real time feedback and interactive activities are helpful in maintaining the interest of the students. This technology motivates students for active participation in their learning. Intelligent tutor systems built by AI provide instant answers and guidance to students, boosting their confidence and stimulating curiosity to learn.

Assistive technologies for students with special needs are an important initiative towards making education inclusive through AI and ML. Speech-to-text and text-to-speech tools for visually

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impaired students, subtitling and sign language translators for hearing impaired students, and customized text content for students with dyslexia are being made available by AI technologies. These assistive technologies help students get an equal opportunity and accessible education while taking care of their special needs. The role of AI and ML in online and distance learning has become extremely important. Especially during the Covid-19 pandemic, when the education system was completely dependent on the online medium, AI-based platforms acted as a bridge between students and teachers. Virtual classrooms, chatbots, and automated assignment evaluation made education simple and effective. The contribution of AI and ML in providing access to quality education even to students living in remote areas has been commendable. Thus, AI and ML technologies are vastly improving the learning process in secondary education. These technologies are not only accelerating the personal development of students, but are also helping teachers in making teaching methods powerful and effective.

The Impact of AI and ML in Secondary Education

Artificial Intelligence (AI) and Machine Learning (ML) have played an important transformative role in the education world, especially in the field of secondary education. These technologies have not only improved the achievements of students and their academic performance, but have also inspired widespread innovation in the role of teachers, curriculum development and teaching methodologies. This has resulted in significant improvement in the quality of teaching, making education more effective, inclusive and result oriented. The impact of AI and ML on student achievement and performance is being directly reflected. Adaptive learning platforms and personalized learning systems powered by these technologies provide content and strategies tailored to each student's educational needs. The result is that students receive support according to their learning level, which improves their understanding and performance. For example, AI-based intelligent tutor systems identify studentsweaknesses and provide personalized feedback, allowing them to quickly correct their errors. The role of teachers has also undergone a remarkable transformation due to AI and ML. The traditional roles, where teachers were only a source of knowledge, have now changed. The teacher is now acting as a guide, facilitator and coach. AI-based data analytics and assessment tools allow teachers to analyze students' progress, enabling them to develop more accurate and personalized learning strategies. The workload of teachers has also come down as evaluation, attendance and other administrative tasks have become automated.

Innovations in curriculum development and teaching methodologies are the gift of AI and ML. These techniques have made the textual content more interactive, multi-media and customizable. The inclusion of tools like digital content, virtual reality and augmented reality makes teaching more interesting and practical. AI-based analysis has made it easier to determine which part of the course is difficult for students and which can be simplified. In this way, continuous development of the curriculum is possible. Improving the quality of teaching is the most important impact of AI and ML techniques. A data-driven approach is now being adopted to measure quality. Real-time assessment of student progress, participation and learning outcomes has been made possible. This process helps the teachers to make necessary corrections in a timely manner. Additionally, adopting an individual approach in teaching has seen an increase in both learning interest and outcomes among students.

Challenges in the use of AI and ML in secondary education

Artificial Intelligence (AI) and Machine Learning (ML) have created new opportunities for innovation and quality improvement in secondary education, but the widespread and effective use of these technologies has also presented many challenges. Effectively integrating these technological innovations into the education system requires addressing problems related to infrastructure, data security, teacher training and socio-cultural inequalities. Problems related to technology and infrastructure are the biggest challenges to the inclusion of AI and ML in secondary education in developing countries like India. Many schools lack the necessary hardware, software, high-speed internet connectivity and technical equipment. The problem is more acute in rural areas. Additionally, the lack of technical maintenance, updating of equipment, and reliable technical support also hinder the

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effective implementation of AI and ML based educational systems. This situation further deepens the digital divide, leading to disparity between urban and rural education system.

Data privacy and security issues have also emerged as a major challenge in the application of AI and ML in secondary education. AI and ML based educational platforms collect huge data of students, which contain their personal information, learning behaviour and performance related information. If these data are not adequately protected, there is a possibility of misuse. Problems like data theft, breach of privacy and cyber attacks can pose a serious threat to the education system. At present, the status of strictness and compliance of data protection laws in India is still not satisfactory, thereby increasing these risks.

Teacher training and technical literacy is also an important factor in the implementation of AI and ML. Most teachers are trained in traditional teaching methods and are not comfortable with the use of modern techniques. Teachers need specialized training and technical proficiency for effective operation and management of AI and ML based learning platforms. Due to lack of adequate training programmes in this area, lack of awareness and lack of change in mindset, there is a reluctance among teachers towards these techniques. In the absence of technical literacy, teachers are unable to take full advantage of these resources. Economic and social inequalities are major barriers to the effective implementation of AI and ML in secondary education. Students from economically weaker sections have limited access to essential devices, internet connections and digital devices. Moreover, social inequalities often make access to technological resources difficult. Girls and students from minority communities are deprived of technical education due to social and gender discrimination, especially in rural areas. This has a negative impact on the quality of education.

Future prospects in secondary education of AI and ML

Artificial Intelligence (AI) and Machine Learning (ML) have redefined the quality of education, access and the way learning takes place in secondary education. The use that these technologies are currently seeing points to the possibilities of a future where the education system will be more inclusive, responsive and innovative. AI and ML-based innovations have the potential to bring about profound and far-reaching changes in research, teaching methods, and assessment systems in education. AI and ML are opening many new doors in the secondary education sector towards innovation and research. The use of these technologies has enabled continuous improvement in Personalized Learning, Adaptive Learning Systems and Intelligent Tutor Systems (ITS). Virtual Reality (VR) and Augmented Reality (AR) based learning methods powered by AI are expected to evolve in the future, which will make learning more interactive and experiential. Further, data analytics based research will aid in the analysis of learning outcomes for both teachers and learners. Educational research focused on AI and ML is being promoted in research centers and universities in India, enabling the development of innovative solutions in the field of education. The possibilities of change in the secondary education system in India have been further strengthened by the influence of AI and ML. The inclusion of these technologies in education is making teaching methods more data-driven and analytical. AI-based assessment systems, training programmes for teachers and personalised learning experiences for students are driving India's secondary education system towards modernity. At the same time, technological transformation in the education system is being prioritized by the government through programs like National Digital Education Framework (NDEAR) and Atal Innovation Mission. To bridge the digital divide in the future, efforts are being intensified to ensure access to AI and ML based education resources in rural and backward areas.

The long-term effects of AI and ML based education system on the quality, efficiency and outcomes of education can be seen widely. These technologies promote the personalization of education, making it possible to tailor learning to the specific needs of each student. In the long run, AI and ML based systems will promote transparency, accountability and accuracy in the education sector. Also, this system will be helpful in developing innovation, problem solving and analytical thinking in students. However, it will also be necessary to adopt a long-term strategy on issues related to data security, privacy and ethics, so that the use of technology remains safe and effective. Thus, the future of

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the secondary education system in India through AI and ML technologies seems to be extremely promising.

CONCLUSION

Artificial Intelligence (AI) and Machine Learning (ML) have opened up many possibilities in the field of secondary education. This research presents a holistic analysis of the use, impact, challenges and future prospects of AI and ML in secondary education. The overall assessment of the impact of AI and ML in secondary education shows that these technologies have not only improved the performance of students, but have also made significant changes in the role of teachers. Teachers are now playing the role of a guide and technical facilitator more than a source of knowledge. Additionally, innovation in curriculum development and teaching methods has received a fillip. Improving educational quality and transparency in the assessment system underline the contribution of AI and ML. These technologies are rapidly expanding in India through NEP 2020 and other government initiatives, which is instrumental in modernizing the education system. Suggestions for the future are to strengthen the technological infrastructure for sustained and widespread use of AI and ML in secondary education. It is necessary to arrange regular training programmes for teachers so that they become proficient in the use of latest technologies. At the same time, stringent laws and their effective implementation are needed to ensure data security and privacy. Efforts should be made to address technological inequalities by promoting digital literacy in rural and disadvantaged areas. It will be possible to build an inclusive and responsive education system only through coordination among policy makers, academicians and technical experts.

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