From Chalk-Dusters To Code: Economic Perspectives On Ai-Driven Education In Nepal

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Abstract:

This study examined how artificial intelligence is being incorporated into Nepal's education system, a nation renowned for its digital innovation. Through case study and document analysis methods, it assessed the practical effects, economic outcomes, and strategic challenges of AI adoption. This research identified AI's potential for economic efficiency within education, while emphasizing the importance of fostering AI literacy among students and educators. Key concerns such as ethics and data privacy are explored, along with institutional strategies to address them. The paper concludes by highlighting AI's transformative role in education and the necessity of strong policy and ethical foundations to guide responsible implementation and economic sustainability.

Keywords: *artificial intelligence, education, Nepal. digital innovation, economic impact, ethics, data privacy, policy*

Introduction

Rapid technological advancements have led to notable developments across various sectors, with education being one of the key areas of impact. Artificial intelligence (AI) has played a transformative role in reshaping daily life, work environments, and educational systems. Nepal, recognized for its less technological innovation and slower the use of AI in education, is examined in this case study. The research investigated the real-world effects of AI integration in education, highlighting potential economic benefits such as cost efficiency and adaptability to shifts in the labor market. It also addressed the challenges encountered during implementation. Furthermore, the study analyzed strategic use of AI, offering insights that hold global relevance. The paper has two main goals: to demonstrate AI's potential to revolutionize education and to emphasize the importance of establishing strong legal and ethical structures to support this transition. Ultimately, the study adds to current system by proposing a detailed framework for responsible and economically beneficial AI adoption by both nations and organizations.

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Review of the scientific literature

Artificial intelligence (AI) has the potential to tackle some of the most pressing issues in today's education, revolutionize teaching and learning methods, and expedite progress. However, the rapid pace of technological advancement brings with it numerous risks and challenges that have, thus far, outpaced discussions on policies and regulatory frameworks. Chen, Chen and Lin (2020) noted that artificial intelligence pertains to the advancement of machines possessing a certain degree of intelligence. As per their statements, these machines are capable of emulating human-like functions, encompassing cognitive processes, learning, decision-making, and adaptability to the surrounding environment. Consequently, certain distinctive features and principles emerge as fundamental in the context of AI. Intelligence, or the machine's capacity to exhibit a certain level of intellect and carry out a diverse array of functions and abilities akin to those of humans, emerges as a pivotal characteristic of AI. The integration of artificial intelligence into education heralds a significant shift with far-reaching economic consequences. This literature review critically examines scholarly discourse on the subject, emphasizing the economic dimensions of artificial intelligence's educational impact.

The education sector is likely to be heavily impacted by AI, making it one of the domains that could experience significant AI-driven changes. Timms (2016) makes an interesting observation, emphasizing the formidable capabilities of artificial intelligence and its potential to deeply affect various sectors of society. It is already integrated and utilised within the field of education, contributing to enhancements across different aspects. Within the context of the narrative and framework proposed by Chassignol et al. (2018), it becomes clear that AI has been applied in education, particularly in roles related to administration and teaching, subsequently influencing and making an impact on students' learning. AI-driven education is becoming increasingly significant as educational needs undergo transformation. This evolution encompasses crucial elements such as intelligent pedagogy, ground-breaking virtual learning experiences, data analysis, and predictive capabilities. In a study by Chen, Chen and Lin conducted in 2020, the authors outlined essential use cases for integrating AI into the realm of education, along with the key technologies that support them, as detailed in Table 1. According to their findings, intelligent educational systems offer timely and customized guidance and feedback to both educators and students. These systems are crafted to enhance educational value and efficiency by leveraging various computational technologies, particularly those associated with machine learning, which closely align with statistical models and cognitive learning theories, findings previously described by Rus et al. (2013).

Table 1

Scenarios of AI Education and related techniques

Scenarios of AI education	AI-related techniques
Assessment of students and schools	Adaptive learning methods and personalized learning approaches, academic analytics
Grading and evaluation of papers and exam	Imagine recognition, computer-vision, and a prediction system
Personalized, intelligent teaching	Data mining, or Bayesian knowledge interference, intelligent teaching systems, and learning analytic
Smart school	Face recognition, speech recognition, virtual labs, A/R, V/R, hearing, and sensing technology
Online and mobile remote education	Edge computing, virtual personalized assistants, and real-time analysis

Source: Chen, Chen and Lin, 2020

Ahmad et al. (2021) delve into artificial intelligence's transformative potential in education, particularly its capacity to surmount barriers to educational access and foster innovative pedagogies. The emergence of social robots, intelligent tutoring systems, and smart learning environments are identified as key artificial intelligence applications that enhance interactive learning. The study calls for empirical research to substantiate the efficacy of artificial intelligence in education and its wider implications for the learning ecosystem. Ocaña-Fernandez, Valenzuela-Fernandez and Garro-Aburto (2019) highlight the urgency for education institutions to adapt to the information society's demands by integrating artificial intelligence. They posit that artificial intelligence's capacity to provide personalized learning experiences is crucial, necessitating the development of digital competencies. The authors argue for the adoption of artificial intelligence driven programmes to meet contemporary educational challenges, emphasizing the role of digital literacy in preparing students for the future labour market. Popenici and Kerr (2017) explored artificial intelligence's nascent role in academia, acknowledging its limitations in understanding complex human interactions but noting its growing proficiency in supporting educational infrastructure. They advocate for a nuanced appreciation of artificial intelligence's capabilities and a strategic approach to its application in education. In another vein, UNESCO (2019) underscores the value of incorporating AI technologies in education to empower human potential and protect human rights, fostering effective cooperation between humans and machines in various aspects of life, learning, and professional development, all while promoting sustainable progress. In conjunction with partners and international organisations, the organization seeks to fortify its leadership role in the realm of AI in education.

During the International Forum on AI and Education in 2022, participating countries presented their national strategies, which emphasized the active integration of AI

into their education systems (UNESCO, 2022). They also highlighted the challenges associated with current technologies, the need for stronger evidence of their effectiveness, the significant role of the corporate sector, and investment in driving AI integration in education. These contributions underscored the importance of promoting extensive international and intersectoral collaboration and opportunities for reflection to better understand the implications of AI integration in education. Additionally, they accentuated the necessity for forward-thinking strategies to prevent AI adoption from perpetuating inequalities. The key to successfully navigating this transformation lies in the design and implementation of unbiased AI systems that are responsible for addressing the needs of all educators and learners. This approach has the potential to elevate education and humanity to new heights.

Collectively, these studies underscore the need for a robust economic analysis of artificial intelligence in education. They suggest that artificial intelligence's role extends beyond pedagogical enhancement to include economic benefits such as cost savings and labour market readiness.

The policy implications arising from these studies are significant. Policymakers must consider how artificial intelligence integration aligns with broader economic objectives, such as workforce development and innovation promotion. The findings also highlight the importance of continued investment in artificial intelligence research within the educational sector to ensure that its deployment is economically sound and beneficial for all stakeholders.

Research methodology

To gain a thorough understanding of the impact of artificial intelligence and information and communication technology (ICT) on the education system, this study utilized two qualitative research methods: the case study approach and document analysis.

Document analysis involves the systematic examination and interpretation of various types of documents to extract relevant and meaningful insights. This method allows for a detailed evaluation of individual texts and helps identify recurring themes across different sources. Its application is crucial for developing a deeper understanding of the broader context related to our research topic. The study analyzed a diverse set of documents, which enabled to build a solid foundation in existing literature while identifying aligned viewpoints.

The case study method offers a detailed examination of a specific real-life context. In relation to the investigation of the economic dimensions of artificial intelligence and the digital evolution of education, the case study approach enabled to closely analyze the performance of a leading education system and the effective practices it has adopted. Main focus was on the high-performing Nepalese education system exploring Nepal's cohesive and well-structured education model, which begins in early childhood and extends beyond traditional schooling hours' examined how digitalization is influencing

education in Nepal, the associated challenges, and the broader implications of these developments. The study believe the insights gained from this context can be applied on a global scale.

Given the dual aims of this paper-first, to demonstrate the influence of AI and ICT on education, and second, to advocate for the development of robust legal and ethical frameworks to support these changes-the chosen research methods are well-suited to the objectives of this study.

Results and discussion

Over the past two decades, Nepal has made significant strides toward building a digital society and is increasingly recognized for its initiatives in digital governance. Government-led efforts to attract technology investments include digital identity programmes and investments in cybersecurity, including exploring blockchain technology to protect national data assets. Digital infrastructure projects, often showcased on national platforms, highlight Nepal's growing commitment to digital innovation.

In terms of the Nepalese education system, early childhood education is available for children from 18 months to seven years of age, focusing primarily on nurturing individual development. The national government oversees the curriculum for pre-primary education, and successful completion is formally recognized, helping ensure a smooth progression into primary school.

Basic education in Nepal spans nine years and is mandatory, with alternatives like home-schooling also supported. The curriculum is strategically structured to offer general education and equip students with skills for continued academic pursuits, vocational training, or direct entry into the job market.

Nepal's higher education system follows a three-tier structure, consisting of bachelor's, master's, and doctoral programs. Certain integrated programs, particularly in fields like medicine and engineering, are also available. Universities in Nepal enjoy a degree of autonomy and exist alongside a range of public and private institutions, with Tribhuvan University standing out as one of the largest and most influential.

The incorporation of artificial intelligence and ICT in Nepal's education sector has led to practical innovations, positioning the country as an emerging leader in educational digital transformation. One notable initiative is Nepal's version of a national digital literacy programme, which aims to teach students from early grades through secondary school about coding, digital tools, and basic robotics. Such efforts reflect a comprehensive strategy to embed digital skills into the educational experience, preparing students for a future where technology is integral.

Economically, digital skill development initiatives hold significant value. By integrating ICT education at a young age, Nepal is cultivating a digitally competent workforce

capable of contributing to the evolving digital economy. This approach helps diversify the labour market and increases the supply of skilled professionals for high-tech industries. As students grow adept in leveraging technology, they are likely to drive productivity and innovation by contributing to the development of new tools, services, and solutions.

A digitally proficient population also strengthens Nepal's position as an attractive destination for foreign investment in knowledge-intensive sectors. Companies often seek to operate in countries where a skilled workforce is readily available, particularly in industries driven by innovation and technology.

The digitalization of education also enhances economic resilience. By broadening the population's skillset, Nepal can mitigate the impact of economic disruptions that affect traditional sectors. Furthermore, early exposure to digital tools contributes to long-term economic growth. As digitally literate students advance into professional roles, they can implement technological solutions across various sectors, improving operational efficiency and fostering institutional growth.

Such initiatives represent strategic investments in Nepal's human capital, with the expectation of future economic returns. These forward-looking policies could serve as valuable models for other nations seeking to modernize their education systems through AI and ICT.

Despite these advancements, several challenges remain. The ethical implications of AI in education, such as algorithmic bias, discrimination, and digital inequality, are critical concerns. Nepal is working toward ensuring fairness and inclusivity in AI applications by developing systems that minimize biased outcomes and promote equal opportunities. This includes carefully monitoring datasets for bias, as imbalanced data can result in unequal access and achievement.

Another key challenge lies in updating educational content and equipping educators with the knowledge and skills to keep pace with rapid technological developments. To address this, Nepal has initiated professional development programmes aimed at enhancing teachers' competence in AI-integrated learning environments. Investments are also being made to improve digital infrastructure in schools, ensuring equitable access to the tools required for effective digital learning.

Building a robust technological foundation is essential for closing the digital divide. Efforts also include involving key stakeholders-teachers, students, and parents-in discussions about AI in education to build mutual understanding and alleviate concerns through collaboration.

Ongoing research into the effects of AI on learning is equally important to inform

future policies and ensure responsible implementation. Data privacy is another major consideration, especially in light of the large volumes of personal data processed by AI systems. To comply with data protection regulations, Nepal has introduced privacy measures that include obtaining informed consent from users, clearly communicating how data will be used, and adopting strong cybersecurity protocols.

 The rise of advanced technologies such as AI and the Internet of Things has also raised questions about the adequacy of existing legal frameworks. Unlike digital governance, these technologies require more nuanced and far-reaching regulations. Experts emphasize the need for political and economic strategies that lay the groundwork for appropriate legal standards (Chounta et al., 2022). Nepal is actively working on regulatory measures to safeguard data privacy and ensure ethical AI usage in educational contexts.

From a policy perspective, the Nepalese government faces the complex task of balancing innovation with protection. This involves setting standards for data quality, ensuring transparency in algorithmic decision-making, and monitoring the long-term impact of AI on employment trends. Policymaking must also account for the shifting demands of the labour market to keep education systems responsive to future technological changes.

The transition to a digital economy requires sustained investment in both technology and education, presenting a significant financial challenge. Policymakers must continually weigh the costs of digital transformation against the potential economic and social benefits it promises.

Conclusion

In summary, the incorporation of artificial intelligence into Nepal's education system acts as a testimony to the country's commitment to technological advancement and stands as a model for worldwide educational restructuring.

The utilization of the case study and document analysis methods in this article has shed light on the many effects of artificial intelligence in the field of education. These effects encompass a wide range of aspects, including the improvement of learning processes and the introduction of economic efficiency. The results emphasize the relevance of incorporating AI literacy into contemporary education as a core element, hence emphasizing the significance of formulating strategic policies and ensuring ethical supervision.

As Nepal traverses these domains, its encounters provide vital insights on the prudent assimilation of AI, underscoring the imperative for strong privacy safeguards and ethical principles. The insights presented in this paper shed light on Nepal's approach, offering guidance for other countries and institutions seeking to harness the potential of artificial

intelligence. By doing so, they can cultivate an education system that not only adjusts to, but also foresees, the requirements of the future job market.

The economic ramifications are evident: with the allocation of resources towards artificial intelligence and digital literacy, Nepal is not only undertaking educational reforms but also strategically positioning its economy to prosper in the digital era.

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