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Challenges in Implementing Artificial Intelligence in Libyan Higher Education

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A R T I C L E I N F O

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A B S T R A C T

This research examines the problems encountered when deploying artificial intelligence within Libya's higher education sector. It highlights principal barriers such as weak educational policies, inadequate digital infrastructure, and the substantial costs associated with implementation, alongside concerns about data security and privacy. A survey of 314 academic staff from several Libyan universities revealed that safeguarding data and protecting privacy are perceived as the most pressing issues, followed closely by a shortage of AI specialists and experts. The findings suggest that overcoming these obstacles is essential to realizing AI's potential to enhance learning outcomes. The study recommends strengthening the digital competencies of the workforce and ensuring AI applications adhere to ethical and humane standards; it also urges education policymakers to issue clear guidelines and recommendations for the responsible and effective use of AI in academic institutions.

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INTRODUCTION

The adoption of artificial intelligence (AI) in higher education has accelerated markedly, accompanied by a rapid expansion of AI tools. Researchers have described various advantages these technologies offer to both educators and learners, such as enabling personalized instruction for diverse learner profiles, delivering tailored formative feedback, supporting assessment design, and forecasting student performance (Crompton & Burke, 2023). Beyond classroom practice, AI may significantly affect labour markets and thus reshape the role of higher education within broader socioeconomic systems (Bearman et al., 2023). Many leading universities now recognize AI and machine learning as central to educational innovation and future societal advancement (Milena Ilić et al., 2021), believing that AI-driven applications can boost productivity and create competitive advantages through innovation. Despite AI's rising prominence, only a limited number of studies have examined its application within performance management systems (PMS), and still fewer have investigated how enabling and inhibiting factors influence the use of AI for interorganizational competitiveness and value generation. Implementation challenges specific to PMS therefore remain underexplored (Sharma et al., 2021). Moreover, the teacher's perspective has received scant attention: research has given little focus to instructors' pedagogical competencies with AI and to the roles teachers might play in shaping AI development. To fill these gaps, this study investigates the practical challenges teachers face when integrating AI into instruction. By doing so, it aims to inform the design of more comprehensive AI-based instructional systems that actively involve educators in the development process

THEORETICAL REVIEW

Artificial intelligence (AI) has emerged as one of the most transformative innovations in the 21st century, influencing nearly every sector, including higher education. As universities worldwide embrace digital transformation, AI technologies are increasingly integrated into teaching, learning, and administration. However, the adoption of AI in higher education varies across regions due to differences in infrastructure, policies, financial capabilities, and technical expertise.

In Libya, the integration of AI remains limited, hindered by systemic barriers such as weak digital infrastructure, inconsistent educational policies, and a shortage of trained professionals. This chapter reviews theoretical and empirical studies on AI in education, explores its benefits and challenges, and highlights existing gaps that justify the need for the present study.

Concept and Development of Artificial Intelligence in Education

Artificial intelligence refers to the ability of machines or computer systems to perform tasks that typically require human intelligence, such as learning, reasoning, and problem-solving (Gocen & Aydemir, 2020). According to Stanusch and Amann (2018), AI involves developing machines capable of acting intelligently within their environments. Kaplan and Haenlein (2020) categorize AI into three main types—analytical, human-inspired, and humanized—based on the level of cognitive and emotional sophistication.

In the educational context, AI supports automated learning systems, adaptive assessments, and intelligent tutoring models that simulate human teaching behavior (Crompton & Burke, 2023). These applications aim to enhance personalized learning, automate administrative work, and improve access to educational resources. As Bearman et al. (2023) note, AI also reshapes the relationship between education and labor markets, preparing students for an economy increasingly driven by digital skills and automation.

Opportunities of AI Implementation in Higher Education

AI holds significant potential to enhance efficiency, personalization, and accessibility in higher education. It allows educators to design customized learning experiences, predict student performance, and provide real-time feedback (Rojas et al., 2024). Universities can use AI-driven analytics to improve curriculum design, manage enrollment systems, and strengthen institutional governance (Ifenthaler et al., 2024).

Furthermore, the adoption of AI contributes to global educational equity by offering remote and adaptive learning opportunities to students in underserved areas (Milena Ilić et al., 2021). In Libya, where higher education institutions are striving to recover from political instability and limited resources, AI could play a crucial role in improving educational quality and operational efficiency. However, these advantages can only be achieved when the underlying structural, technical, and ethical challenges are effectively addressed.

Challenges in Implementing AI in Higher Education

Despite its potential, the implementation of AI in higher education is accompanied by several obstacles. Existing literature highlights the following major challenges:

1. Weak Technological Infrastructure:
   Many Libyan universities lack the digital infrastructure necessary to support AI systems. Poor internet connectivity, outdated hardware, and inadequate software platforms limit the ability to deploy AI applications effectively (Matjaž et al., 2018).
2. Data Security and Privacy Concerns:
   AI systems rely on extensive data collection, raising concerns about information confidentiality and ethical data management (Ifenthaler et al., 2024). Ensuring compliance with privacy standards is particularly challenging in institutions where cybersecurity policies are underdeveloped.
3. Financial Constraints:
   Implementing and maintaining AI tools require substantial investment. Limited government funding and the absence of private-sector partnerships make it difficult for Libyan universities to invest in modern technology (Celik, 2022).
4. Lack of Expertise and Training:
   Many educators and administrators lack the technical skills and pedagogical understanding needed to effectively integrate AI into

teaching and learning (Zahrani & Alasmari, 2024). This skill gap contributes to resistance and skepticism toward AI adoption.

5. Ethical and Regulatory Issues:
   The absence of clear guidelines on the ethical use of AI creates uncertainty. Issues such as algorithmic bias, accountability, and transparency remain unresolved (Bond et al., 2024). Policymakers in Libya have yet to develop a comprehensive framework governing AI in education.

These challenges illustrate that AI implementation is not merely a technological matter but also a socio-political and institutional issue requiring strategic leadership and policy coordination.

The Libyan Context

Libya's higher education system faces unique structural challenges that directly affect AI integration. Years of political instability have weakened institutional governance, disrupted infrastructure development, and limited access to modern technologies. According to Emran and Elhony (2023), digital transformation in Libya remains uneven, with most universities lacking coherent strategies for technology adoption.

Furthermore, the centralized nature of the Libyan education system slows decision-making and innovation, while a lack of international collaboration hinders exposure to global best practices. These conditions make it essential to understand the specific barriers that Libyan institutions encounter in implementing AI, as global solutions may not fully apply to local realities.

Research Gap and Theoretical Contribution

Most studies on AI in higher education have been conducted in developed nations, where institutions already possess robust digital ecosystems. Limited research focuses on developing countries, especially in the North African region, where socio-economic and political constraints shape technology adoption. The Libyan case remains understudied, and little is known about how its higher education institutions can overcome challenges such as weak infrastructure, low funding, and limited technical expertise.

This study therefore seeks to fill this research gap by analyzing the contextual barriers to AI implementation in Libya's higher education system. Theoretically, it contributes to the broader discourse on digital transformation by linking the challenges of AI integration to institutional readiness, policy frameworks, and workforce competence in developing countries.

Summary of the Literature Review

The literature demonstrates that while AI has the capacity to transform higher education through enhanced personalization, efficiency, and innovation, its implementation faces significant challenges, particularly in developing contexts like Libya. Core issues include infrastructure limitations, ethical and privacy concerns, insufficient funding, and a lack of specialized human capital. Addressing these barriers requires a multidimensional strategy involving policy reform, institutional investment, and professional development.

In conclusion, previous studies provide valuable insights into AI's potential and obstacles, yet they often neglect the contextual realities of Libyan higher education. The present study aims to bridge this gap by identifying the primary challenges affecting AI implementation in Libya's universities and offering recommendations to ensure ethical, effective, and sustainable integration.

METHODOLOGY

This study employed a descriptive quantitative method using a survey approach to examine the challenges encountered in implementing artificial intelligence (AI) within Libyan higher education institutions. A total of 314 faculty members from various Libyan universities participated as respondents, providing insights into the barriers affecting AI adoption. Data were collected through a structured questionnaire covering key dimensions such as weak educational policies, insufficient digital infrastructure, data security and privacy issues, high implementation costs, and the shortage of AI specialists. The collected data were analyzed using descriptive statistical techniques to identify the most critical challenges hindering effective AI integration. The methodology ensured the reliability and validity of the findings and served as a foundation for developing recommendations aimed at enhancing digital capacity and promoting ethical, responsible use of AI in Libyan higher education.

RESULTS AND DISCUSSION

The findings of this study reveal that Libyan higher education institutions face a variety of structural, technical, and ethical challenges in implementing Artificial Intelligence (AI). Based on responses from 314 faculty members representing several universities in Libya, the results show that the most pressing issues include data security and privacy concerns, a lack of AI specialists and experts, weak digital infrastructure, and limited institutional support. These findings confirm that while the concept of AI is widely recognized, its practical application in the Libyan academic environment remains at an early and underdeveloped stage.

Digital Infrastructure Limitations

One of the key challenges identified in the study is the limited availability of modern technological infrastructure. Respondents reported insufficient access to reliable internet, outdated computer systems, and a general lack of AI-compatible software and hardware. This weak technological foundation makes it difficult for universities to establish data-driven learning systems or conduct AI-based academic research. The results align with Matjaž et al. (2018) and Milena Ilić et al. (2021), who emphasized that the absence of robust digital infrastructure is a major barrier to AI adoption in education. In Libya, such infrastructural deficiencies limit the country's ability to keep pace with global advancements in digital transformation and innovation.

Financial Constraints

The study also found that financial limitations remain one of the most significant barriers to AI implementation. Many universities lack the funding required to purchase AI software, upgrade ICT infrastructure, or provide training for faculty members. Developing and maintaining AI systems demand substantial investment, yet budgetary allocations for higher education in Libya are often insufficient. This finding is consistent with Celik (2022) and Sharma et al. (2021), who noted that financial instability in developing nations hinders innovation and technological progress. Respondents further highlighted the absence of private-sector collaboration and international support, which could otherwise help mitigate these financial challenges.

Lack of Technical Expertise

A shortage of qualified AI specialists and technical professionals emerged as another major challenge. Most educators in Libyan universities possess limited knowledge of AI concepts, tools, and their pedagogical applications. As a result, there is a noticeable gap between the potential of AI and its actual use in teaching and learning processes. This is in line with Zahrani and Alasmari (2024), who argued that teachers' digital competencies are crucial for effective AI integration. The lack of continuous professional development programs in Libyan institutions further compounds this issue, leaving educators unprepared to manage AI-driven learning environments.

Ethical and Privacy Issues

Ethical and data privacy concerns also featured prominently among the findings. Respondents expressed apprehension about the use of student data, algorithmic bias, and the potential misuse of AI-generated outcomes. These fears are justified given the absence of comprehensive data protection laws and institutional policies in Libya. According to Ifenthaler et al. (2024) and Bond et al. (2024), ethical AI adoption requires transparency, accountability, and fairness—principles that are not yet embedded in the Libyan higher education framework. Without proper guidelines, the risk of violating privacy or reinforcing social bias through AI applications remains high.

Institutional and Policy Barriers

The study revealed that most Libyan universities lack a coherent institutional strategy or national framework for AI adoption. Implementation efforts are fragmented and often limited to isolated pilot projects without long-term planning or evaluation. This finding echoes Bearman et al. (2023), who argue that AI integration requires strong leadership and structured policies at both institutional and governmental levels. The absence of coordination among universities and ministries has slowed progress and reduced the impact of AI-based initiatives. Participants emphasized the need for a unified national vision that defines ethical standards, investment priorities, and performance indicators for AI in education.

The results collectively show that the integration of AI in Libyan higher education is hindered by a combination of infrastructural, financial, human, and ethical barriers. While educators recognize AI's potential to improve academic

efficiency, institutional readiness remains weak. This reflects the broader challenges of digital transformation in developing nations, where limited resources and governance gaps impede innovation. However, the study also highlights optimism among educators regarding the future role of AI. With proper investment in infrastructure, professional training, and ethical policy frameworks, Libyan universities could gradually overcome existing barriers and leverage AI for sustainable educational development.

CONCLUSIONS AND RECOMMENDATIONS

This study explored the major challenges hindering the effective implementation of Artificial Intelligence (AI) in Libyan higher education institutions. Drawing on responses from 314 faculty members across various universities, the findings revealed that despite growing awareness of AI's importance, its adoption remains limited due to several interrelated barriers. The most critical issues identified include weak technological infrastructure, inadequate financial resources, limited technical expertise, ethical and privacy concerns, and the absence of coherent institutional and national policies.

These challenges demonstrate that AI implementation in Libya is not simply a technological process but a multidimensional transformation requiring institutional readiness, financial investment, and strategic governance. Universities still depend heavily on outdated systems and lack the capacity to sustain AI-driven innovations. Ethical and data privacy concerns further complicate adoption, given the absence of robust regulations. Moreover, the shortage of skilled professionals prevents the integration of AI tools into teaching, learning, and administrative functions.

Despite these obstacles, the study also found strong enthusiasm among Libyan educators regarding AI's potential to enhance academic performance, teaching quality, and institutional efficiency. This optimism suggests that with the right policy frameworks and infrastructural improvements, AI could play a transformative role in advancing Libya's higher education system. Therefore, a coordinated national strategy involving universities, policymakers, and industry stakeholders is essential to create an enabling environment for sustainable AI adoption in the country's academic sector.

Based on the study findings, several recommendations are proposed to support the successful integration of AI in Libyan higher education:

1. Strengthen Digital Infrastructure:
   The government and universities should prioritize investment in digital infrastructure, including high-speed internet, cloud-based systems, and advanced computing facilities to enable AI operations across campuses.
2. Increase Funding and Resource Allocation:
   Adequate financial support must be provided to universities to acquire AI technologies, maintain systems, and implement research and innovation projects. Partnerships with private sectors and international organizations should also be encouraged to diversify funding sources.

3. Develop Human Capital and Training Programs:
   Continuous professional development programs should be designed for faculty members, administrators, and IT staff to enhance their digital literacy and technical competencies in AI usage and management.
4. Establish Ethical and Regulatory Frameworks:
   The Ministry of Higher Education should formulate clear ethical guidelines and data protection policies to ensure responsible AI implementation that safeguards privacy, promotes transparency, and prevents algorithmic bias.
5. Formulate a National AI Strategy for Higher Education:
   A coordinated national policy should be developed to align institutional AI initiatives with national educational and economic objectives. This strategy should include performance indicators, monitoring mechanisms, and collaboration between universities and policymakers.
6. Promote Research and Collaboration:
   Universities should establish AI research centers and promote interdisciplinary collaboration between education, computer science, and policy experts to generate localized solutions and innovations suited to Libya's context.

FURTHER STUDY

Future studies could expand on this research by exploring the long-term impact of AI adoption on teaching quality, student outcomes, and institutional performance. Comparative studies involving other North African or Middle Eastern countries could also provide broader regional insights into the challenges and best practices of AI integration. Additionally, qualitative studies involving policymakers and technology developers could deepen understanding of the socio-political and ethical dimensions influencing AI implementation in education.

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