Review And Mapping The Evolution of Artificial Intelligence In Education

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Abstract- *The study presents a comprehensive overview and an in-depth examination of the current and past state, trends and future prospects of Artificial Intelligence integration in educational settings. The purpose of this research is to map the evolution of Artificial Intelligence and trace its importance in the field of education. As the impact of Artificial Intelligence cannot be ignored longer it is better to understand its pros and cons before declaring its strengths and shortcomings. The scope of this study is teaching and learning and it is concerned with academics of an educational institution/organization. The primary goal of this study is to offer insights into the patterns and directions within the realms of artificial intelligence and education. This will help researchers in understanding worldwide trends and determining future research directions. The study believes that AI provide support and opportunities to educator and learners for better planning, implementation and assessment and argues for a cohesive collaboration between AI tools and the pressing requirement for ethical guidelines, pedagogical adjustments, and strategic partnerships and hence to analyze the historical development of AI in education, tracing its evolution from its inception to the present, identifying key milestones and breakthroughs is something this study aims to achieve.*

Keywords- Artificial Intelligence; Artificial Intelligence in Education; Evolution of Artificial Intelligence; Future of AI in Education

I. INTRODUCTION

The rapidly evolving field of artificial intelligence holds immense potential to revolutionize how we engage with one another. Within the realm of education, AI is pioneering innovative teaching and learning techniques presently undergoing rigorous evaluation across diverse settings. Technology has significantly elevated student engagement and educational planning through avenues such as gamification, learning management systems, video-assisted learning, and virtual and augmented reality. The integration of artificial intelligence into education has undeniably wielded a profound impact on the educational system, propelling it into a transformative phase. Through the utilization of cutting-edge technologies, education is undergoing a metamorphic shift, with AI fostering personalized learning visualizations. The influence of digital learning solutions on the educational ecosystem is monumental, with AI evidently leading the charge. Furthermore, it enables students to engage in logical aptitude exams and attend lectures that are exceedingly captivating, ensuring they receive optimal instruction tailored to their learning requirements. This, in turn, facilitates the maximization of knowledge utilization by young, eager minds.[1]

The objective of this research is to conduct a thorough and systematic review and overview of the evolution of Artificial Intelligence (AI) in the realm of online education. The aim is to comprehensively map the progression of AI technologies, applications, and their impact on the online education landscape. This research intends to scrutinize the ethical considerations and societal implications arising from the integration of AI in online education, aiming to ensure responsible and equitable implementation.

Let us commence by defining artificial intelligence (AI) before delving into its impact on the field of education. Intelligence is defined as "the capacity to grasp and employ suitable methodologies for problem-solving and goal attainment, adapted to the context within an uncertain and constantly evolving world," according to Stanford University's Human-Centered Artificial Intelligence (HAI). The term artificial intelligence (AI) was initially coined by John McCarthy, a retired Stanford professor, in 1955. He later refined the definition to encompass "the science and engineering devoted to crafting intelligent machines," now with a specific emphasis on instructing machines to learn in a manner somewhat akin to humans.[2] Marvin Minsky had a similar view on AI and defined it as “AI is the science of making machines do things that would require intelligence if done by men.”

Artificial Intelligence (AI) holds promise in advancing educational objectives efficiently, scaling operations, and reducing costs. It offers potential enhancements by tailoring learning resources to students' unique strengths and requirements. Addressing the

improvement of teaching roles is a priority, with AI presenting automated assistants and tools to bolster teacher support. It extends the reach of educators to provide personalized attention to individual students when time constraints arise. However, concerns arise over system-level risks and apprehensions about future implications.[10]

These concerns encompass potential infringements on student privacy due to heightened surveillance. Moreover, worries persist about the possibility of replacing teachers with AI, a notion firmly rejected by the Department. The imperceptible nature of AI in certain applications raises questions about transparency and engendering trust. It is crucial for edtech to demonstrate efficacy to educators and adhere to procurement policies. [6]

Furthermore, the authenticity of AI-generated information is of utmost importance, as misleading data can have detrimental effects. AI introduces new risks alongside well-known data privacy and security concerns, including the risk of propagating "algorithmic discrimination" that unfairly impacts specific student populations. Urgency heightens due to the potential for unintended or unexpected consequences at scale. Quality of available data can lead to unexpected outcomes, such as AI systems perpetuating bias if historical data is of poor quality. For instance, an AI-driven teacher hiring system may unintentionally sideline candidates capable of contributing both diversity and talent to a school's teaching workforce due to flawed reliance on historical data.[4]

II. IMPACT OF ARTIFICIAL INTELLIGENCE ON EDUCATION

Artificial Intelligence can be defined as a computer endowed with substantial processing capabilities. This includes adaptive behavior, integrating sensors, and other functionalities that allow it to emulate human-like cognition and functional abilities. Ultimately, these enhancements improve its interaction with human beings.[5] Artificial intelligence (AI) tailors and individualizes learning experiences, recognizing that individuals assimilate knowledge diversely and at different paces. Furthermore, AI technologies are augmenting tutoring by integrating conversational educational assistants and personalized methodologies. Through this autonomous tutoring, students have the opportunity to learn at their own pace. The undeniable advantages that AI has bestowed upon the educational system are evident, and there is a strong anticipation that machine learning and AI will underpin all future educational endeavors. [3]

AI, once a mere vision confined to science fiction, has evolved into an indispensable force reshaping our educational landscape. In the past, its infancy was marked by theoretical frameworks and ambitious hypotheses, exploring the potential of machines to simulate human intelligence. Early attempts grappled with basic algorithms and limited datasets, struggling to replicate cognitive functions.

Fast forward to the present, AI stands as an omnipresent catalyst revolutionizing education. Its integration has birthed adaptive learning systems, personalized tutoring, and data-driven insights into student performance. Machine learning algorithms analyze vast amounts of educational data, offering tailored experiences to learners, transcending the one-size-fits-all paradigm. [10, 6]

The influence of AI on the education sector is significant, particularly as per the National Education Policy (NEP), which necessitates students to undertake online certification courses for extra credits. This approach enables students to concentrate on honing their skills alongside their regular studies.

In this continuum, AI's trajectory in education mirrors a journey from conceptualization to pragmatic implementation, and now poised for an era of unparalleled innovation, where its potential to augment, personalize, and transform learning experiences is boundless.

Thematic analysis

Theme 1: Artificial Intelligence is helpful to develop the quality of education Artificial intelligence helps by developing different software applications for improving the quality of the education system. Artificial intelligence helps to introduce different types of PowerPoint presentations and graphical presentations in order to give better clearing concepts to the students (Holmes et al. 2019). Artificial intelligence helps the students by giving answers to all the queries that have been asked by the students at any time of the day (Chen et al. 2020). Artificial intelligence improves the quality of the learning techniques in every possible term.

Theme 2: Different factors of AI is responsible for generating cognitive and formative skills There are different factors of artificial intelligence that help to improve different skills in terms of cognitive and formative skills. Artificial intelligence has different influencing factors that have a significant impact on the different aspects of the quality of learning (Anyim 2021). Different aspects of the quality management of the learning methods are cognitive skills and formative skills (Seta et al. 2020). Cognitive skills help to develop the

infrastructure of the education system and the formative skill refers to the skill that is required for the formation of the base of the education system. Artificial intelligence is also capable of solving complex problems which means that artificial intelligence has the ability to perform solving more than one problem at a time. In this research project, the researcher also highlighted the importance of maintaining the proper quality of the learning in the higher academy. The quality of the learning process and the learning objectives need to be maintained by the teacher or the guide of the higher academy.
Thematic coding

Table: Thematic coding

Author	Code	Themes
Themes Holmes et al. (2019) Chen et al. (2020)	Artificial intelligence, education, students, problem solving skill, software applications	Artificial Intelligence is helpful to develop the quality of education.
Anyim, (2021) Seta et al. (2020)	Different factors, cognitive skills, formative skills, a community of practice, communication skills.	Different factors of AI is responsible for generating cognitive and formative skills

III. LITERATURE REVIEW

1. In their paper titled "Research Landscape of Artificial Intelligence and e-Learning: A Bibliometric Research," K. Jia, P. Wang, Y. Li, Z. Chen, X. Jiang, C. L. Lin, and T. Chin employed a literature metrology method to analyze the current state of research at the intersection of artificial intelligence (AI) and e-learning. They identified five primary research directions within this domain: adaptive systems and personalization, profiling and prediction, evaluation and assessment, other, and intelligent tutoring systems. This comprehensive review sheds light on the evolving landscape of AI's integration with e-learning, providing valuable insights into the trajectory and focus of research efforts in this field. The study relies on presenting keyword nodes qualitatively, with their value determined solely by the frequency of occurrences within the literature dataset. This approach may overlook nuances and contextual relevance, potentially leading to oversimplified representations of the research landscape.
2. In their paper titled "The Effect of Artificial Intelligence on Learning Quality & Practices in Higher Education," Rajesh E., Dr. Shreevamshi, Dr. V.N. Deshmukh, Dr. S.H. Krishna, and L. P. Maguluri adopt a qualitative methodology to delve into the impact of artificial intelligence (AI) on educational quality and practices within higher education. The research underscores the manifold benefits of AI in enhancing educational efficiency, foreseeing potential challenges in education, ensuring exam integrity, and detecting plagiarism. Furthermore, it highlights AI's role in aiding students' comprehension of intricate concepts and fostering their problem-solving skills. This comprehensive review not only elucidates the positive influence of AI on higher education but also anticipates its pivotal role in shaping the future of learning methodologies and outcomes. Despite the growing concerns surrounding the ethical use of AI and its potential to diminish critical and creative thinking skills, the paper does not adequately address these issues. There is a need for deeper exploration into how AI integration in education may inadvertently lead to over-reliance on technology, potentially stifling students' ability to think critically and creatively.
3. In their qualitative review titled "Artificial Intelligence in Education: A Review," L. Chen, P. Chen, and L. Zhijian comprehensively examine the positive impacts of artificial intelligence (AI) in education. Their study delves into various facets of personalized learning, shedding light on how AI technologies can be harnessed to tailor educational experiences to individual learners' needs. By identifying and analysing these positive impacts, the research provides valuable insights for educators seeking to leverage AI tools effectively within educational settings. This review serves as a valuable resource for educators and policymakers alike, offering guidance on how AI can be integrated into educational practices to enhance learning outcomes and improve the overall quality of education. The study primarily relies on a literature review approach and fails to delve into the ethical and social implications of AI integration in education. Given the profound impact of AI on various aspects of society, including education, it is imperative to address potential ethical dilemmas and societal implications arising from its adoption in educational settings.
4. In S. Doroudi's paper titled "The Intertwined Histories of Artificial Intelligence and Education," a historical narration approach is employed to explore the interconnected evolution of artificial intelligence (AI) and education. The paper offers a comprehensive historical narrative that traces the development of AI alongside its integration into educational practices over time. By delving into this intertwined history, the research sheds light on the significant milestones, breakthroughs, and

challenges that have shaped the relationship between AI and education. This historical perspective provides valuable insights into how AI technologies have influenced and been influenced by educational processes, offering a deeper understanding of the complex dynamics between these two domains. Through its historical lens, the paper contributes to a more nuanced appreciation of the ongoing evolution and future potential of AI in education. The paper hints at the need for reinvigorating the ethos present in earlier days of AI and learning sciences research. However, it does not provide concrete insights or proposals on how this can be achieved. There is a clear research gap in exploring strategies to reintegrate foundational principles from earlier AI and learning sciences research into current educational AI endeavors, fostering a more holistic and ethically grounded approach.

5. The study titled "The Promises and Challenges of Artifcial Intelligence for Teachers: A Systematic Review of Research" I. Celik, M. Dindar, H. Muukkonen, and S. Järvelä examines how artificial intelligence (AI) is used in education by teachers. It looks at trends in teachers' AI usage, the data they provide, their roles in AI research, benefits, and challenges they face, as well as the AI techniques used. It stresses the importance of teachers' input in training AI and understanding their perspectives on AI integration. It highlights benefits like personalized feedback and reduced workload, alongside challenges such as technical limitations and infrastructure needs. The paper underscores teachers' crucial role in effectively integrating AI into education.
6. The study titled "The impact of artificial intelligence on learner–instructor interaction in online learning" K. Seo, J. Tang, I. Roll, S. Fels, and D. Yoon examines AI's impact on learner-instructor interaction in online learning, emphasizing communication, support, and presence. Through storyboards, it explores AI scenarios. While AI is perceived as beneficial for communication and support, concerns regarding responsibility and surveillance arise. The literature underscores the potential benefits and challenges of AI integration in online education, shedding light on its transformative potential and ethical considerations.
7. In their paper titled "A Study on Impact of Artificial Intelligence on Teaching and Learning- Post Covid-19" M.Balram, and V.V. Puram employed that the burgeoning impact of AI in education is evident in the visualization of personalized and blended learning experiences. However, AI in Education (AIEd) remains in its early stages, with a gap between potential and implementation in educational institutions. Machine learning and AI technologies are leveraged for data collection and performance enhancement. Automated grading, personalized learning solutions, and feedback mechanisms empower both teachers and students. Notably, AI reshapes the teacher's role, offering crucial support, especially during the Covid-19 pandemic. Future projections anticipate sustained growth in AI advancements within the education sector, with the market expected to reach $557.03 million by 2025.
8. Motlagh, N.Y., Khajavi, M., Sharifi, A., and Ahmadi, M. in their research paper titled "The Impact of Artificial Intelligence on the Evolution of Digital Education: A Comparative Study of OpenAI Text Generation Tools including ChatGPT, Bing Chat, Bard, and Ernie" examines the burgeoning role of artificial intelligence (AI) in education, focusing particularly on the utilization of ChatGPT, among other OpenAI text generation tools. ChatGPT, a generative model trained on a large dataset, offers versatile applications in education, including writing assistance and code troubleshooting. However, the integration of ChatGPT into platforms like Bing Chat has sparked criticism due to behavioral concerns. This research underscores the challenges and opportunities posed by the rise of AI in education, emphasizing the need for careful consideration. By exploring the impact of AI tools, including ChatGPT, on education and academic integrity, the study contributes to a deeper understanding of the evolving landscape of digital education.
9. In this research paper titled "The Influence of Artificial Intelligence Technology on Teaching under the Threshold of "Internet+" Y. Liu, and L. Ren investigates the impact of artificial intelligence (AI) on student performance in an online English course. Despite the gradual integration of AI in education, adoption remains slow. The study employs deep learning-based methods to personalize teaching approaches and utilizes a genetic algorithm to assess student and teacher actions. Findings indicate that AI enhances learning management and teaching effectiveness in English courses. This study underscores AI's growing influence on education, particularly in English language learning contexts.
10. In this research review titled" Impact of Artificial Intelligence on human loss in decision making, laziness and safety in education." S.F. Ahmad, H. Heesup, M.M. Alam, M.K. Rehmat, M. Irshad, M. Arrano-Munoz, and A. Arzia-Montes underscores pervasive ethical concerns in AI for education, spanning design and implementation stages. Security and privacy are paramount, given the sensitive nature of educational data. Increased human-AI interactions may lead to dependency and diminished decision-making. The profound impact of AI on human behavior, particularly laziness, is evident. To mitigate these challenges, AI systems must prioritize transparency,

ethical considerations, and safeguard human creativity and intuition, ensuring responsible and beneficial integration in educational contexts.

IV. RESEARCH SHORTFALL

The study follows a descriptive methodology and it evaluate the impact of AI on various aspects of online education, including student engagement, personalized learning, adaptive resources, and teaching support, aiming to quantify enhancements and identify areas for further improvement. The study is based on a qualitative approach using interpretative phenomenological analysis which has been developed by reviewing the existing research progress in the field of artificial intelligence in education that are mostly peer-reviewed.

- Implement a mixed-methods approach where quantitative analysis of keyword occurrences is complemented with qualitative assessments of their significance and relevance within the context of educational AI research. This can involve incorporating expert judgments or conducting qualitative interviews with stakeholders to assign deeper meaning to keyword nodes.
- Integrate ethics modules into AI education programs to foster ethical decision-making skills among students and educators. Encourage the development of AI systems that promote critical thinking and creativity rather than solely focusing on automation. Emphasize interdisciplinary collaborations between ethicists, educators, and technologists to address ethical concerns from multiple perspectives.
- Conduct empirical studies to explore the ethical and social implications of AI integration in education, including privacy concerns, bias in algorithms, and the digital divide. Encourage interdisciplinary research teams to examine these issues holistically, drawing insights from fields such as philosophy, sociology, and psychology. Foster dialogue between policymakers, educators, and technology developers to develop guidelines and regulations that ensure ethical AI use in educational settings.
- Encourage retrospectives and critical reflections on past AI and learning sciences research to identify foundational principles that can be reinvigorated in current educational AI endeavors. Foster collaboration between AI researchers and learning scientists to bridge the gap between technological advancements and educational theory. Promote the development of AI systems that align with pedagogical principles, such as learner-centred approaches and scaffolding strategies.
- Despite the emphasis on teachers' perspectives and roles in the integration of artificial intelligence (AI) into education, there appears to be a lack of comprehensive understanding regarding the specific training needs and support mechanisms required for teachers to effectively utilize AI tools in their classrooms. While the research addresses the benefits and challenges associated with AI integration, there is a gap in exploring how educators can be adequately prepared and supported to harness the full potential of AI technology in their teaching practices. Further investigation into the development of targeted training programs, resource allocation, and pedagogical strategies tailored to empower teachers in utilizing AI could provide valuable insights for enhancing the successful implementation of AI in educational settings.
- Despite the study's use of storyboards, which may restrict participants' experiences compared to direct interaction with AI systems, there's a gap in research examining diverse AI systems' actual impact on learner-instructor interaction in online learning. Furthermore, perceptions of AI could vary across disciplines, highlighting the necessity for investigating these differences among students and instructors from diverse backgrounds. Additionally, establishing clear data norms and agreements for collecting and presenting data to instructors is recognized as imperative, yet requires further investigation to ensure ethical implementation of AI in online education.
- The research paper acknowledges the growing influence of AI in education but lacks in-depth exploration of specific AI technologies and methodologies employed in educational settings. It fails to offer detailed analysis regarding the practical implementation of AI, and lacks concrete examples or case studies to substantiate claims about its impact on teaching and learning. Moreover, there's a dearth of discussion on potential challenges and ethical considerations, including biases and limitations inherent in AI systems in education. Furthermore, the paper overlooks the examination of long-term implications and sustainability of AI-driven educational systems. These gaps highlight the need for further research to comprehensively address the nuanced complexities of AI integration in education.
- The research paper's limitations reveal key gaps for further study. Firstly, it lacks detailed methodology descriptions, hindering understanding of AI's

educational impact. Additionally, insufficient discussion on biases in data collection undermines reliability. Long-term effects of AI in education receive inadequate analysis, and focus on specific models like ChatGPT may bias interpretation. Ethical implications and challenges remain unexplored. Addressing these gaps is crucial for a comprehensive understanding of AI's role in education and for fostering ethical and effective integration.

- The research paper highlights several gaps warranting further investigation. Firstly, there's a need for rigorous evaluation and validation of the proposed AI-driven methods. Secondly, reliance on simulation studies and datasets may not capture the intricacies of real-world educational environments. Thirdly, challenges in implementing the genetic algorithm in practical settings remain unexplored. Additionally, more research is needed to assess the scalability and generalizability of the findings. Finally, the paper may overlook certain constraints and complexities inherent in English test management systems. Addressing these gaps can enhance the robustness and applicability of AI in educational contexts.
- The study's focus on three primary ethical concerns—loss of decision-making, human laziness, and privacy and security—underscores a need for broader investigation into additional ethical considerations surrounding AI in education. Incorporating diverse research methodologies would enhance generalizability. Furthermore, while the study examines Pakistan and China, insights from studies across different regions are necessary for comprehensive understanding. Addressing these gaps would enrich our understanding of the multifaceted ethical implications of AI in education and contribute to more inclusive and applicable research outcomes.

V. FUTURE SCOPE OF ARTIFICIAL INTELLIGENCE IN EDUCATION

1. **Virtual Teaching Assistants-** AI-driven chatbots and virtual assistants will support educators by handling routine queries, providing instant support, and facilitating discussions, allowing teachers to focus on more personalized interactions with students.
2. **Personalized Learning Paths-** Carnegie Mellon University's tool, Open Simon, stands out as a robust exemplar in this domain. It delves into student data to offer personalized, real-time feedback derived from both academic performance and behavioral patterns. This amalgamated data trains an algorithm, enabling it to forecast the most efficacious learning activities or interventions tailored to each student.

As these tools evolve, their capabilities surge. They are swiftly progressing from mere predictors and recommenders to creators of interventions, dynamically generating personalized content and activities in response to real-time data. Envisioning the near horizon, educators might find a significant portion of their role encompassing a blend of data scrutiny and student mentoring.

3. **Adaptive Assessments-** AI-powered assessment tools will offer real-time feedback, gauging student progress and identifying areas needing improvement. These systems will move beyond standardized testing to provide more comprehensive evaluations.
4. **Automated Essay Grading-** Machine learning algorithms have ushered in a new era of automated essay grading. Platforms like Gradescope and E-rater utilize these algorithms to assess essays, evaluating elements like grammar, coherence, and organization. This technological advancement not only saves valuable time for educators but also offers students prompt feedback on their written work.

These tools are evolving rapidly, gaining prowess to appraise compositions based on intricate parameters such as critical thinking, analytical aptitude, and originality. It's foreseeable that in the near future, educators may find themselves less burdened by the administrative task of grading and more focused on the artistry and scholarly aspects of teaching, learning, and research.

5. **Lifelong Learning and Reskilling-** AI-powered platforms will facilitate continuous learning, offering skill-based courses and adaptive learning pathways to support individuals in upskilling or reskilling throughout their careers.
6. **Intelligent Tutoring Systems-** Among the intriguing advancements in AIED tools, "intelligent tutoring systems" or, as some may call them, teacher bots, emerge as compelling yet potentially daunting innovations for educators like myself.

These systems, exemplified by Georgia Tech University's Jill Watson, utilize machine learning to adapt to individual student needs. Unlike personalized learning pathways, these systems engage students through dialogue-based interfaces, offering tailored academic and social-emotional feedback and support.

Jill Watson gathers data on student performance during interactions, leveraging reinforcement learning algorithms to predict the most effective learning interventions for each student. Notably, these systems excel in providing personalized attention and feedback, a significant advantage, especially in larger classes where individualized instruction is challenging.

Moreover, the versatility of these tutoring systems extends beyond academics. Georgia Tech has crafted versions of Jill that specialize in academic support and social-emotional assistance, empowering educators to connect with students on various levels.

Recently, Georgia Tech introduced "Agent Smith," allowing academics to develop their personalized versions of Jill using their unique resources. This development hints at a future where educators delve into understanding, constructing, and validating machine learning algorithms to amplify their teaching impact on a broader scale.

7. **Ethical and Responsible AI Use-** As AI becomes more integrated into education, there will be a focus on ethical considerations, ensuring data privacy, preventing bias in algorithms, and teaching students about responsible AI use.

VI. CONCLUSION

In this investigative study, we endeavor to deliver a comprehensive understanding of artificial intelligence. AI emulates the functions of the human brain, engaging in problem-solving akin to human cognition. Its role lies in comprehending issues and seeking solutions, mimicking human problem-solving approaches. This correlation is vital as it directly impacts the educational prospects of students in higher academia. The influence of artificial intelligence extends to shaping the caliber of learning methodologies and objectives in advanced education. Within the sphere of online learning, the interaction between the learners and instructors holds significant sway over students. It is crucial to ascertain how AI systems affects this interaction, identifying any gaps, challenges or barriers that hinder these systems from realizing their intended potential and jeopardize the safety of these interactions.[15]

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