PROFESSIONAL PRACTICE

Exploring the impact of Artificial Intelligence and Machine Learning in Education: Challenges and Solutions.

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Abstract

Combining Artificial Intelligence (AI) and Machine Learning (ML) in teaching and learning in the education system is rapidly transforming the whole learning process with innovative procedures. These technologies improves individualized learning, systematize administrative tasks, and enhance educational outcomes. However, their adoption also introduces a range of challenges, including ethical issues, social inequalities, legal concerns, and sustainability issues. This study evaluates the effect of Artificial Intelligence and Machine Learning on education, examining the challenges that arise from their use and proposing creative solutions. It accentuates the need for a balanced and inclusive approach to ensure that Artificial Intelligence and Machine Learning technologies can be applied effectively and responsibly in educational settings. The study concludes with recommendations for future research and pragmatic solutions.

CHAPTER 1

1.1 INTRODUCTION

In a constantly changing. society, individuals need to develop the skills that will allow them to thrive in the workplace and successfully lead organizations. The development of artificial intelligence and machine learning has greatly charged the educational world, giving students enhanced skills and providing a synergistic learning environment (Kuleto et al., 2021) .Historically, deliberations regarding the skills that primary and secondary education should cultivate generally departed from three basic principles: (a) delivering a common culture; (b) promoting socialisation in a common framework; and (c) giving both those at the top, as well as those at the bottom of the social groups, a sense of social integration. However, today's most high-stakes professions require skills that have not typically been a fundamental part of primary or secondary education, such as problem-solving, critical thinking, creativity, collaboration, and communication. Artificial intelligence and Machine learning have accumulated substantial interest in the educational system (Rejeb et al., 2024). The adoption of artificial intelligence in education is fast gaining ground with 77.6% of schools in China already adopted AI in their learning process and 46% of school Districts adopting it in USA as of 2021 (Dönmez, 2024). Rapid development in technology, namely data availability, increasing computational capabilities, advanced theoretical approaches etc have unmasked the possibilities of using data in an endless array of subjects. More specifically, education hinges on big data, artificial intelligence, machine learning, internet of things, augmented reality, virtual reality, robotics etc. Data science, characterized by the development of effective and efficient algorithms capable of finding structure in large and diverse databases, has been greatly enhanced by the availability of extensive databases. The use of artificial intelligence and, in particular, machine learning to detect patterns in extensive databases of educational data to develop important features for predicting educational outcomes is building steam. With the grow in the quantity and quality of information in the

education system comes an increase in our proficiency to predict students' academic outcomes. By gaining new insights into large educational data sets, we can substantially improve educational technology, remodel education systems, and support technologies that meet individual students' needs and expectations not only at the content level but also in respect to the learning process itself. The creation of strong models to find the best possible outcomes may help convert identified causes into actionable policies, supporting the success of the institutions and the well-being of the students. Artificial intelligence and machine learning in education is a changing integrated sphere unifying artificial intelligence technologies to remodel and enhance teaching and e-learning environments (Almasri, 2024). In this digital era, both artificial intelligence and machine learning are making their place in almost all aspects of our lives. The educational system is significantly impacted by the recent advancements in artificially intelligence and machine learning techniques. The increasing use of huge e-learning platforms in higher education along with a rapid increase in independent e-learning courses in different domains like STEM, medical, social sciences, commerce, law, and arts, is facilitating the process of learning.

1.2 BACKGROUND STUDY

Since its 'birth' at the 1956 Dartmouth Conference, the field of artificial intelligence (AI) has continued to attract the interest of industries (Pedro et al., 2019) .The use of artificial intelligence in the educational system can be traced to several decades ago, with early studies on learning support and expert systems built to model the skill of human educators. The impactful significance of artificial intelligence and machine learning in the educational system cannot be overemphasized. However, there are concerns that if not properly attended to, will have negative effects on the educational structure. One of the concerns focuses on artificial intelligence spreading bias and discrimination in education procedures and research (Kooli, C., 2023). Due to the unique structure of artificial intelligence and machine learning modelling with respect to data, the safety of students information and data privacy poses

concern (Rizvi, 2023). Despite the benefits of artificial intelligence and machine learning in education, there have been concerns ranging from ethical, social, legal and sustainability issues in balancing its responsibly usage in the educational system without altering the learning structure of the system especially in assessing student performance.

By analyzing existing literature and case studies, this study aims to present a comprehensive overview of the current landscape of artificial intelligence and machine learning in education with respect to bias, discrimination and safety of data and highlight key areas for creative problem solving and further exploration.

CHAPTER 2 : CRITICAL ANALYSIS OF ISSUES

2.1 ETHICAL ISSUES

The use of artificial intelligence and machine learning in education raises some ethical concerns with respect to data privacy, procedural transparency, and fairness. One of the high profiled ethical concern is the collection and use of individual data. Artificial intelligence and machine learning systems in education rely on large datasets that include sensitive information such as student demographics, academic performance, behavioral patterns, and even biometric data. The use of such data without adequate protection or informed consent can lead to privacy breach, violating GDPR data privacy regulations.

Some of the ethical issues are;

1) Bias and Discrimination
2) Privacy and data protection
3) Transparency in decision making

2.1.1 Bias and Discrimination: This is a very sensitive ethical issue in the context of AI and ML as the systems are only as unbiased as the data they are trained on. If the data exhibit bias of any form (e.g., racial, gender, socioeconomic), it will reflect in the decision of the AI (Opesemowo and Ndlovu, 2024). A practical example was In 2020, during the COVID-19 pandemic, the UK government implemented an AI-based grading system to replace traditional exams for GCSEs and A-levels and the outcome was the excessive downgrade of students from schools in disadvantaged areas because the algorithm was discovered to be bias against students from schools with history of low performance (Smith, 2020).

2.1.2 Privacy and Data Protection: Compliance with data protection regulations such as the General Data Protection Regulation (GDPR) in the EU or the Family Educational Rights and Privacy Act (FERPA) in the U.S is another important concern under ethical issues. However, many AI systems are not transparent about how data is collected, processed, and stored,

raising concerns about surveillance and data misuse. Students and their families may not fully understand how their data is used, making it challenging to ensure informed consent. A practical example was the "Google for Education" issue in 2021 where several privacy groups raised concerns about the data collection practices of Google's AI-powered tools in schools, particularly through its *Google for Education* suite, which includes tools like *Google Classroom* and *Google Drive*. It was discovered that google used those data to improve its AI algorithm and advertising models without the consent of those involved (Lossec,and Millar, 2021).

2.1.3 Transparency in Decision-Making: AI and ML systems often execute as black boxes. In this situation, the decision making processes behind the algorithms are not always clear or explainable. This lack of transparency makes it difficult for stakeholders to understand how AI systems arrive at particular decisions. The cloudiness in the educational system can be disadvantageous, especially if AI is used to assess student performance or recommendations.

2.2 SOCIAL ISSUES

AI and ML have some social impact in education with respect to equity, accessibility and digital divide. Although they have significantly enhanced education, but the benefits are not distributed fairly.

2.2.1 Digital divide

Technologies like computers, Tablets and internet connection are needed to access AL and ML but unfortunately some areas like rural and disadvantaged areas lack access to these resources. A practical example is the Zearn online program used by many schools. It was observed that children in higher-income households are more likely to have access to electronic devices (computer, laptop, or tablet) and high-speed interne than those from low income households (Bansak and Starr, 2021).

2.2.2 Impact on educators employment

Automating tasks originally handled by educators such as grading and other assessment task can lead to job displacement. While AI and ML can create a more enhanced learning platform for students, there is concern that excessive dependent on it may reduce the need for human input in education thereby cutting short educators employment and leading to high job displacement.

2.2.3 Social interaction and emotional intelligence

The issue of social interaction is another major concern in the area integrating AI into the education system. Education is not just about acquiring academic knowledge, it also involve developing social and emotional skills. Although AI is helpful in learning, it cannot reproduce the natural connection between teachers and students. There is concern that an over dependence on AI and ML can devalue the importance of face to face interactions, which are very important for students' emotional and social development.

2.3 LEGAL ISSUES

It is very important to address the legal issues surrounding the use of AI and ML in education is order to maintain a balance in the use of these technologies in education.

2.3.1 Data Privacy Laws

 Data privacy is central to AI in education. While collecting, processing, and storing data on students and employees, educational institutions must comply with laws and regulations such as the General Data Protection Regulation (GDPR), the Family Educational Rights and Privacy Act (FERPA) among others. The use of AI and ML should put into consideration these regulations to avoid violating data protection rules. A practical example of this issue can be traced to google that uses their educational online platforms to collect students data and use them in enhancing their models without consent (Krutka, Smits and Willhelm, 2021).

2.3.2 Compliance with Computing codes of conduct

Compliance with professional computing codes of conduct such as the Association of Computing Machinery (ACM), the British Computing Society (BCS), among other in the use of AI and ML by educational institutions is very crucial to help implement its effective contribution to the society as these ethical regulations advocate for inclusivity so that the benefits of AI technology can be enjoyed by all

2.3.3 Intellectual Property (IP) - Copyright, Patents and Trademarks: Another legal issue has to do with the ownership of materials created by AI and ML. AI tools used in education often produce educational materials, evaluations, and even curriculum recommendations. The question of who owns the rights to these contents—whether it is the institution, the developers of the AI system, or the students themselves is a complex issue that requires clear legal guidelines.

2.3.4 Liability and Accountability: The issue of liability and accountability is also crucial in this context. There have been situations where bias algorithms led to bad decision making by AI and ML in students performance assessments, recommendations, etc The question now is, who is to be held responsible for the erroneous decisions make by AL and ML. Legal structures should be developed to decide accountability for AI-influenced decisions, especially when they affect students' academic progress or future opportunities.

2.4 SUSTAINABILITY ISSUES

No doubt, AL and ML propel improvement in education, enhancing personalized learning environment, but the issue of long term feasibility and environmental impact with respect to energy consumption and emission of carbon remain concern in effectively balancing the integration of these technologies in education.

2.4.1 Long term feasibility

AI and ML technologies need steady sustenance and improvement to be impactful such as software upgrade, model retrain and providing compatibility framework with existing and new technologies. For schools with insufficient funding, the challenge of AL and ML maintenance can become unmanageable.

2.4.2 Environmental Impact

With the campaign for green technologies, it is necessary to review the environmental impact of AI and ML since training and deploying AI and ML in wide range leads to high energy consumption resulting to carbon emission. Education institutions should evaluate the effect of this issue against its benefits and facilitate framework to promote green technologies.

CHAPTER 3 : CREATIVE PROBLEM-SOLVING SOLUTIONS

3.1 RATIONALE FOR SOLUTION

From the above review of some of the issues associated with AI and ML in education ranging from ethical to social, legal and sustainability in chapter two of this study, it is crucial to come up with multi-dimensional strategic pragmatic approach to mitigate the effect of these challenges. The solutions should balance technological innovation with ethical considerations, social equity, legal compliance, and environmental conservation. By implementing AI and ML responsibly in education, institutions can ensure that these technologies provide maximum benefits while minimizing their risks.The justification for choosing a multi-dimensional pragmatic approach is because the issues associated with the use of AL and ML in education are real life problems that require qualitative and quantitative evaluation

3.2 APPROACH AND FRAMEWORKS TO EMPLOY

3.2.1 Data Governance and Privacy Protection: Establishing strong data governance system is essential to ensure that students data are handled securely and transparently. Institutions should adopt clear data protection policies, ensure informed consent, and implement strong pseudonymisation of data which involves replacing personally identifiable information with unique pseudonyms. It is advisable to retain a separate secure mapping between pseudonyms and original data for later re-identification and keep it confidential if needed. Also, periodic review of AI and ML systems and the data they collect can also help maintain privacy standards and compliance

3.2.2 Transparency models and predictions.

Educational institutions should put in place explainable frameworks to decipher the operation of the black box alongside its process and make the decisions and predictions of AI and ML systems understandable to human. This can be achieved by opting for simpler and more transparent algorithms like the decision trees where decisions can be easily understood.

3.2.3 Bias Mitigation: In order to deal with algorithmic bias, AI and ML systems used in education should be subjected to frequent testing for fairness and inclusivity. Program developers should use diverse datasets that consider the experiences of a wide range of students, and AI and ML models should be trained to recognise and mitigate biases. Collaboration with educators, ethical theorists, and community groups can help ensure that AI and ML systems are designed to promote fairness and equity.

3.2.4 Closing the Digital Divide: Governments and educational organizations should fund projects that focus on closing the digital divide by ensuring that all students have access to the necessary technology and internet connectivity by providing low-cost devices, offering subsidised internet access, and building learning infrastructure in rural and disadvantaged areas. Furthermore, compliance with the code of conduct of Association of Computing Machinery (ACM) under the general ethical principles which advocate for the needs of those less advantaged to be given attention, in addition to the British Computing Society code of conduct under public interest which states that equal access to the benefits of IT should be promoted among others should be given ample consideration to address this issue.

3.2.5 Teacher Training and Professional Development: AI should be seen as a tool that complements, rather than replaces, the role of teachers. To ensure successful implementation, educators should be provided with training on how to use AI effectively in the classroom. Teachers should be involved in the design and deployment of AI and ML systems to ensure these tools align with academic objectives and enhance the learning experience.

3.2.6 Legal Frameworks for AI and ML :To address this issue, Governments and educational institutions should work together and establish well defined legal frameworks to regulate the use of AI and ML in education and implement the copyright, designs and patents Act 1988 for proper regulation alongside the Intellectual Property Rights (IPR) legislation. These structures should address data privacy, intellectual property, liability, and accountability,

ensuring that AI and ML technologies are used responsibly and that legal rights are protected.

3.2.7 Environmental Sustainability: In order to address the issue of environmental impact of AI and ML, educational institutions should focus on energy-efficient technologies, promote green technologies by minimising the carbon emission of AI systems. Sustainable practices in the development and deployment of AI systems should be integrated into the long-term planning of educational institutions.

3.3 UNSUITABLE PARADIGM

The perception of small institutions thinking that AI and ML technologies are meant for big institutions, therefore should not be integrated into their operational tasks is an unsuitable paradigm that should be address. Another ineffective approach for AI and ML in education is treating these technologies as a replacement for human educators rather than complementary tools. While AI and ML can support individualized learning and automate administrative tasks, it cannot replace the critical role of teachers in developing emotional intelligence, social skills, and tutoring. In addition, a limited perspective on technological proficiency without considering ethical, social, legal and sustainability implications could lead to detrimental results, leading to reduced trust in AI and ML systems.

CONCLUSION

The use of AI and ML in education presents significant opportunities to enhance learning experiences, improve educational outcomes, and streamline administrative processes. However, the challenges of ethics, social equity, legal compliance, and sustainability must be carefully addressed to ensure that these technologies are used responsibly. By embracing a holistic and inclusive approach, educational institutions can maximize the benefits of AI and ML while minimizing their risks. The solutions proposed in this research

offer a framework for the responsible integration of AI and ML in education, ensuring that these technologies contribute to a more equitable, transparent, and sustainable future for education worldwide. Furthermore, I intend to advocate for accessibility to AI and ML technologies for those in disadvantaged areas in order for all to benefit from the dividends of AI learning platforms by leveraging on the professional computing codes of conduct of regulatory bodies like ACM, BCS and others to see to it that inclusivity is adhered to.

Reflective paragraph

- Link to Github account - https://github.com/Gentony01
- Link to LinkedIn Profile - www.linkedin.com/in/anthony-ogunna-023a79150
- Certifications to pursue - Associate Certified Analytics Professional
                 (aCAP)
                 Microsoft Certified: Azure Data Scientist
                 Associate

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