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AI -Driven Innovations in Higher Education: Key Challenges and Future Prospects.

Rajdeep Singh Solanki[1], Kuber Datt Gautam[2], Abdul Salam Khan[3], Ravinder Kaur[4] and Ajay Sudhir Bale[5*]

[1] Assistant professor, Medi-caps university Indore, Computer science department; rajdeep. solanki@medicaps.ac.in
[2] Assistant Professor, Department of Computer Applications, Medi-Caps University Indore; Kuber.gautam@medicaps.ac.in
[3] Assistant Professor, Amity School of Fine Arts, Amity University, Noida, Uttar Pradesh, India; abdulsalamkhan4@gmail.com
[4] Head, Jaipur School of Economics, JECRC University, Jaipur; hod.economics@jecrcu.edu.in
[5*] Dept. of ECE, New Horizon College of Engineering, Bengaluru, India; ajaysudhirbale@gmail.com

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Abstract
Artificial Intelligence and its use are growing rapidly in higher education. It offers lots of advantages in learning, teaching and tother management work in the institutions. This paper explores the new trends, challenges and what may be the possible solutions of AI in higher education. This study examines the main breakthroughs, obstacles, and future possibilities of AI integration in higher education. We analyse the influence of AI on individualised education, adaptive tutoring systems, and scholarly support. The research underscores the role of AI in augmenting the educational process, enhancing institutional efficacy, and equipping students for a swiftly changing employment landscape. It also tackles significant obstacles, like standardisation, equality issues, and the need for reliable AI systems. This study examines many AI applications, such as MOOCs, adaptive learning pathways, and IoT-based educational systems, offering insights on AI's transformative potential in the future of higher education.
Keywords: AI, education, applications, learning.

1. Introduction

Research focused on the advantages artificial intelligence offers for HE especially and for education in general centre on certain fundamental points. Under its complicated comprehension, all elements that individuals require to pass via for them gain fresh information and abilities and which finally affect their mindsets, choices, and actions. One significant and highly recognised effect of carrying out artificial intelligence relates to the teaching–learning process [1]. Merely to cite just a handful of the numerous additional uses, the tools provided by artificial intelligence have shown to be successful; several have been extensively employed in colleges and high schools in Western nations, such virtual and augmented reality (AR/VR), virtual assistants, etc. Created with the intention of filling in any deficiencies in knowledge and enhancing instructional approaches, technology and creative strategies are meant to help to achieve academic achievement. The AI curriculum helps educators as it lets students advance quicker and more effectively to ensure that their learning objectives are reached at a speed in line with the always shifting needs of the twenty-first century. Translating tools, conversational chatbots, VR and gaming, customised teaching and learning tools, and immediate evaluation and feedback are just a few of the thing's AI may bring students. From establishing possibilities to integrate concepts across academic borders, becoming more inclusive, and providing a more personalised education, these advantages span constructing worldwide classrooms for diverse kinds of learners and dealing with different learning requirements. One instance of the unexpected contribution new technology may provide is the COVID-19 epidemic. For learners and educators that had become familiarised with the latest innovations and on those institutions that were already linked and provided with cutting-edge technology, the unexpected involvement of most of the schools in online learning demonstrated to be more manageable and enjoyed fewer adverse outcomes. Regarding the academic process, one might value the advantages of using artificial intelligence in HE. As AI lets you browse through an extensive array of reports, choosing eclectic subjects passing procedures about one field to a different one or integrating methods of study when looking difficult issues, it presents remarkable chances for fostering multifaceted, multidimensional, and cross-disciplinary studies. New paths for research are created, new ideas flow, and new solutions become simpler to find and implement by gathering and analysing massive data, enabling cooperative research, and streamlining interactions between scientists. An additional field wherein AI is said to be very beneficial is the effectiveness of HE institutions. From the enrolment process to the operation of a HE organisation, there are several events for which the use of artificial intelligence might provide more productivity and increased safety. HE is flourishing for internationalisation in all spheres (learners, educators, and instruction); hence, it must create creative and innovative approaches for making the application process easier and more efficient, give faculty and students superior amenities, and increase security. Using enrolment statistics to get out to as many pupils as possible, distribute money and split multiple amenities, there are instances of colleges that currently use chatbots for advertising to offer personalised assistance and advice for students, minimise monotonous duties such getting ready lessons or evaluating quizzes, and distribute monetary resources and distribute various facilities. Far behind the advantages of using artificial intelligence in HE is the need of AI demanded by the market. The problems brought about by technology developments must be absorbed by educators if HE is expected to produce better employees, greater managers, and better citizens. This will help to react to the changing work setting. The coming decade is predicted to provide fresh employment; so, new skills and competences must be developed for it. The pro and Con of using AI in education is depicted in Figure 1.

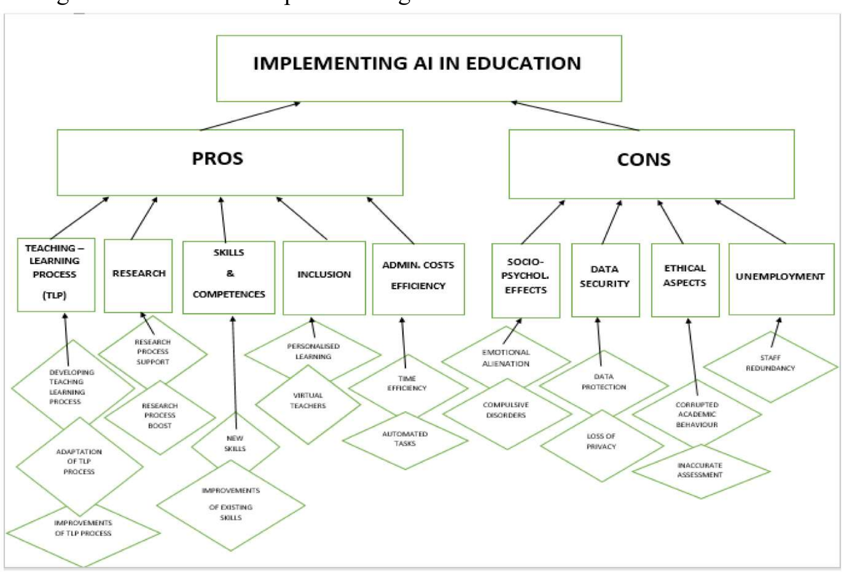

Figure 1: Pro and Con of AI [1].

2. Comparative Study:

2.1. Using MOOC

Massive Open Online Courses (MOOCs) are favoured by students due to their minimal enrolment requirements and flexible study schedules. Students possess the autonomy and opportunities to choose superior courses and high-quality activities [11]. Nonetheless, several impediments, including diminished completion rates, reduced pass rates, and decreased learning effectiveness, hamper the advancement of MOOCs [2,3]. Fixed learning sequences persist inside specific courses in MOOCs. A fixed learning sequence is inappropriate for all learners, since pupils possess varying structures of knowledge and learning conditions. In-person courses enable lecturers to effectively and efficiently assist students. Nonetheless, online learning diminishes the teacher's responsibility in providing assistance. Learners find it difficult to choose suitable learning resources or sequences according to their specific learning contexts. Consequently, different learners increasingly need varied learning recommendations in an online educational context. The U.S. Department of Education's 2017 National Educational Technology Plan defines personalised learning as an instructional technique that customises the pace and methods of learning to meet the individual requirements of each student. Learning goals, instructional approaches, and the sequencing of instructional information may differ based on student needs. Prior research indicates that personalised learning enhances academic progress and satisfaction with the learning process [5]. Offering customised scaffolds enhances diverse students' mastery of information and facilitates the improvement of their future learning [11]. The information collected within MOOC systems consists mostly of two components: course material data and learning behaviour data. Each class has several chapters with videos and activities. Figure 2 depicts the ordered arrangement of the instructional materials.

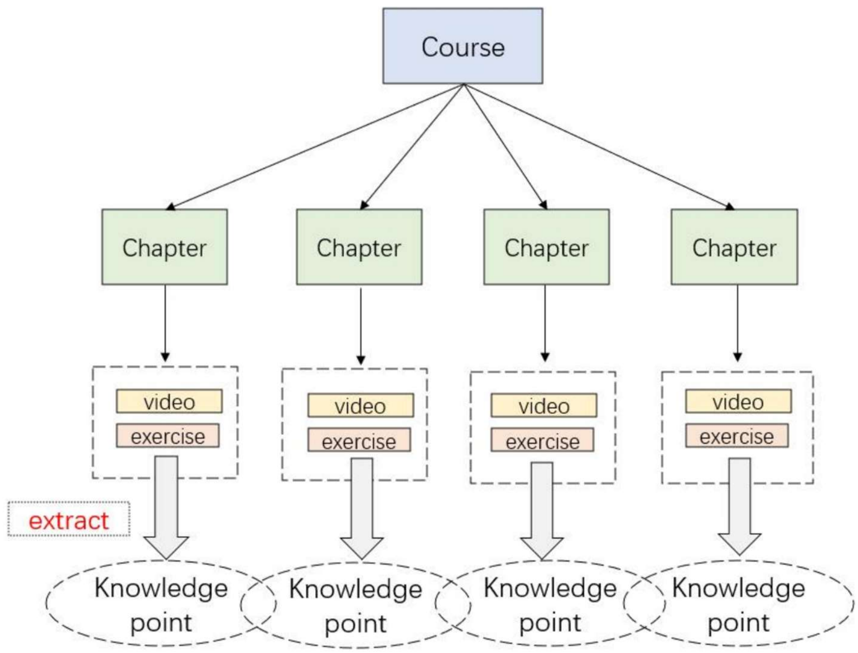

Figure 2: Structure of courses material information [11].

Figure 3 depicts three representative learning trajectories produced by the suggested technique in [11]. Learning tracks shown in Figures 3a and 3b markedly diverge from those anticipated by the method, but the development paths illustrated in Figure 3c align with the program's projected trajectories.

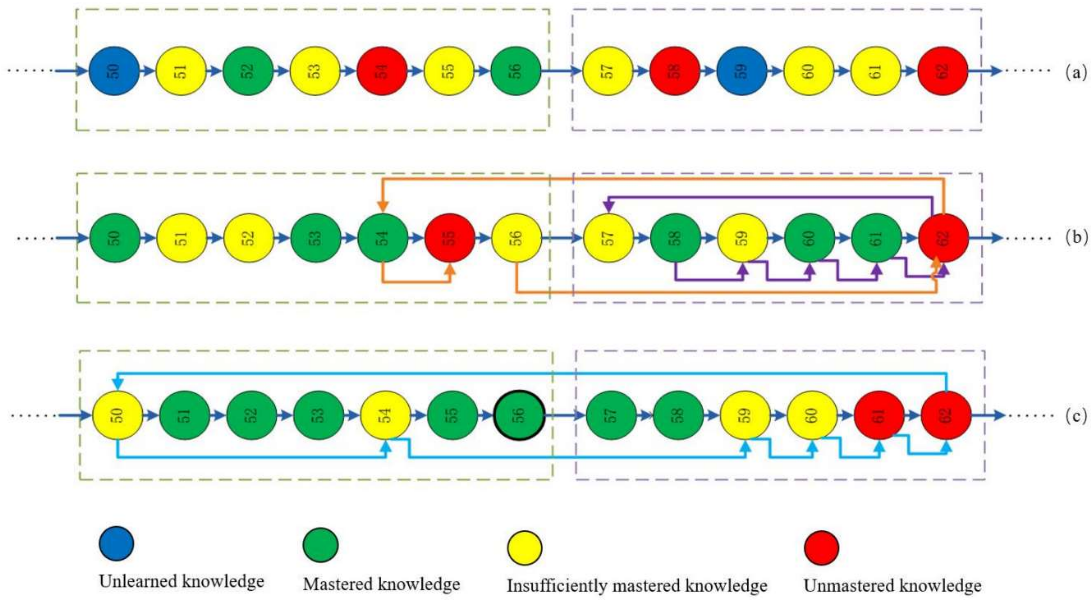

Figure 3: Model in [11].

Figure 3a illustrates that the first standard learning trajectory is linear in nature. Students acquire information in a linear fashion without reflection, leading to a considerable accumulation of inadequately grasped, forgotten, and unmastered concepts during the learning process that remain unaddressed. Consequently, this kind of learning advancement is unproductive. Figure 3b illustrates that the second common learning trajectory is circular. During the educational process, pupils autonomously examined the key concepts. Inadequately learnt concepts were overlooked, although some well-mastered information was examined often. Consequently, this kind of learning advancement is also ineffective.

In contrast to Figures 3a and 3b, the third example learning route autonomously produced by the system in Figure 3c comprehensively encompasses all unlearned, unmastered, and inadequately mastered information. The expertise points are rated according to required connections and degrees of difficulty. The flexible learning planning algorithm produces adaptable learning routes for pupils. The customised learning trajectory, informed by learner states, conserves time and enhances educational efficiency [11].

The endorsement of personalised learning routes puts learners at the core, suggesting suitable educational trajectories based on their individual attributes (intellectual level, ability to learn, style of learning, and educational severity) to enhance learning efficacy. Consequently, in the virtual classroom, the proposed learning trajectory for learners must take into account not only the appropriateness of the sequence for students but additionally the order of the targeted knowledge points [11-13]. This research presents an instructional recommendations system using multi-algorithm fusing for offering personalised services to students in virtual educational settings. As seen in Figure 4, this concept is primarily segmented into two sections [12]. The aim of the first module is to precisely produce the learning process from the designated information point for learners. Subsequent to processing, the data are entered into the Fuzzy-CDF model to ascertain the mental capacity of learners. The unmastered knowledge set is derived via the established threshold value μ. The apriori linkage method and the developed knowledge map are used to produce the knowledge sequence. The aim of the second module is to provide individualised learning trajectories for learners, including a blend of knowledge points and associated resources [14-16]. A swarm intelligence algorithm is used, complemented by the instructional asset database and learner feature database, to create the final personalised learning route.

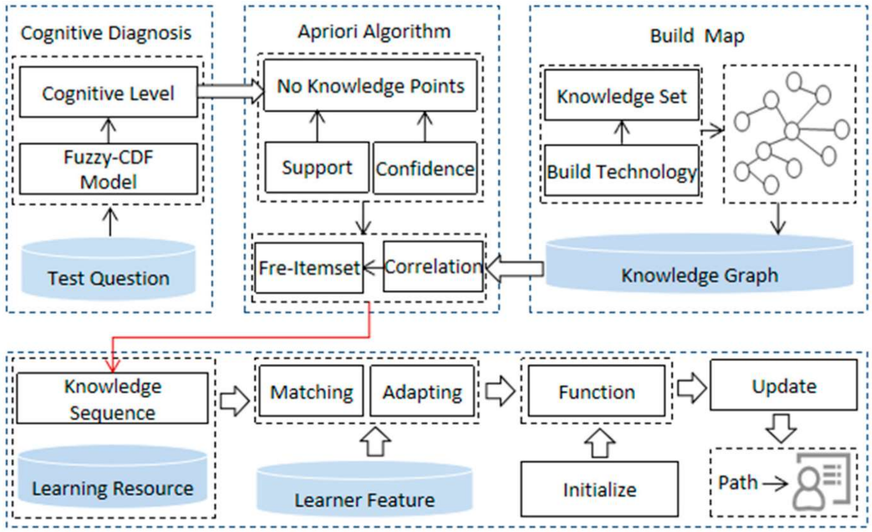

Figure 4: Model architecture in [12]

The cognitive level pertains to the comprehension of concepts, including both acquired and unacquired information. In cognitive neuroscience, the method of representing the acquisition of a subject is termed a cognitive diagnostic model [17-19]. Common cognitively diagnostic frameworks for personalised learning consist of the DINA and DINO models, which primarily assess learners' comprehension of acquired information and determine if they have mastered the relevant concepts. They are second grade cognitively diagnosis theories, characterised by two states: mastery and non-mastery. The research in [12] employs a fuzzy cognitive diagnostic model, Fuzzy-CDF [13], to assess the cognitive levels of learners with more precision, hence determining their subject matter competence. The result of the model is a continuous number ranging from 0 to 1, which more precisely reflects the learners' comprehension of knowledge points. The Fuzzy-CDF framework initiates with the learner's prospective attributes, assesses the learner's skill competency, evaluates the candidate's mastery of the task, and produces the examinee's observable score by accounting for mistake and guessing variables [14, 20]. Fuzzy-CDF posits that the cohort of students who acquire complete (or partial) mastery of the information and skills necessary for Problem *i* constitutes a combination (or union) of fuzzy sets pertaining to those competencies [12]. Fuzzy-CDF use fuzzier numbers to measure personal, qualitative, and ambiguous data. Students' understanding capability level is presumed to reflect their degree of participation in the fuzzy set associated with that understanding ability.

2.2. Intelligent tutoring systems (ITS)

Recently, there has been significant development in web-based ITSs designed to facilitate instructional procedures, with the objective of assisting students in adaptively navigating online learning resources. Web-based educational platforms enable distant learning and provide convenient access to many knowledge domains and learning processes at any time, accommodating learners from different walks of life with distinct requirements, tastes, and traits [1]. Consequently, effective online instruction necessitates multimedia methods, adaptable strategies, and analytical skills, alongside an intuitive interface. Students often like the user-friendliness and interaction in educational settings, together with customised learning trajectories [3]. Consequently, the objective is to create web-based educational platforms that are constantly tailored to each user's needs to facilitate successful information delivery. Consequently, web-based learning environments ought to be dynamically adaptive to individual learners, competent of recording student actions, and able to provide personalisation for unique requirements, choices, and knowledge. Furthermore, these systems must provide students with greater autonomy to explore online course materials and choose their learning speed and sequence. Due to these characteristics, educational institutions, both conventional and online, swiftly commenced the adoption of adaptable classrooms, virtual classrooms, and e-learning management tools to augment the enrolment of learners in online courses [3,5]. Adaptive navigation technology facilitates accelerated information acquisition and enhances learning outcomes, making it a prevalent tool in web-based schooling [6]. Numerous intelligent tutoring systems (ITSs) use

technologies like the intelligent tutoring systems platform (ITSPL), which facilitates student navigation in cyberspace by tailoring to the objectives and expertise of each individual user. The capacity of an Intelligent Tutoring System to provide adaptivity relies on its method of student modelling. The student modelling process is not binary; it often involves ambiguity, making it difficult to definitively ascertain if a student has mastered a subject. Consequently, the issue lies in developing a successful pupil model, which is a crucial element of an Intelligent Tutoring System to address ambiguity. Uncertain in systems of learning may arise from evaluating student factors, such as the assessment of student knowledge levels [10].
Intelligent Tutoring Systems (ITSs) use artificial intelligence (AI) methodologies to autonomously tailor educational material to align with learners' requirements and objectives. AI approaches may be used to create personalised and adaptive e-learning environments, primarily focussing on information representation, learning strategy management, and student status tracking [11]. Artificial Intelligence is a domain of computer science focused on enabling computers to emulate human behaviour. Its abundant supplies of tools, technologies, and computational paradigms, including fuzzy logic and Bayesian networks, have shown significant use in addressing complex challenges across several domains, as well as in educational settings characterised by incomplete and/or ambiguous information. Bayesian networks and fuzzy logic are extensively used in the literature to construct student models and address ambiguity in adaptable e-learning systems [12,13,14]. The Bayesian system is a mechanism for organising information from various scenarios and modelling the interrelationships among domain subjects. Furthermore, it enhances an Intelligent Tutoring System's capacity to make suitable decisions depending on students' attributes. A Bayesian network is a directed acyclic graph (DAG) used to represent dependencies among different ideas inside a certain area according to a distribution of odds [15]. Bayes networks are currently used as a model of probability for the dynamic management and update of student models [16]. These networks may include several elements of a student model, including information level, learning styles, objectives, and motivation, among others. Bayesian networks attract significant interest from architects and designers of adaptive educational environments owing to their robust mathematical underpinnings and capacity to manage uncertainty via probability. Fuzzy logic enhances an Intelligent Tutoring System's capacity to evaluate and analyse a student's academic achievement, a critical component of the process of learning. Fuzzy logic is an outgrowth of the fuzzy set theory introduced by Lotfi Zadeh in 1965. It illustrates cognitive processes and attempts to simulate human comprehension of language and decision-making. The fuzzy logic approach, capable of managing imprecise information and ambiguity, has been used to enhance the performance of an adaptive e-learning system and to analyse and evaluate student knowledge [19,20]. This research in [21] presents an ITS, termed FB-ITS, which employs a hybrid approach integrating Bayesian networks and fuzzy logic to provide adaptive help for students in an Excel course; the adaptation is facilitated by modelling individuals determined by their expertise levels. This paper examines the integration of Bayesian networks and fuzzy logic in the development of Intelligent Tutoring Systems (ITSs) that personalise instructional content for individual learners, advancing the assessment of the proposed system through comparison with existing models. FB-ITS leverages the benefits of fuzzy logic and Bayesian networks. Fuzzy logic is employed to assess student performance in a specific domain based on previous experience, while the Bayesian network is utilised to ascertain the readiness of related topics for learning, informed by evidence from the fuzzy logic system. Consequently, this research formulates and executes three iterations of the ITS. The first version is developed only using the Bayesian network; the subsequent version is formulated exclusively with fuzzy logic, while the third version integrates both the Bayesian network and fuzzy logic, referred to as FB-ITS. Furthermore, the assessment is performed by juxtaposing the proposed FB-ITS with a conventional e-learning system that was designed without the incorporation of AI technology.

2.3. AI-powered research assistants

In an epidemic, like COVID-19, AI and the IoT may be used in environmentally friendly schools to improve students' learning possibilities. AI-powered chatbots can address student enquiries and provide personalised instruction. IoT solutions may be used to monitor students' progress and provide feedback to educators. Furthermore, pupils with disabilities and unique requirements might get advantages from the use of AI-driven virtual assistants. Industrial IoT and AI abilities may be used to provide personalised feedback and coaching to students and patients [4]. A comparable method was implemented for medical care throughout the COVID-19 epidemic, and thus, it may be duplicated to improve education. Figure 5 illustrates an IoT-based educational system that links educators and learners via a cloud-based teaching platform, enabling students to engage in remote learning using their RFID-based IDs and mobile devices. This helps professors in monitoring students and the procedure from a distance [22]. Moreover, IoT-enabled devices may be used to monitor attendance of pupils, participation, and advancement, while providing real-time data to administrators and teachers to enhance the learning environment. AI and the IoT may significantly enhance remote learning and maintain regular classes for students throughout an outbreak. Notwithstanding the prospective advantages of AI and the IoT in learning, certain challenges need attention. A primary difficulty is the absence of standardisation in the development and implementation of these technologies. This may hinder instructors' ability to successfully incorporate these advances into their instructional methodologies. Moreover, there are apprehensions over the possibility for emerging technologies to reinforce existing disparities in education, since not all pupils could have equal utilisation of possibilities and resources.

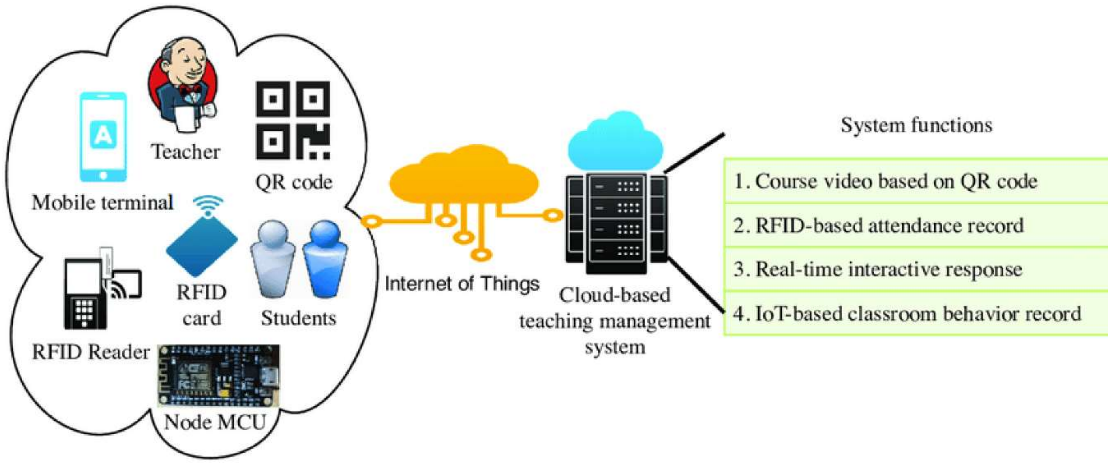

Figure 5: A system of teaching based on the IoT [22]

3. Challenges and Future Prospects

Trust in artificial intelligence encompasses several facets. In education, AI may be deemed reliable when it performs its intended functions accurately, as well as when there is confidence that humans will use it fairly and appropriately. For instance, AI-driven alert systems will generally assess students and determine those at danger of discontinuing their education. If their efficacy in selecting suitable pupils is insufficient, they are not entirely reliable and need enhancement via more study and growth, even if they cause no more detriment than the absence of a system. A different possibility could be that they are precise yet misapplied. Identifying individuals at risk of dropout is significant only if an effective approach is executed to help these students and mitigate that risk. Certain interventions may seek to enhance completion and promote fairness, equity, and non-discrimination. Nonetheless, other interventions may aim to eliminate "at risk" students from educational institutions, since their presence might result in fines against the school or damage to its image under certain governance frameworks. Trustworthiness is required not just from AI but also in the interactions between humans and AI. In some instances, which remain uncommon in most educational institutions, AI may result in automated determinations or recommendations that are likely to evolve into choices. This may pertain to admittance to educational institutions using certain algorithms. In some instances, this may enhance equity (such as in the case if the structure used to be prejudiced), however it may also yield unforeseen repercussions. The new approach is expected to alter the recipients of the most sought-after schools; thus, trust can only be established via openness and clarity about the requirements and algorithms used. Enhancing "openness" in algorithms is one approach to achieving transparent; yet, for many AI methodologies, like deep learning, elucidation continues to pose challenges. Certain nations, like France, have abandoned the use of specific algorithmic during official decision-making due to the challenges in elucidating them to a general audience. The future of AI in education has lot of future prospects in all the cross-domain applications. One can expect more sophisticated techniques in learning, quick adapting to students will be required to happen. The integration between AI and educators will be more refined, which will add more benefits. The interdisciplinary knowledge will help in the collaboration as well.

4. Conclusion

Research emphasising the benefits of artificial intelligence for higher education specifically, and education broadly, revolves on many key aspects. Through its intricate understanding, all factors that people encounter to acquire new knowledge and skills ultimately influence their attitudes, decisions, and behaviours. A notable and widely acknowledged impact of using artificial intelligence pertains to the educational process. Adaptive navigation technology promotes rapid knowledge acquisition and improves learning outcomes, becoming it a widely used instrument in online education. Many intelligent tutoring systems (ITSs) use technologies which customises student navigation in cyberspace according to the goals and proficiency of each user. The efficacy of an Intelligent Tutoring System's adaptivity depends on its approach to student modelling. Thus, the challenge is in creating an effective student model, an essential component of an Intelligent Tutoring System to mitigate uncertainty. Uncertainty in learning systems may emerge from the evaluation of student variables, including the assessment of students' knowledge levels The future of AI in education has significant potential across several interdisciplinary applications. Anticipation of increasingly advanced learning strategies necessitates rapid adaptation to pupils. The collaboration between AI and educators will get more sophisticated, resulting in further advantages. The multidisciplinary knowledge will facilitate cooperation as well.

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