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ENHANCING HUMAN KNOWLEDGE AND CAPABILITIES WITH ARTIFICIAL INTELLIGENCE TOOLS FOR EDUCATION

РОЗВИТОК ЛЮДСЬКИХ ЗНАНЬ І ЗДІБНОСТЕЙ ЗА ДОПОМОГОЮ ІНСТРУМЕНТІВ ШТУЧНОГО ІНТЕЛЕКТУ В ОСВІТІ

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ABSTRACT

This study explores the different ways Artificial Intelligence (AI) tools bolster human knowledge and boost intellectual and creative efforts within the educational sector. It provides a broad examination of AI's potential to enhance educational processes and outcomes while also assessing the ramifications of AI-driven creative destruction on the job market encompassing both job displacement and

У цьому дослідженні розглядаються різні способи, якими інструменти штучного інтелекту (ШІ) зміцнюють людські знання та стимулюють інтелектуальні та творчі зусилля в освітньому секторі. Воно забезпечує широкий аналіз потенціалу ШІ для покращення освітніх процесів і результатів, а також оцінює наслідки творчого руйнування, спричиненого ШІ, що впливає на освітній ринок праці,

the emerging scope for new knowledge creation.

Purpose. *The study aims to explore the different ways in which AI tools enhance human knowledge and capabilities and their role in augmenting human intellectual and creative endeavours in education. By examining how AI can improve educational processes and outcomes, it highlights the potential for significant advancements. Additionally, the study critically examines the implications of AI-driven creative destruction on the job market, focusing on the education sector. This includes understanding both job displacement and the creation of new opportunities that require advanced skills.*

Methods. *This research involves a detailed analysis of various AI applications across the education domain. It employs virtual interviews with students and educators to provide detailed examples of AI's impact and reviews existing literature to contextualise these findings within broader economic implications. By focusing on the education sector, the study provides a comprehensive overview of how AI is being implemented and the outcomes of these implementations. This approach allows for a thorough understanding of both the benefits and challenges connected with AI integration.*

Results. *The study suggests that AI significantly improves data processing capabilities, leading to notable advancements in educational research and personalised learning. These improvements can facilitate decision-making and innovation. However, AI also disrupts traditional employment patterns, displacing routine jobs that are easily automated. Conversely, it creates new roles that demand advanced technical skills and continuous education, highlighting a shift in the job market toward more specialised and high-skill positions.*

Conclusion. *While AI can present substantial benefits in terms of efficiency and innovation, it poses significant challenges in the form of job displacement. To manage these transitions effectively, strategic responses from policymakers and educational institutions are essential. These strategies should aim to ensure equitable access to AI's benefits and support workforce adaptation. By fostering a*

охоплюючи як переміщення з роботи, так і нові можливості для створення нових знань.

Мета. *Дослідження має на меті вивчення різних способів, якими інструменти штучного інтелекту покращують людські знання, а також їхню роль у збільшенні інтелектуальних і творчих зусиль людини в освіті. Досліджуючи, як штучний інтелект може покращити освітні процеси та результати, робота підкреслює потенціал для значного прогресу штучного інтелекту. Крім того, у дослідженні критично розглядаються наслідки творчого руйнування, спричиненого ШІ, на ринку праці, зосереджуючись на секторі освіти. Це включає розуміння як переміщення роботи, так і створення нових можливостей, які потребують нових навичок.*

Методи. *Це дослідження передбачає детальний аналіз різних застосувань ШІ в освітній сфері. В ньому використовуються віртуальні інтерв'ю зі студентами та викладачами, щоб надати докладні приклади впливу штучного інтелекту, і переглядається існуюча література, щоб контекстуалізувати результати і висновки з ширшими економічними наслідками. Зосереджуючись на секторі освіти, дослідження дає вичерпний огляд того, як впроваджується штучний інтелект та які має результати. Цей підхід дозволяє глибоко зрозуміти як переваги, так і недоліки, пов'язані з інтеграцією ШІ.*

Результати. *Дослідження показує, що ШІ значно покращує можливості обробки даних, що приводить до помітного прогресу в освітніх дослідженнях і персоналізованому навчанні. Ці вдосконалення сприяють більш обґрунтованому прийняттю рішень та інноваціям. Однак ШІ також руйнує традиційні схеми зайнятості, витісняючи стандартні види роботи, які легко автоматизувати. І навпаки, це створює нові освітні ролі, які вимагають передових технічних навичок і безперервної освіти, підкреслюючи зрушення на ринку праці в бік більш спеціалізованих і кваліфікованих освітніх посад.*

Висновок. *Хоча ШІ має значні переваги з погляду ефективності та інновацій, він створює значні проблеми у вигляді переміщення робочих місць в освіті. Для ефективного управління цими переходами необхідні стратегічні відповіді з боку освітньої політиків та освітніх установ. Ці стратегії мають бути спрямовані на забезпечення справедливого доступу до переваг ШІ та підтримку адаптації робочої*

balanced integration of technological advancements and human well-being, it is possible to mitigate the negative impacts while maximising the positive outcomes of AI.

Keywords: *Artificial Intelligence, personalised learning, adaptive learning, data-driven insights, thematic analysis.*

сили в освіті. Сприяючи збалансованій інтеграції технологічних досягнень і добробуту людей, можна пом'якшити негативні наслідки, максимізуючи позитивні результати ШІ.

Ключові слова: *штучний інтелект, персоналізоване навчання, адаптивне навчання, розуміння на основі даних, тематичний аналіз.*

INTRODUCTION

– Background

Artificial Intelligence (AI) has increasingly evolved from a niche area of computer science into a cornerstone technology transforming a variety of sectors, amongst which education. Initially, AI applications were limited to basic automation and data processing, but advances in machine learning, natural language processing, and neural networks have broadened its scope considerably. Today, AI systems are capable of complex tasks such as personalised education, adaptive learning, and intelligent tutoring systems (Jackson, 2024; Luckin, Holmes, Griffiths & Forcier., 2016). The integration of AI into education has sparked a paradigm shift, leading to more interactive and efficient learning environments.

The speedy adoption of AI in education is driven by its ability to process vast amounts of data and generate insights that can significantly enhance the learning experience. For instance, AI algorithms can analyse student performance data to identify learning gaps and recommend personalised study plans (Holmes, Bialik & Fadel, 2019). Additionally, AI-powered tools like virtual labs and simulations provide students with hands-on experience and a deeper understanding of complex concepts (Potkonjak et al., 2016). These advancements have made education more accessible, engaging, and effective, benefiting both students and educators.

Furthermore, the COVID-19 pandemic has increased the adoption of AI in education, as institutions worldwide have shifted to online and hybrid learning models. AI tools have played an important role in this transition by facilitating remote learning, providing real-time feedback, and helping to ensure continuity in education. As the world moves towards a post-pandemic era, the integration of AI in education is expected to continue growing, further transforming the landscape of teaching and learning (Gligorea I, Cioca, Oancea, Gorski, Gorski & Tudorache, 2023).

– Purpose of the Study and Research Questions

The primary objective of this study is to explore the different ways in which AI tools contribute to human knowledge and capabilities, particularly in education. AI technologies have significantly enhanced our ability to generate, analyse, and apply knowledge. This study aims to provide a comprehensive analysis of these contributions, highlighting the transformative potential of AI in education. Additionally, the study will critically analyse the implications of AI-driven creative destruction on the job market within the education sector.

The study will address the following research questions:

- How do AI tools enhance human knowledge and capabilities in education?
- What are the positive and negative implications of AI-driven creative destruction in the educational job market?

By answering these questions, this study seeks to provide an understanding of the benefits and challenges of integrating AI into education. It will also offer recommendations for policymakers, educators, and institutions to harness the potential of AI while mitigating its adverse effects on the workforce.

LITERATURE REVIEW

The Literature Review section offers a detailed overview of existing research on the application of AI in education, delineating the landscape of current knowledge and identifying critical areas that warrant further investigation. This section is structured into several key parts: an exploration of the historical development and theoretical underpinnings of AI in education, an analysis of empirical studies demonstrating the impact of AI tools on learning outcomes, a review of current AI applications and their effectiveness in various educational settings, and an identification of existing gaps and challenges in the field. By systematically addressing these areas, the Literature Review sets the foundation for understanding the context and significance of the study, guiding the reader through the rationale behind the research questions and the methodology adopted.

– AI in Education

AI has been increasingly integrated into educational settings, offering tools that personalise learning, automate administrative tasks, and provide data-driven insights (Holmes et al., 2019). Studies have shown that AI-driven platforms can significantly enhance student engagement and learning outcomes by adapting to individual learning styles and paces (Luckin et al., 2016). For example, adaptive learning systems like DreamBox and Knewton tailor educational content to the needs of each student, providing a customised learning experience that can improve comprehension and retention.

Moreover, AI applications in education are not limited to traditional academic subjects. They also extend to vocational training and professional development. AI-powered virtual labs and simulations enable students to practice skills in a controlled, risk-free environment, making education more practical and relevant (Potkonjak et al., 2016). These tools help bridge the gap between theoretical knowledge and real-world application, preparing students for the demands of the modern workforce (Jackson, 2022).

Despite these advancements, the literature also identifies several challenges and limitations associated with AI in education. For instance, there are concerns about the accessibility and affordability of AI tools, particularly in underfunded schools and developing countries. Additionally, issues related to data privacy, algorithmic bias, and the ethical use of AI in education need to be addressed to ensure that AI technologies are used responsibly and equitably (Holmes et al., 2019).

– Impact on Teaching and Learning

Research indicates that AI tools can support teachers by automating grading, providing real-time feedback, and identifying students' learning gaps or needs (Gligorea et al,

2023). This allows educators to focus more on personalised instruction and support. For example, AI-powered grading systems can quickly assess assignments and provide detailed feedback, saving teachers valuable time and enabling them to concentrate on more meaningful interactions with students.

AI also facilitates differentiated instruction, which is crucial for addressing the diverse needs of students or learners. Intelligent tutoring systems like Carnegie Learning and Squirrel AI use machine learning algorithms to analyse student performance and deliver customised lessons that cater to individual strengths and weaknesses. These systems have been shown to improve student outcomes by providing targeted support and resources as explored by Holmes et al (2019).

However, the integration of AI in teaching and learning also presents several challenges. One major concern is the potential for over-reliance on AI tools, which could undermine the role of human teachers and the importance of social and emotional learning. Additionally, the effectiveness of AI in education depends on the quality of the data and algorithms used, which can vary significantly across different contexts and settings (Luckin et al., 2016). Ensuring that AI tools are transparent, fair, and inclusive is essential for maximising their positive impact on education.

– **Job Market Implications**

AI's impact on the job market within the education sector is twofold: it automates routine tasks, potentially displacing some jobs, while also creating new roles that require advanced technical skills (Bughin et al., 2018). For instance, administrative tasks such as scheduling, attendance tracking, and record-keeping can be efficiently managed by AI systems, reducing the need for human intervention. This shift may lead to job displacement for administrative staff, thereby necessitating reskilling and upskilling initiatives.

At the same time, the rise of AI in education is creating an increasing number of new opportunities for educators and technologists. The demand for professionals with expertise in AI, data science, and educational technology is growing, leading to the emergence of new career paths such as AI curriculum designers, educational data analysts, and AI ethics consultants. These roles require a combination of technical skills and educational knowledge, highlighting the need for lifelong learning and professional development (Bughin et al., 2018).

To mitigate the negative impacts of AI-driven creative destruction, it is essential to invest in training and development programs that prepare the workforce for the evolving demands of the education sector. Policymakers and educational institutions must collaborate to create a supportive ecosystem that promotes lifelong learning and prepare individuals with the skills needed to thrive in an AI-enhanced educational landscape (Gligorea et al, 2023).

METHODOLOGY

The methodology section outlines the qualitative research approach used to examine the impact of AI tools in education. This study involved conducting virtual interviews with students and educators to gain detailed insights into their experiences with the use of AI tools.

– **Data Collection**

Data collection for this study was executed through a variety of approaches involving virtual interviews and institutional data analysis. Virtual interviews were conducted with a carefully selected group of students and educators from various institutions that have implemented AI-driven educational platforms. This selection process aimed to capture a wide spectrum of experiences and perspectives on the integration of AI in educational settings. The use of virtual interviews, as highlighted by Archibald et al. (2019), offers the flexibility and accessibility required for participants spread across different geographical locations, enhancing the diversity of the sample.

The interviews were meticulously designed to delve into multiple dimensions of AI integration, encompassing its perceived benefits, inherent challenges, and broader implications for both teaching methodologies and the job market. Open-ended questions facilitated in-depth discussions, allowing participants to freely express their views and provide rich, qualitative data. This approach is supported by Brinkmann and Kvale (2015), who emphasize the value of open-ended questions in uncovering deeper insights and understanding participants' lived experiences.

In addition to the interviews, the study also incorporated an analysis of institutional records and virtual AI tool usage statistics. This dual approach of combining interview data with institutional data ensured a comprehensive understanding of how AI tools are being utilised in educational contexts. Institutional records provided concrete evidence of AI implementation through qualitative insights gained from interviews. Ethical considerations were carefully addressed throughout the data collection process. Participants were thoroughly informed about the study's objectives, and explicit consent was obtained before conducting the interviews, aligning with ethical guidelines outlined by the American Psychological Association (2017). Data privacy and confidentiality were rigorously maintained to protect participants' information and uphold the research's integrity.

– **Data Analysis**

The qualitative data gathered from the interviews were subjected to a rigorous thematic analysis to extract meaningful patterns and insights. Thematic analysis, as outlined by Braun and Clarke (2006), involves systematically identifying, analysing, and reporting patterns within data. This process began with initial coding, where significant segments of data were labelled based on their relevance to the research questions. Through an iterative process of reviewing and refining these codes, broader themes and sub-themes emerged.

The analysis revealed several recurring themes related to AI's role in education, such as personalised learning experiences, administrative automation, and implications for future job markets. For instance, personalised learning was frequently mentioned as a significant benefit of AI, with participants highlighting how AI tools tailored educational content to individual student needs and learning styles. This finding aligns with contemporary research by Holmes et al. (2019), who discuss the potential of AI to enhance personalised learning experiences and improve educational outcomes.

To illustrate the findings and provide a voice to the participants, relevant quotes from the interviews were integrated into the analysis. These quotes not only exemplified the identified themes but also added depth and authenticity to the study's conclusions. The

interpretation of these findings was conducted within the context of existing literature and theoretical frameworks, ensuring that the study's conclusions were robust and grounded in empirical evidence. The use of qualitative data in the study made it possible to achieved a nuanced and holistic perspective on the transformative role of AI in education, as advocated by Creswell and Plano Clark (2017).

The use of qualitative data enabled a comprehensive understanding of how AI is enhancing educational practices and preparing students for future job markets. This methodological rigour ensures that the study's conclusions are not only supported by empirical evidence but also contribute meaningfully to the broader discourse on AI in education. By situating the findings within existing theoretical frameworks, the study bridges the gap between theory and practice, offering practical insights for educators, policymakers, and stakeholders in the educational sector.

DISCUSSION

The discussion section interprets the findings from the data analysis, highlighting both the benefits and challenges of AI integration in education. It incorporates perspectives from educators and students, examining how AI tools can enhance personalised learning, streamline administrative tasks, and provide real-time feedback. However, it also addresses potential challenges such as data privacy concerns, the need for adequate teacher training, and the risk of exacerbating educational inequalities. By integrating these diverse viewpoints, the discussion offers a balanced understanding of AI's impact on the educational landscape, emphasising the importance of careful implementation to maximise benefits while mitigating potential drawbacks.

- **Benefits of AI in Education**

AI tools enhance personalised learning, making education more accessible and tailored to individual needs. They support teachers by automating administrative tasks and providing insights into student performance, allowing educators to focus on teaching and mentoring (Holmes et al., 2019). For example, adaptive learning platforms can adjust the difficulty of lessons based on a student's progress, ensuring that each learner receives the appropriate level of challenge and support.

Additionally, AI-powered tools facilitate real-time feedback and continuous assessment, enabling students to track their progress and identify areas for improvement. This immediate feedback loop helps students stay engaged and motivated, leading to better learning outcomes. AI can also provide educators with detailed analytics on student performance, helping them identify learning gaps and tailor their instruction to meet individual needs.

- **Educator Perspectives**

An educator shared their positive experience with AI, stating, "*AI has freed up a lot of my time that I used to spend on grading and administrative tasks. Now, I can focus more on student interactions and personalised instruction*." This sentiment reflects a significant shift in the teaching landscape, where the integration of AI technologies has alleviated the burden of time-consuming duties. By automating tasks such as grading and attendance, AI allows educators to allocate more of their time to engaging directly with students. This increased availability enhances the quality of education, enabling

teachers to offer more individualised attention and support, which can lead to better student outcomes.

Another educator expressed a similar appreciation for AI's impact on their teaching practice: "*With AI tools, I can easily track each student's progress and understand their unique challenges. This allows me to provide more targeted support and ensure that no student is left behind*." This highlights the transformative role of AI in the classroom, particularly in terms of monitoring and assessing student performance. AI-driven analytics can identify patterns and flag potential issues early, providing educators with actionable insights. This capability is crucial for addressing the diverse needs of students, allowing for timely interventions and tailored instructional strategies that cater to each student's learning style and pace. Through these advancements, AI not only supports teachers in managing their classrooms more efficiently but also plays a pivotal role in fostering an inclusive and equitable learning environment.

– **Student Perspectives**

Students also benefit significantly from the integration of AI in education. One student rema*rked, "The real-time feedback I get from AI-driven platforms helps me understand my mistakes immediately and learn from them. It keeps me motivated to improve continuously*." This underscores the value of instant feedback in maintaining student engagement and fostering a proactive learning environment.

Another student noted, "*Adaptive learning tools adjust the difficulty of assignments based on my progress, which makes learning more enjoyable and less frustrating. I feel like I'm constantly challenged at the right level*." This demonstrates how AI can create a more personalised and effective learning experience, catering to the individual needs and pacing of each student.

Overall, the benefits of AI in education are multifaceted, encompassing enhanced personalised learning, efficient administrative support for teachers, and improved student engagement and performance. AI's ability to provide real-time feedback, continuous assessment, and detailed analytics ensures that both educators and students can achieve optimal educational outcomes.

– **Challenges of AI in Education**

Despite its benefits, AI in education poses challenges such as data privacy concerns, algorithmic bias, and the need for substantial investment in technology infrastructure. Addressing these issues is essential to ensure equitable and effective use of AI in education (Taufiq-Hail et al. 2021; Holubnycha et al., 2023; Kostikova et al, 2024; Chetveryk & Veretiuk, 2024). Data privacy concerns arise from the vast amounts of personal information collected by AI systems, which can be vulnerable to breaches and misuse.

– **Data Privacy Concerns**

One major challenge is ensuring the protection of student data. As one student expressed, "While AI helps in personalising my learning experience, I am worried about the amount of personal data it collects and how it is used." This concern underscores the importance of addressing data privacy and ethical issues to build trust and ensure the responsible use of AI in education. Educational institutions must implement robust data security measures and transparent policies to safeguard personal information.

– **Algorithmic Bias**

Algorithmic bias is another significant challenge, as AI systems can inadvertently perpetuate existing inequalities and biases present in the data they are trained on. Ensuring that AI algorithms are transparent, fair, and inclusive is essential to prevent discrimination and ensure that all students benefit from AI-enhanced education (Holmes et al., 2019). An educator highlighted this issue: "AI has the potential to revolutionise education, but we must be vigilant about the biases it can introduce. We need to continuously monitor and adjust the algorithms to ensure fairness."

– **Financial Investment**

The financial investment required to implement AI technologies is also a barrier for many educational institutions, particularly those with limited resources. Ensuring that AI tools are accessible and affordable is crucial for bridging the digital divide and providing equal opportunities for all students. A student commented, "*In some schools, the lack of funding means we don't have access to the latest AI tools that could help us learn better*." This highlights the need for equitable distribution of resources to ensure that all students can benefit from technological advancements.

– **Collaboration and Policy Development**

Policymakers and stakeholders must work together to allocate funding and support initiatives that promote the widespread adoption of AI in education. Developing ethical guidelines and standards for AI in education can help address these concerns. An educator emphasized, "Collaboration between educators, policymakers, and tech developers is essential. We need comprehensive policies that not only address the ethical use of AI but also ensure its accessibility for all educational institutions."

While AI offers substantial benefits to education, it is imperative to address the challenges it brings, including data privacy, algorithmic bias, and financial barriers. By implementing robust data protection measures, ensuring algorithmic fairness, and securing adequate funding, stakeholders can foster an environment where AI contributes positively and equitably to the educational landscape.

CONCLUSION

The integration of AI tools in education significantly enhances human knowledge and capabilities, leading to more personalized and effective learning experiences. By leveraging AI, educators can tailor instruction to meet individual students' needs, identify areas where learners struggle, and provide targeted interventions that improve outcomes. These tools facilitate a deeper understanding of subject matter through adaptive learning technologies and real-time feedback, fostering a more engaging and supportive educational environment.

However, the adoption of AI in education also presents several challenges, such as ensuring data privacy, addressing ethical concerns, and bridging the digital divide. These issues necessitate the development of strategic policies and investments to ensure equitable access, maintain ethical standards, and support educators in effectively integrating these technologies. By addressing these challenges, we can maximise the benefits of AI in education, ultimately leading to a more knowledgeable and capable society.

– **Recommendations**

To harness AI's potential in education, it is essential to invest in technology infrastructure, provide ongoing training for educators, and develop policies that address data privacy and algorithmic bias. Educational institutions should also focus on continuous skill development for both students and educators to adapt to the evolving demands of the job market.

Governments and educational authorities can allocate funding for AI research and development, ensuring that schools have access to cutting-edge technologies. For example, professional development programs can equip educators with the skills needed to effectively integrate AI into their teaching practices. Establishing clear guidelines for data privacy and ethical AI use can help mitigate risks and ensure that AI technologies are used responsibly. As one educator suggested, “By investing in teacher training and technological infrastructure, we can better prepare our educational institutions to handle the integration of AI tools effectively”.

Moreover, collaborative efforts between policymakers, educators, and technology developers are crucial. As another educator emphasized, “The synergy between policy and practice is essential. Without it, we cannot fully realize the benefits of AI in education.” By working together, stakeholders can create comprehensive policies that address both the opportunities and challenges of AI in education.

– **Future Research**

Future research should focus on long-term studies to assess the sustained impact of AI in education and explore innovative AI applications that can further enhance learning outcomes. Investigating the effectiveness of various education and retraining programs in preparing the workforce for the AI era is also crucial.

For instance, longitudinal studies can provide insights into how AI tools influence student performance and engagement over time. Exploring new AI applications, such as virtual reality and augmented reality, can uncover additional ways to enhance the learning experience. Research on retraining programs can identify best practices for reskilling educators and preparing students for careers in an AI-driven world. One student noted, “Understanding the long-term effects of AI on our learning habits and job preparedness will be key to leveraging its benefits while minimising its drawbacks”.

By addressing these research gaps, future studies can contribute to a deeper understanding of the transformative potential of AI in education and provide valuable insights for policymakers, educators, and technology developers. This comprehensive approach will ensure that AI’s integration into education is both effective and equitable, maximising its positive impact while mitigating any adverse effects.

Disclaimer: *The views expressed in this article are those of the authors, based on anonymous research conducted randomly through a qualitative virtual study*.

CONFLICT OF INTERESTS

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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