

A COMPREHENSIVE OVERVIEW OF ARTIFICIAL INTELLIGENCE (AI) IN EDUCATION

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Abstract:

In today's era as Education constitutes an essential development standard for individuals and societies, researchers have been exploring the use of Artificial Intelligence (AI). In this paper we focus on how new trends of AI use in education fields. In order to provide a detailed overview of the efforts, this article pays particular attention to these developments by high-lighting key application areas of data-driven development. In addition to this we also incorporate data analysis for decision making, various learning processes in education where they make use of AI. AI in Education; it also analyses existing tools, research trends, as well as limitations of the role data-driven AI can play in Education. The article also provides detailed analysis to highlight the salient research trends in AI in Education and also provides detailed platforms developed as the outcome of research and development.

Keywords: *Personalized Learning , Data Analysis for Decision-Making, Facilitating Collaborative Learning, Professional Development for Teachers, Adaptive Learning Platforms, Sentiment Analysis in Education*

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Introduction:

In the modern world, Artificial Intelligence (AI) is revolutionizing the way humans live their lives. Similar to other domains, the field of education is also going through a paradigm shift through the use of AI, which can be used to unleash insights about understanding how students learn, how to personalize the learning experience of students, how to get more information to help in the decision-making process, how to model the complex interaction between student learning, the knowledge domain, and the tools that enable students to interact with the domain. AI can be useful in addressing education-related challenges that are rooted in both the inadequacy of the traditional way of teaching the current generation and the complexity of the educational system itself. Over the past decade, the

role of AI in learning has been on the radar of education institutions, government agencies, funding agencies, and industry. It is expected to grow by more than 47% from 2018 to 2022 in the US Education Sector based on the AI Market . We use the term AI broadly as an umbrella term that subsumes methods, algorithms, and systems that learn from data (data science, statistical learning, machine learning, deep learning) or aim to create machine intelligence that can perform tasks such as perception, reasoning, inference (such as expert systems, probabilistic graphical models).

The AI techniques in education can be broadly divided into two different categories, namely (i) representational/knowledge-based AI, and (ii) data-driven AI . The knowledge-based AI algorithms aim to employ human experts' knowledge in decision making,

such as rule-based systems. The majority of the efforts in the previous decade were based on knowledge-based AI. However, recently the trend shifted towards data-driven techniques. In this paper, we focus predominantly on data-driven AI techniques in education and review the recent efforts made in the domain with a particular focus on applications and tools.

There are three main roles for AI in education including assisting (i) individual students,

(ii) the whole class, and (iii) the whole cohorts of students. At the individual level, the focus is more on adapting teaching methods and approaches to a particular learner's needs.

On the other hand, at the class-level, AI aims to help teachers in managing a whole class instead of individual learners. Some key applications of AI in the classroom include tutoring, grading, and Virtual Reality (VR) based learning to improve the teaching and learning experience in a classroom via an effective teacher and AI collaboration. At the cohort-level, AI aims to analyze learners' interaction with the systems and tune the learning system based on the failure and success of learners' interaction with the system. Some key applications at the cohort-level include identification of learners at the risk, learners' interests, behavior, performance, and dropout prediction. Different research communities have taken different approaches to the use of data-driven methods for addressing educational problems at different levels. For instance, the data mining research community addresses educational research problems using a big data approach while AI communities address research problems focusing on algorithms and methodologies as part of their efforts towards the development of interactive and adaptive learning environments. Although these fields are overlapping, these communities tend to develop distinct research areas as they have had different research histories. The

Knowledge Discovery and Data Mining (KDD) research community aim to discover patterns and extract knowledge through data mining techniques. The Educational Data Mining (EDM) community attracts interdisciplinary scientists from computer science, education, psychometrics, and other fields to analyze data acquired from the educational environment and apply data mining techniques to solve educational challenges.

1. Personalized Learning:

AI technologies help to analyse students' learning patterns, strengths, and weaknesses to provide personalized learning experiences. This tailored approach helps students grasp concepts more effectively and progress at their own pace.

such as:

1.1 Adaptive Learning Platforms:

AI-powered adaptive learning platforms can adjust content difficulty based on individual student performance. This ensures that students are appropriately challenged and receive targeted support where needed.

1.2 Increased Accessibility:

AI can improve accessibility to education by providing tools for language translation, transcription services, and other assistive technologies. This helps students with diverse needs and backgrounds to access and engage with educational content.

1.3 Support through Virtual Assistants:

AI-driven virtual assistants and chatbots can offer instant support to students, answering questions, providing clarification, and guiding them through assignments. This additional assistance can enhance the learning experience and promote independent problem-solving skills.

1.4. Enhanced Engagement with Interactive Content:

AI enables the creation of interactive and engaging learning materials, such as simulations, virtual reality

experiences, and gamified content. These resources make learning more enjoyable and can enhance students' understanding of complex concepts.

1.5.Skills Development:

Exposure to AI technologies can help students develop skills that are increasingly valuable in the modern workforce, such as critical thinking, problem-solving, and digital literacy. Familiarity with AI tools can prepare students for the evolving job market.

1.6.Efficient Feedback and Assessment:

AI can automate the grading process, providing quicker and more detailed feedback to students. This timely feedback allows students to understand their mistakes, make corrections, and improve their performance.

Data Analysis for Decision-Making:

AI can process vast amounts of data to generate insights into student performance and learning patterns. Teachers can use this information to make data-driven decisions, identify areas for improvement, and implement targeted interventions. AI technologies can be used to develop interactive and engaging learning materials, including simulations, virtual reality experiences, and gamified content. These resources can make learning more enjoyable and effective. AI-powered language translation tools can break down language barriers, making educational content more accessible to students from diverse linguistic backgrounds. This promotes inclusivity and ensures that a broader range of students can benefit from the educational materials.

Facilitating Collaborative Learning:

AI can support collaborative learning environments by providing tools for online collaboration, facilitating group projects, and encouraging communication among students in virtual spaces.

Professional Development for Teachers:

AI can assist in identifying areas where teachers can enhance their skills by analyzing their teaching methods and suggesting personalized professional

development opportunities. Educators need to be mindful of the ethical implications of AI in teaching, including issues related to data privacy, bias in algorithms, and the potential for exacerbating inequalities. Training programs should address these concerns to ensure responsible AI integration in education.

Customized Career Guidance:

AI tools can assist students in exploring career paths based on their interests, strengths, and skills. This personalized guidance can help students make informed decisions about their educational and career journeys. Students should be educated about the ethical implications of AI, including issues related to data privacy, bias in algorithms, and responsible use of technology. This promotes digital citizenship and ensures that students are aware of the societal impact of AI.

Sentiment Analysis in Education:

Sentiment Analysis attempts to improve the learning process by analyzing students' feedback to better understand their opinion and make adjustments to the content or delivery of the learning material accordingly. Sentiment Analysis plays a significant role to account for the effects of social media as a platform for airing students' opinions of the learning process; a major metric in the assessment of learning. From a MOOCs perspective, assert the valuable insights of Sentiment Analysis in student feedback while at the same time highlighting the great difficulty in assessing their feedback about the learning process with human intervention. Hence they propose an Aspect-Level Sentiment Analysis framework specifically aiming to highlight polarity in student feedback about MOOCs. Liu et al. argue that the "temporal nature" of student feedback in MOOCs environments stipulates that students' emotions and learning activities be tracked for understanding learning requirements. To classify emotional aspects of students, the authors propose a

Temporal Emotion-Aspect Model (TEAM) which tracks emotions over time with two main outputs: a) aspect probabilistic distributions that are emotion-specific and b) their time-based evolution, which uncovered emotional salient student emotions as well as their evolutionary trends. The results indicated that: (i) content-related aspects were the main emphasis with higher likelihood to confused or negative emotions; (ii) there were higher likelihoods of emotional expressions at the start and end of a semester; (iii) under-achieving students were less active in emotional engagement and tended to express more confusion towards the end of a semester when compared to high-achieving and medium-achieving students.

Conclusions:

In this paper, we have reviewed applications of data-driven AI in the education sector from different perspectives. On the one side, we provided a detailed overview of the existing tools and applications developed as a result of the efforts of the AI community in education. AI will facilitate global collaboration by overcoming language barriers. Advanced translation tools will enable seamless communication and collaboration among students, educators, and researchers from diverse linguistic backgrounds.

AI for Skill Development: AI-driven platforms will continue to support skill development by identifying in-demand skills and offering personalized learning pathways. This can help students align their education with evolving workforce needs.

AI in Research: AI will be increasingly used in research endeavors, aiding researchers in data analysis, literature reviews, and experimental design. Machine learning algorithms can assist in identifying patterns and generating insights from vast datasets.

Ethical AI Education: Given the ethical considerations associated with AI, there will likely be an increased emphasis on educating students and educators about the responsible and ethical use of AI. This includes

understanding biases, ensuring data privacy, and addressing the societal impacts of AI.

Continuous Professional Development for Educators: AI will support educators in their professional development by identifying areas for improvement, recommending relevant training, and providing ongoing support to enhance teaching skills.

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