Journal of Harbin Engineering University
ISSN: 1006-7043

Vol 45 No. 2
February 2024

The Affordances of Artificial Intelligence on Education

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Abstract: The advent of artificial intelligence (AI) has ushered in a new era of innovation and revolution across a wide range of industries, including the educational sector. Traditional approaches to learning and teaching have the potential to be revolutionized through the impactful algorithm of artificial intelligence which becoming an integral part of our daily activities not only in the teaching and learning methods but at all levels of human activities and living styles. AI stimulation of human thinking and intelligence in a machine by performing tasks commonly recognized and associated with human intelligence and imagination. This new development is not subjected to teaching-learning only but also gaining momentum in transforming the conventional educational system into new smart teaching and learning.

This research article aims to synthesize and connect different literary research ideas to provide insightful information on the impact of AI on educational settings and rending an ethical transformation from conventional teaching and learning processes to more comprehensive human interactions.

Finally, the research seeks to offer an overview of the current literature on the use of AI in education, with an emphasis on many successful AI-powered educational tools and platforms for pedagogical purposes like chatbots such as ChatGPT, Squirrel AI and Grammarly which are sophisticated artificial intelligence systems that can create replies that are human-like based on natural language models are the core focus of this research. It further addresses the potential advantages of artificial intelligence in education, as well as the ethical and practical issues underlying the usage of these technologies.

Keywords: Artificial Intelligence, Intellectual Literacy, Search Engine, Smart Education, Educational Machine.

1. Introduction

The emergence of artificial intelligence (AI) in the field of education may be traced back to Computer-Assisted Instruction (CAI) systems developed in the 1960s (Suppes, 1966). This rudiment paved the way for the term; Information and Communication Technology (ICT) which refers to a set of tools that are increasingly used in a variety of disciplines, including administration, education, and commerce. According to Sadik (2008), Computer-Assisted Instruction (CAI), is a teaching method that was created to make classroom settings more productive. As it was introduced by Patrick Suppes at Stanford University in the 1960s, it has evolved into a learning tool that provides students with text and multiple-choice questions or problems, offers immediate feedback, notes incorrect responses, summarizes students' performance, and generates exercises for worksheets and tests. Patrick Suppes is credited with being the inventor of the program for Computer-Assisted Instruction (CAI) which often provides problems for which there is only one solution that is right. This program can assess replies that are basic numerical or extremely simple alphabetic, but it cannot evaluate complicated responses from students. CAI systems, in their most basic form, provide students with tutoring and drills, identify difficulties, collect records of student progress, and deliver information to students. CAI has come a long way from its early days, and its impact now spans across all fields of study. (Piccoli, Ahmad and Ives 2001).

The primitive methods mentioned above played a foundational role in the development of intelligent tutoring systems (ITS) throughout the latter part of the 20th century. These ITS aimed to replicate the individualized interaction between a student and a tutor (Woolf, 2009). In contemporary times, artificial intelligence (AI) solutions have made significant advancements, including adaptive learning, immediate feedback, tailored information, and the capability to assess a student's emotional state (Baker & Siemens, 2014).

The emergence of Artificial Intelligence (AI) has initiated a new epoch of innovation and metamorphosis in several sectors, with particular emphasis on the educational domain. Advancements in AI technology have the potential to change traditional learning and teaching methodologies via the introduction of novel tools and applications. This article is characterized by its emergent nature and rapid growth, focusing on the advancement of intelligent computers capable of executing a wide range of activities that traditionally need human-level intellect. These tasks include but are not limited to visual perception, voice recognition, decision-making, and language translation. Due to the growing accessibility of data and computing resources, AI has the potential to revolutionize various industries and improve our daily lives in numerous ways such as automating administrative tasks, personalize education, enhancing learning abilities, and providing new opportunities for the availability of global access to educational instructions and information, improves students' academic performance, objective assessment, reducing student's anxiety. (Dwivedi, el al., 2021). With this vast range of applications of AI in education, it has the capacity to completely transform the educational system by facilitating more individualized student experiences, enhancing grading practices, alleviating the workload for teachers and lecturers, and thereby enhancing high productivity in writing skills, learning results, individualized education, immediate feedback, and student engagement are all things that are improved with the emerging adoption of AI technology. As an interdisciplinary area adopted by researchers and experts across a variety of academic disciplines, this will facilitate constant contributions to knowledge, skills, and innovations in various perceptions and terminology. However, it's important to ensure that AI is developed and used ethically and responsibly, with a focus on fairness, transparency, and safety. However, it's important to ensure that AI is developed and used ethically and responsibly, with a focus on fairness, transparency, and safety. Therefore, the study seeks to provide an overview of the current literature on AI in education and to synthesize and connect different literary research ideas on the impact of AI on education settings.

2. Literature Review

The development of Artificial Intelligence (AI) has been a driving force behind the dramatic upheaval that has taken place in the technology sector and gradually heading into the educational industries. Many people believe that Artificial Intelligence (AI) is something that will make their job easier; nevertheless, this is only one of the characteristics that Artificial Intelligence has. The principles and platforms of artificial intelligence and machine learning make it possible to solve a wide range of educational (teaching and learning) problems and organizational problems.

Therefore, the important ideas discussed in this article pertain to areas improving learning in higher education learning, enhancing teaching, access to reliable scholastic resources, quick AI information, and AI-powered solutions, such as automated scoring systems, play a crucial role in supporting educators by enabling them to provide precise and uniform feedback to every student. The term "artificial intelligence" is derived from the combination of the terms "artificial" and "intelligence."

A. Artificial-something is said to be artificial if it was fabricated or manufactured by people rather than occurring naturally.

B. Intelligence-Intelligence can be defined as the capacity to acquire and make use of knowledge and skills.

2.1. Definition of Artificial Intelligence in Education

Artificial Intelligence refers to the capacity of machines to execute cognitive processes often attributed to human brains; and for those experts who are very knowledgeable in a particular field, it may be challenging to provide an accurate description or exact definition of 'Artificial Intelligence' (AI) as an emerging trend and a continuous discovery which could be incorporated into wider universal applications beyond the educational sectors and industries. This is because AI adoption is still an ongoing innovation task that can be refined. Therefore, Artificial Intelligence (AI) refers to the capacity of computers to engage in cognitive activities, including processes such as

thinking, perceiving, learning, problem-solving, and decision-making. The phenomenon under consideration pertains to the cognitive processes used by persons in the acts of observation, learning, problem-solving, and decision-making (Wu el al., 2013).

Various previous studies such as Knapp (2006) argued that the field of 'Artificial Intelligence' (AI) emergence as an academic field may be traced back to 1956. Subsequently, Artificial Intelligence (AI) has had many phases of optimism, leading to its division into distinct sub-fields. According to Kuleto and Dumangiu (2021), the sub-fields within the area of Artificial Intelligence (AI) are largely categorized based on technical factors such as distinct objectives, as seen in Machine Learning (ML) a mathematical modeling of neural networks that served as the inspiration for its initial development, and unique methodologies, such as "logic" or "ANNs (Artificial Neural Network)." Artificial Neural Networks (ANNs) draw inspiration from the intricate neural network structure of the human brain, resulting in a learning process that surpasses the capabilities of conventional machine learning models (Gustineli, 2022). These divisions illustrate the significant evolutionary progression of AI, starting with early AI, then advancing to ML, and culminating in the more recent development of Deep Learning (DL) which is referred to as a class of algorithms that has the ability to examine data in a manner that resembles the logical reasoning process used by humans in drawing conclusions (Hohenecker, at el., 2020). The following Figure 1 displays the major evolutionary process of AI.

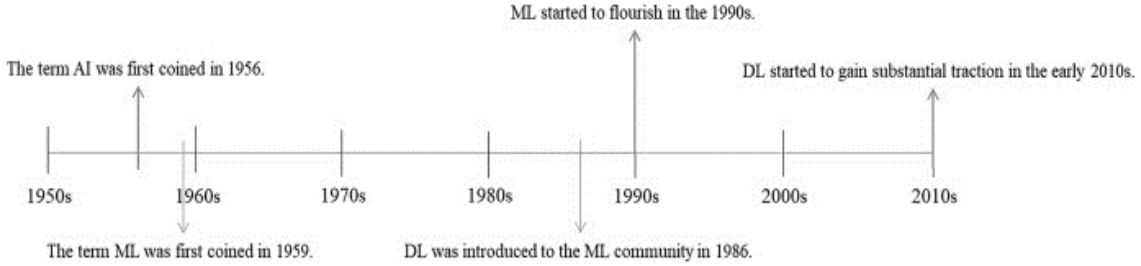

Figure 1: The Evolution of AI

Adopted from the work of ''Xieling Chen, Haoran Xie, Di Zou, Gwo-Jen Hwang, Application and theory gaps during the rise of Artificial Intelligence in Education, Computers and Education: Artificial Intelligence", Volume 1, 2020, 100002, ISSN 2666-920X,
https://doi.org/10.1016/j.caeai.2020.100002

Artificial Intelligence (AI) can now be defined based on the introduction by Wikipedia as "the intelligence of machines or software, as opposed to the intelligence of human beings or animals. AI applications include advanced web search engines (e.g., search), recommendation systems (used by YouTube, Amazon, and Netflix), understanding human speech (such as Siri and Alexa), self-driving cars (e.g., Waymo), generative or creative tools (ChatGPT and AI art), and competing at the highest level in strategic games (such as chess and Go)". (AlphaGo, 2016).

The 'World Economy Forum' refers to AI as "The software engine that propels the Fourth Industrial Revolution is artificial intelligence (AI). It has already had an impact on people's lives, businesses, and political processes. It will soon be driving automobiles, stocking warehouses, and caring for the young and elderly in its embodied form of robots. It holds the prospect of resolving some of society's most serious problems."

Artificial intelligence (AI) refers to the process of artificially augmenting human intelligence by creating software or machines that can perform tasks that are typically performed by humans (Zhong et al., 2017). Bartneck et al. (2020) define the term 'Artificial Intelligence' as 'the process by which a machine reproduces the cognitive functions associated with other human brains, such as learning, problem-solving, etc. In another similar term by Sheikh et al. (2023), he expressed the 'European Artificial Intelligence' that "AI isn't a well-defined technology, and there isn't a single description that everyone agrees on. It's more of a catch-all word for data analysis and pattern detection tools". According to Grewal (2014), "Artificial Intelligence refers to a mechanized

simulation system that is designed to gather knowledge and information, as well as process intelligence from the universe. This system aims to collate and analyze this intelligence, and afterward disseminate it to those who are eligible in the form of actionable intelligence".

In this regard, there are strengths of artificial intelligence drilling of students, help diagnose problems, keep academic records, improving the management of the educational process, individualization of the learning process, and serving as a catalyst for curriculum development and presentations of materials to students.

On a global scale, humanity has entered a transformative period characterized by the emergence of high-tech intelligence and highly advanced machines. There is a growing trend in various industries to customize machinery and systems in order to cater to the specific needs and preferences of individual customers, hence addressing their high-demand requirements. The progression of Artificial Intelligence (AI) alongside human society is often denoted in Communication Industries and acknowledged as the transition from the fourth generation (4G) to the fifth generation (5G) and above. The advent of 5G mobile broadband, which stems from the fourth industrial revolution, is significantly impacting the socio-economic landscape for humanity as a whole, hence catalyzing the emergence of new industrial tech acting more like humans with smarter thought as only for humans.

2.2. The Innovative Elements of Artificial Intelligence on Education

The emergence of Artificial Intelligence (AI) will momentarily become active like humans that will perform smarter, be more accessible, and be able to do things that were once thought of as only for humans. As AI's cutting-edge capabilities have the potential to transform teaching paradigms, student involvement, administrative effectiveness, and inclusion, it promises a more adaptive, personalized, and efficient learning environment. While educational sectors try to figure out how to keep up with the ever-changing world, AI is becoming more and more significant as a way to drive more innovation and stay ahead of the curve. This article provides revolutionised educational innovative elements of AI in education as tools for pedagogical dimension and new development opportunities that enable access to techniques and sound innovative tools with the adoption of AI, educational sectors most especially the teachers/lecturers will have new ways of interacting and accessing learning materials, and inspire students to gather new ideas which will foster creativity and essential skills in today's competitive world where software development has transformed the traditional learning method into a digital campus, mobile digital courses, virtual lecture room, online referencing materials are made available to educators and the students. With this new dimension, education will be more accessible and less strenuous,

The following highlights the new dimensions AI can be used for Education in an emerging world.

1. **An improved writing and research outcome:** The use of AI writing and research tools has significant promise in enhancing the efficiency of the writing and research process. AI can simulate the role of a human tutor, providing personalized attention to learners and responding to their needs. This provides guidance, feedback, and structured learning experiences to help students gain a better understanding of the material and minimize the amount of time dedicated to monotonous chores, these tools enable researchers to concentrate their efforts on analysis and the development of a coherent narrative. Nevertheless, it is crucial to acknowledge that these technologies still need human involvement in the process of research and storytelling (Sottilare et al., 2017).

2. **Learning Analytics and Automated Administrative Tasks:** Artificial Intelligence (AI) is capable of analysing large volumes of data to provide predictive insights into student outcomes, dropout rate, and other fundamental indicators, which can be used to inform the decision-making process of educators and educational institutions. It goes further to have the capability to effectively manage repetitive assignments, including but not limited to scheduling, monitoring student attendance, and, in some cases, even grading. This automated system provides instructors with more time to dedicate to the tasks of instruction and fostering the development of pupils (Baker and Siemens, 2014).

3. **Natural Language Processing (NLP) and Emotional Recognition:** AI can provide the potential to facilitate language acquisition by providing instantaneous translations, rectifying pronunciation errors, and comprehending the contextual nuances of many languages. Consequently, these tools have the capacity to democratize language instruction. Furthermore, its use sensors and algorithms to see what kind of emotions students are feeling, like when they're annoyed, bored, or excited. This kind of data can be really important for changing how content is delivered and making sure students have a great learning experience. (Li et al., 2021)

4. **Accessibility and Inclusion:** AI has the potential to support students with disabilities via several means, such as converting speech into written text, providing visual descriptions for those with visual impairments, and delivering customized learning tools tailored to individual requirements. By incorporating these AI-based solutions, educational institutions may promote inclusion and provide equal access to education for all students, regardless of their abilities.

5. **Lifelong Knowledge and Upskilling:** AI-powered platforms can detect global and local employment trends and direct learners to the courses and competencies they need to meet therefore guiding individuals seeking to enhance their competitiveness in the labour market by identifying relevant courses and skills (Lombardi et al., 2011).

6. **Faculty Development:** AI can be adopted and developed as intelligent assistants for effective teaching strategies by University professors, including Q&A assistants, tutors, how to interpret data and analytics to advance students' education as well as library assistants, and lab assistants.

To sum up, the use of Artificial Intelligence (AI) in the field of education has the potential of transforming instructional approaches, enhancing student involvement, teaching paradigms, improving administrative effectiveness, and foster inclusion. With the ongoing development of (AI), as it progresses, it is anticipated that it will increasingly attain more accessibility and specialization within distinct domains, including healthcare, finance, and transportation. Additionally, the potential for a transformed educational environment is characterized by enhanced adaptability, personalization, and efficacy which this development will lead to in the growth of job prospects in sectors such as data Science, Technology, Religion, Engineering, Art, and Mathematics (STREAM) for machine learning, and ethical considerations of artificial intelligence. Nevertheless, this development will inevitably give rise to ethical considerations pertaining to privacy, security, and prejudice.

2.3. An Informative-Intelligent System (IIS)

This article introduced an 'Informative-Intelligent System' (IIS) which is a learning system characterized as having the capability to diagnose and adjust to knowledge by being capable of delivering accurate responses and being proficient in presenting the searched response as required by the learner. The IIS diagram below (figure 2) explains that the educational platform, which employs a personalized coaching methodology, aims to provide learners with comprehensive feedback on their problem-solving skills. The proposed approach offers a more comprehensive methodology by including exploratory activities aimed at fostering the application of search engines using AI concepts in real-world scenarios to aid the abilities of students.

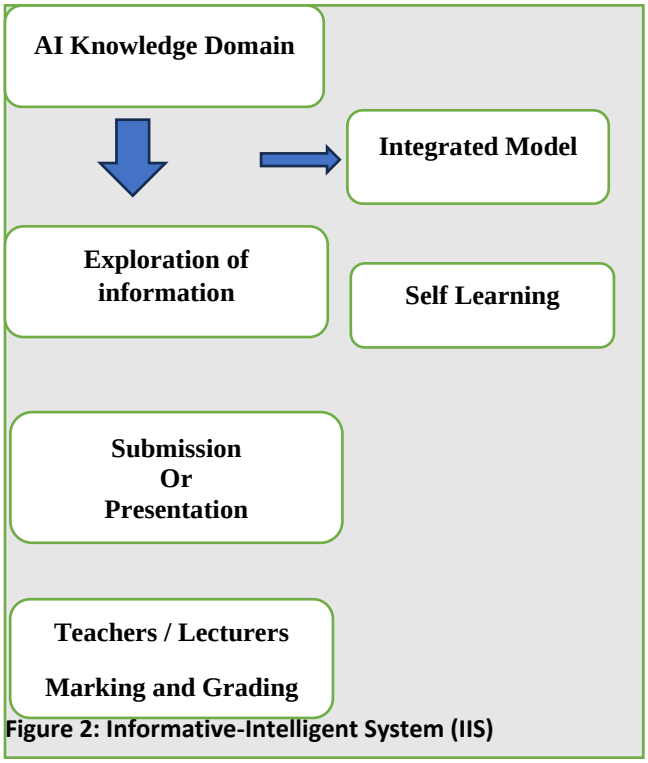

Figure 2: Informative-Intelligent System (IIS)

A general model of an Informative-Intelligent System (IIS) that consists of six basic models: AI Knowledge Domain, Exploration of Information, Integrated Model, Self-learning, Submission or presentation, and lastly, the teachers/lecturers marking and grading. This model can be derived from the use of the following table 1 below.

Table 1: AI tool for Education

No.	AI tool for Education		No.	AI tool for Education
1.	OpenAI		10.	IBM Watson
2.	Smodin.io		11.	Microsoft Azure
3.	Jenni.ai		12.	Openread.academy
4.	Google Bard		13.	Sholarcy library
5.	Scite Assistant		14.	Consensus
6.	Chatpdf		15.	Research Rabbit
7.	Elicit		16.	Scrivener
8.	SciSpace		17.	Paperpal
9.	Copy.Ai		18.	Writefull

The researcher tabulations of AI tools for pedagogical purposes.

3. The Paper Methodology

This study employs a qualitative-interpretative research design, specifically using a documentary approach in order to comprehensively analyze the existing research and provide an accurate evaluation of the current status of artificial intelligence (AI) in education, it is necessary to conduct systematic reviews of the literature. The purpose of this study is to ascertain potential applications of (AI) in the present and the future impact of Artificial Intelligence (AI) in the field of education; a particular focus on its prospective to improve both learning and teaching within the domain of education; to enhance comprehension of the present status of (AI) in the field of education and its impact on the process of learning, it is essential to do a comprehensive literature search. During this phase, it is important to actively pursue and thoroughly analyze appropriate articles, research papers, books, and other relevant sources.

For the purpose of this study, a total of 30 publications have been carefully chosen, including a range of scholarly articles, review articles, and reputable material sourced from recognized organizations' websites. The search queries were constructed using the following keywords: "Artificial intelligence" and "education." The criteria used for document selection were the publication year, relevance to the study topic, and reliability as a source. Upon careful examination of each document, the pertinent data was meticulously recorded into the bibliographic matrix. This matrix serves as a comprehensive system for organizing the papers based on certain categories, which are then presented in a structured manner in Table 2 below.

Table 2 Bibliographic Matrix

Name	Type	Objectives	Remarks

Table of bibliographic matrix expressing categories of documents studied.

3.1. Results and Discussions

AI is a vital technology that plays a vital role in everyday social and economic life. In recent decades, AI has become a key enabler for economic development in developed countries like Europe and the US, as well as in emerging economies like China and India. By bringing on board the concept of globalized education that involves the use of Artificial Intelligence (AI) to provide high-tech quality educational opportunities to regions that are geographically isolated or lack sufficient access to educational resources.

The issue of equity arises when considering that some students or educational institutions may lack access to cutting-edge AI-driven technologies, which may result in inequities in the quality of education. The quality and efficacy of AI technologies may exhibit variability, like to other technological advancements. It is important for educators to exercise discernment and verify that the tools they use really enhance the process of learning. Additionally, the use of artificial intelligence often entails the accumulation and examination of enormous quantities of data, so giving rise to apprehensions over the privacy of students. However, the excessive dependence on Artificial Intelligence (AI) in educational settings has

the potential to diminish the significance of human contact within the learning process.

3.2. Challenges and Concerns

There is crucial need to reduce any kind of risk to students in order to ensure the accuracy of information from AI, technological resilience, and safety of AI systems, also, it is essential to incorporate human agency and supervision. This involves conducting thorough evaluations to verify the performance of AI, its ability to handle new data and its susceptibility to hacking. Diversity is essential in order to provide a balanced representation of various demographic groups within data and to mitigate the influence of prejudice. The principle of non-discrimination and fairness aims to mitigate the potential for unjust treatment of individuals by Artificial Intelligence (AI) systems. The importance of privacy and data governance lies in safeguarding individuals' autonomy over their personal data. By establishing robust frameworks, every educational institution may exercise its right to regulate the use and dissemination of AI generation of information. Additionally, transparency plays a crucial role in promoting comprehension and awareness of (AI) technologies. The promotion of social and environmental welfare is crucial in order to mitigate any potential damage caused by Artificial Intelligence (AI). Moreover, establishing accountability mechanisms is essential to guarantee that individuals or entities are held responsible for any negative consequences resulting from AI activities.

3.3. Ethical Issues

Ethics in Artificial Intelligence (AI) has become a major concern for researchers and practitioners alike due to a number of incidents that have occurred in the real world. The increasing number of substantial volumes of data resulting from the implementation of online learning during the pandemic is anticipated to lead to a rise in the prevalence of educational technology solutions that are driven by artificial intelligence. However, the topic of ethics in Artificial intelligence in education (AIEd) is not considered a priority for the majority of educational technology (edu-tech) enterprises. One of the contributing factors to this phenomenon is the limited level of consciousness or knowledge about the matter at hand. The inquiry pertains to the perspectives of relevant stakeholders on potential pitfalls in the development and deployment of artificial intelligence in the educational industries. This implies that the disadvantaged uses of artificial intelligence (AI) might potentially lead to instances of discriminatory practices targeting certain populations as a consequence. Other considerable issues could be associated with the followings;

1. The presence of data inadequacies and the stigmatization resulting from an over-dependence on certain sources
2. Deficiencies and Exploitation in Machine Learning Modelling and References
3. The potential for personal data and rigorous research to remain undetected owing high rate of paraphrasing due to a lack of awareness and its annihilation
4. Lacking any kind of responsibility or obligation with a bias towards students hailing from socioeconomically disadvantaged backgrounds. Similar to other industries that are seeing significant advancements in (AI), the field of AI in education (AIEd) also presents a crucial ethical concern pertaining to giving students the autonomy to choose whether or not to participate in AI-driven forecasts and automated assessments.

3.4. Affordance Benefits of AI

Artificial Intelligence (AI) has regained significant attention and awareness among the general population. The benefits and vices of (AI) are now a subject of everyday discourse in the educational industries that AI has the potential to significantly impact several aspects of society. The discussion around the educational implications of AI has generated much discourse and differing viewpoints. However, there is a general consensus that AI has the capacity to have a profound influence on multiple facets of society.

Advanced analytics and artificial intelligence can create novel insights and enhance decision-making processes in several domains, such as predictive maintenance, quality management, and demand forecasting. This is achieved by leveraging these technologies on extensive datasets. The efficacy of machine-learning algorithms is increasing in tandem with advancements in computer power and the widespread availability of large datasets. Nevertheless, the whole extent of artificial

intelligence's capabilities remains untapped in operational settings, where only a limited portion of data is being used for making decisions.

The use of Artificial Intelligence (AI) has the capacity to revolutionize the field of education via a multitude of avenues, including the customization of learning experiences, the augmentation of assessment methods, the refinement of feedback mechanisms, and the facilitation of collaborative endeavours. Nevertheless, the use of (AI) also presents a set of obstacles and potential hazards, including ethical, societal, and technological concerns. Hence, it is imperative to thoroughly examine the potential and constraints of (AI) in the context of education and to formulate suitable laws and procedures that can guarantee its efficient and ethical use.

Moreover, AI has the potential to facilitate the democratization of education. The advent of AI-driven tutors, translation services, and accessibility features has the potential to significantly diminish geographical, linguistic, and physical obstacles in the realm of education. This implies that the accessibility of excellent education may be extended to individuals from various socio-economic backgrounds, promoting equity and fairness.

In summary, the findings suggest that Artificial Intelligence (AI) has the capability to provide several benefits within the realm of education. Nevertheless, it is crucial to recognize that there exist certain concerns and challenges linked to its execution that need meticulous examination and resolution. The paper elucidates other deficiencies and offers recommendations for prospective investigations and advancement within this specific field. The study results suggest that Artificial Intelligence (AI) has promise as a beneficial resource within the education sector, as long as it aligns with the values and goals of education that favour human-centered methods.

4. Conclusion

Throughout the investigation of AI-powered educational solutions, many noteworthy findings were uncovered. The adaptive learning capabilities of AI have the potential to provide personalized learning routes, whereby knowledge and resources may be customized to meet the distinct needs of each learner. This strategy not only facilitates the enhancement of educational outcomes but also ensures the inclusion of all students, accommodating diverse learning preferences and rates of academic advancement. Moreover, the use of predictive analytics within the realm of Artificial Intelligence (AI) has the potential to provide significant insights into the learning behaviours of students, therefore empowering educators to intervene strategically at crucial junctures with the aim of optimizing the learning experience. Furthermore, the capacity of AI to automate administrative duties enables educators to shift their attention away from paperwork and towards more meaningful endeavours, such as direct engagement with pupils. This practice guarantees that instructors are able to use their inherent human traits such as empathy, guidance, and mentoring, which cannot be replicated by robots.

Nevertheless, the progress in these areas presents some difficulties. The ethical considerations pertaining to the protection of data privacy, the possibility of bias in artificial intelligence algorithms, and the excessive dependence on technology, call for comprehensive supervision. The integration of (AI) into educational settings necessitates a conscientious consideration of the problems involved. It is imperative that the approach of integration is a keen understanding of the potential risks, so as to safeguard human values and principles while striving for innovative advancements.

In summary, it is evident that the potential of artificial intelligence (AI) to transform the field of education is indisputable. However, it is crucial to see AI as a supplementary tool that enhances the capabilities of human educators, rather than a substitute for them. In light of the current state of education, it is incumbent upon us to exercise prudent control over the capabilities of artificial intelligence, ensuring that the comprehensive growth of students remains the central focus in all technological progressions.

References:

[1] AlphaGo – Google DeepMind". Archived from the original on 10 March 2016. Retrieved August, 19, 2023 from ttps://web.archive.org/web/2021110209065

0/https://wildoftech.com/alphago-google-deepmind/

[2] Andres, J. M. L., Baker, R. S., Siemens, G., Gašević, D., & Spann, C. A. (2016). Replicating 21 findings on student success in online learning. Technology, Instruction, Cognition, and Learning, 10(4), 313-333.

[3] Baker, R., & Siemens, G. (2014). Educational data mining and learning analytics. In K. Sawyer (Ed.) Cambridge handbook of the Learning Sciences: 2nd Edition (pp. 253 – 274). New York, NY: Cambridge University Press

[4] Bartneck, C., Lütge, C., Wagner, A. R., & Welsh, S. (2020a). What is AI? In *Springer Briefs in ethics* (pp. 5–16). https://doi.org/10.1007/978-3-030-51110-4_2

[5] Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., ... & Williams, M. D. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. International Journal of Information Management, 57, 101994.

[6] Grewal, D. S. (2014). A critical conceptual analysis of definitions of artificial intelligence as applicable to computer engineering. *IOSR Journal of Computer Engineering*, *16*(2), 09–13. https://doi.org/10.9790/0661-16210913

[7] Gustineli, M. (2022). A survey on recently proposed activation functions for Deep Learning. arXiv preprint arXiv:2204.02921.

[8] Hohenecker, P., & Lukasiewicz, T. (2020). Ontology reasoning with deep neural networks. Journal of Artificial Intelligence Research, 68, 503-540.

[9] Kuleto, V., Ilić, M., Dumangiu, M., Ranković, M., Martins, O. M., Păun, D., & Mihoreanu, L. (2021). Exploring opportunities and challenges of artificial intelligence and machine learning in higher education institutions. Sustainability, 13(18), 10424.

[10] Li, C., & Xing, W. (2021). Natural language generation using deep learning to support MOOC learners. International Journal of Artificial Intelligence in Education, 31, 186-214.

[11] Lombardi, A. R., Murray, C., & Gerdes, H. (2011). College faculty and inclusive instruction: Self-reported attitudes and actions pertaining to Universal Design. Journal of Diversity in Higher Education, 4(4), 250.

[12] Ogata, H., & Uosaki, N. (2012). A new trend of mobile and ubiquitous learning research: towards enhancing ubiquitous learning experiences. *International Journal of Mobile Learning and Organisation*, *6*(1), 64. https://doi.org/10.1504/ijmlo.2012.046883

[13] Piccoli, G., Ahmad, R., & Ives, B. 2001. "Web-based virtual learning environment: A research framework and a preliminary assessment of effectiveness in basic IT skills training". *MIS Quarterly*, vol. 25, no. 4, pp. 401-426.

[14] Sadik, A. (2008). Digital storytelling: a meaningful technology-integrated approach for engaged student learning. *Educational Technology Research and Development*, *56*(4), 487–506. https://doi.org/10.1007/s11423-008-9091-8

[15] Sheikh, H., Prins, C., & Schrijvers, E. (2023). Artificial intelligence: definition and background. In *Springer eBooks* (pp. 15–41). https://doi.org/10.1007/978-3-031-21448-6_2

[16] Sottilare, R. A., Brawner, K., Goldberg, B., & Holden, H. K. (2017). The Generalized Intelligent Framework for tutoring (GIFT). In *CRC Press eBooks* (pp. 223–233). https://doi.org/10.1201/9781315583655-20

[17] Suppes, P. (1966). The uses of computers in education. *Scientific American*, *215*(3), 206–220. https://doi.org/10.1038/scientificamerican0966-206

[18] Suppes, P. (1966). The uses of computers in education. *Scientific American*, *215*(3), 206–220. https://doi.org/10.1038/scientificamerican0966-206

[19] Woolf, B. P. (2009). Building intelligent interactive tutors: Student-centered strategies for revolutionizing e-learning. Burlington MA: Morgan Kaufman Publishers.

[20] Wu, Z., Reddy, R., Pan, G., Zheng, N., Verschure, P. F. M. J., Zhang, Q., Zheng, X., Principe, J. C., Kreilinger, A., Rohm, M., Kaiser, V., Leeb, R., Rupp, R., & Müller-Putz, G. (2013). The convergence of machine and biological intelligence. IEEE Intelligent Systems, 28(5), 28–43. https://doi.org/10.1109/mis.2013.137

[21] Yusuf, B., Walters, L. M., & Sailin, S. N. (2020). Restructuring Educational Institutions for Growth in the Fourth Industrial Revolution (4IR): A Systematic review. *International Journal of Emerging Technologies in Learning (Ijet)*, *15*(03), 93. https://doi.org/10.3991/ijet.v15i03.11849

[22] Zhong, R. Y., Xu, X., Klotz, E., & Newman, S. T. (2017). Intelligent Manufacturing in the context of Industry 4.0: A review. *Engineering*, *3*(5), 616–630. https://doi.org/10.1016/j.eng.2017.05.015