

From Challenge to Transformation: AI Integration in Libyan Higher Education - An Analytical Review of Challenges and Proposed Integration Strategies

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من التحدي إلى التحول: دمج الذكاء الاصطناعي في التعليم العالي الليبي؛ مراجعة تحليلية للتحديات واستراتيجيات الدمج المقترحة

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Received: November 23, 2025

Accepted: January 25, 2026

Published: February 01, 2026



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Abstract:

This paper examines the key role of AI and its transformative applications in the Libyan higher education environment. Despite the numerous challenges facing the Libyan educational system, AI offers innovative solutions to improve the quality of education, enhance institutional performance, and deliver personalised learning experiences. This paper reviews various applications of AI in education with particular emphasis on adaptive learning systems, intelligent tutoring platforms, the automation of administrative processes, and educational data analysis. Based on this review, this paper proposes a practical multi-stage framework for integrating AI into Libyan higher education. This comprehensive plan includes capacity development, infrastructure enhancement, pilot project implementation, and scaling of successful initiatives. Additionally, this paper examines potential barriers to integration, such as limited financial resources, community resistance to change, privacy concerns, inadequate technological infrastructure, insufficient skilled personnel, and no existing legal and regulatory structure. To address these challenges, this paper presents strategic recommendations, including fostering public-private partnerships and investing in R&D.

This paper makes the case that adopting AI in Libyan higher education is a strategic imperative, not merely a technical option, essential for securing a prosperous and sustainable educational future.

Keywords: Artificial Intelligence, Higher Education, Libya, Digital Transformation, Educational Applications, Smart Learning, Educational Management.

المخلص

تستعرض هذه الورقة البحثية الدور المحوري للذكاء الاصطناعي وتطبيقاته التحولية في بيئة التعليم العالي الليبية. وفي ظل التحديات المتعددة التي تواجه النظام التعليمي الليبي الراهن، يقدم الذكاء الاصطناعي حلاً مبتكرة للارتقاء بجودة التعليم، وتعزيز الأداء المؤسسي، وتقديم تجارب تعلم مخصصة. وتتناول الورقة التحليل الاستخدامات المتنوعة للذكاء الاصطناعي في المجال التربوي، مع التركيز بشكل خاص على أنظمة التعلم التكيفي، ومنصات التدريس الذكية، وأتمتة العمليات الإدارية، وتحليل البيانات التعليمية.

وبناءً على هذه المراجعة، تقترح الدراسة إطاراً عملياً متعدد المراحل لدمج الذكاء الاصطناعي في مؤسسات التعليم العالي الليبية؛ تشمل هذه الخطة المتكاملة تنمية القدرات البشرية، وتطوير البنية التحتية، وإطلاق المشاريع الريادية، ومن ثم تعميم النماذج الناجحة. كما تبحث الدراسة في المعوقات التي قد تحول دون هذا الدمج، مثل محدودية الموارد المالية، والمقاومة المجتمعية للتغيير، ومخاوف الخصوصية، وتهالك البنية التحتية التقنية، ونقص الكوادر المؤهلة، فضلاً عن غياب الأطر القانونية والتنظيمية. وفي مواجهة هذه التحديات، تقدم الدراسة توصيات استراتيجية تشمل تعزيز الشراكات بين القطاعين العام والخاص والاستثمار في البحث والتطوير. وتخلص الدراسة إلى أن تبني الذكاء الاصطناعي في التعليم العالي في ليبيا لم يعد مجرد خيار تقني، بل هو ضرورة استراتيجية لضمان مستقبل تعليمي مزدهر ومستدام.

الكلمات المفتاحية: الذكاء الاصطناعي، التعليم العالي، ليبيا، التحول الرقمي، التطبيقات التعليمية، التعلم الذكي، الإدارة التعليمية.

Introduction

The global landscape is currently undergoing a profound digital transformation, driven by rapid advances in Artificial Intelligence (AI). AI is no longer a far-off concept; it is a present reality that is shaping all aspects of life, including the education sector (Ali et al, 2024). In higher education in particular, we see AI as a player which is going to bring about a great shift, not in terms of what tools and technologies are at play, but in fact in the very philosophy, goals, and results of education itself. AI technologies have the inherent ability to transform teaching and learning methods by offering innovative solutions to the traditional and current challenges that global education systems face.

In Libya, the education sector is a field that is very much in the crosshairs of significant challenges, ranging from resource scarcity and deteriorating infrastructure to the effects of long-term conflict (UNESCO,2024; Makhzoum, 2024). These issues are hindering the achievement of sustainable development goals and are largely responsible for the youth's lack of access to quality education. In this setting, AI emerges as a valuable asset that may help overcome these issues and lead the Libyan educational system towards a more promising future (Alahwal et al., 2025). Also, higher education institutions are the main players in knowledge production and in developing human capital, which is key to social progress. In a global economy founded on knowledge and innovation, the ability of these institutions to keep pace with and adopt technology is a must, not a choice. AI puts at our disposal great opportunities for higher education which range from personalisation of the learning experience to meet individual student's needs, and also in the automation of administrative and evaluation tasks which in turn takes the load off the faculty, to also in enhanced scientific research and the provision of powerful analysis tools that support in the decision-making process to better the quality of educational output (Ruslan & Youssef, 2024).

However, we also see a large gap between what these technologies can do and what is actually implemented in higher education institutions in Libya (Al-Zahrani & Alasmari, 2025). This nation faces many issues that, in turn, affect its ability to take advantage of the AI revolution fully. These issues are many, including technical infrastructure, human resources, and a lack of a supportive legal and regulatory framework. It is in this setting that we present our study, which is to bring to the fore the state of AI in the Libyan educational system and its role in the growth of higher education in Libya. This study reports many of the common issues and success stories observed across the Arab world (Alzahrani, 2022). By examining what has worked in other Arab countries, we have conducted a study of current developments and requirements and have also put forth a roadmap to improve the role of AI within the higher education framework in Libya (Demaidi, 2023). Also, we aim to present a practical implementation model that addresses key issues and what we believe will lead to success in this change.

Methodology

This paper reports on the use of a Descriptive and Analytical Research Approach, specifically a Systematic Literature Review, to achieve our goals. Given the current issues that are putting the brakes on the collection of large-scale primary data in Libyan higher education, we found this method ideal for compiling global and regional best practices and tailoring them to the local context. The systematic review process included the following steps: Scope and Search approach: We included in this review academic publications from the past five years, identified using terms such as "AI in Education MENA", "Libya Higher Education Challenges", "AI Implementation Frameworks", and "Educational Technology Strategy". We looked at a range of academic databases for this – Google Scholar, ScienceDirect and relevant institutional repositories.

The materials we put forward as high-impact include academic journals, peer-reviewed conference papers, and reports from international organisations (for instance, UNESCO) that address AI adoption, challenges, ethical frameworks, and policy recommendations as they relate to development in the global south and the Arab world.

Data Collection and Analysis: We identified and collected data on AI applications, the challenges we see, and the success stories to report, and developed strategic roadmaps. This process served as the empirical base for the development of a context-specific implementation framework for Libyan higher education.

Using this approach, which we have adopted in our study, we present a strategic roadmap grounded in well-known theories and supported by regional case studies, thereby enhancing the rigour and applicability of our results.

Analytical Framework: SWOT Analysis for AI Integration

To provide a strong foundation for the strategic roadmap and recommendations, we conducted a SWOT Analysis (Strengths, Weaknesses, Opportunities, Threats) of the internal and external environments for AI in Libyan higher education. This framework identifies the core challenges, for which we have proposed doable strategic actions.

Description and Impact on AI Integration

Strengths (Internal)

High Digital Acumen among Youth: Many of our students are highly curious and quick to adopt new tech, creating a receptive audience for AI tools.

Political support is building for AI to play a key role in economic diversification and global competitiveness.

Weaknesses (Internal)

Technological Infrastructure Deficit: Outdated hardware, insufficient bandwidth, and poor power supply prevent the rollout of cloud-based AI systems.

Human resources Issue: We see a significant gap in faculty and IT staff with specialised skills in AI, data science, and educational technology.

Lack of Standardised Data Systems: We also see a lack of widespread implementation of uniform educational data systems, which, in turn, makes it hard to develop and use effective predictive AI models (Ruslan & Youssef, 2024).

Opportunities (External)

Regional Collaboration and Information Exchange: We can look to advanced Arab states (e.g., the UAE and Saudi Arabia) and organisations such as UNESCO to develop joint training programs, funding, and proven educational AI models.

Global Open-Source Tools: We see a growing array of free and low-cost AI educational tools that can also be tailored to local needs, thereby mitigating high up-front software costs.

3. Curriculum Transformation Agent: AI is a great impetus and technical tool for rethinking traditional curricula, which in turn brings our educational output in line with the demands of the 21st-century labour market (Al-Zahrani & Alasmari, 2025).

Threats (External)

Socio-political instability: We see ongoing political division and security issues, which in turn disrupt large-scale infrastructure projects and prevent foreign investment in tech partnerships.

Talent Outflow – also known as Brain Drain: we see that very often, local high achievers and professionals are drawn to what they perceive as more stable, tech-oriented economies, which, in turn, worsens (Demaidi, 2023).

Algorithmic Bias in Education: We see how, in the implementation of AI, we reproduce educational inequality through data issues that may not be representative of all populations.

Literature Review and Theoretical Framework

Artificial Intelligence (AI) has become a transformative entity in many fields. Although it is a familiar term, its definition may vary depending on the context and the school of thought one considers. As a broad field of Computer Science, AI is dedicated to the design and development of computer-based systems and programs that can replicate human mental functions, including learning, reasoning, problem-solving, natural language understanding, and perception (Omar et al., 2024; Demaidi, 2023).

Some definitions of AI present its goal as getting machines to do what humans do that is, think, learn, and create meaning—which also includes machines carrying out certain tasks usually done by humans (Ali et al., 2024). Other definitions focus more on the rationality of intelligent systems' actions, which is the selection of the most logical action available at the time to achieve a given goal (Al-Zahrani & Alasmari, 2025). This latter definition includes the systems' ability to ingest external data, make sense of it, learn from it, and use that information for automation and problem-solving (Al-Zahrani & Alasmari, 2025).

Historically, AI took off after World War II, progressing through stages from chess to natural language processing and expert systems. In the 21st century, we have seen accelerated growth in AI, including Machine Learning, Deep Learning, and Generative AI (Ali et al., 2024). This period saw the introduction of "breakthrough" applications that produce text, image, and video content, which is very different from what was previously known of AI.

AI is also dedicated to developing machines that mimic human cognitive functions, including learning, problem-solving, and decision-making. In the field of education, AI goes beyond automating routine tasks, it also improves the quality of the educational process, making it more effective and personalised (Ruslan & Youssef, 2024).

Characteristics of AI and Reasons for Its Growing Interest

AI has distinct features that have put it at the forefront of interest across many fields, including education. These features include:

Handling Ambiguous and Complex Situations: AI processes and analyses large amounts of data, enabling it to address unclear and complex issues that may exceed the scope of a quick human response (Ali et al, 2024).

Rapid Response: It can respond to new issues at a moment's notice, making it highly effective in ever-changing environments (Ali et al, 2024).

Learning from Experience: AI can learn from past mistakes and experiences, applying them to new situations to improve future performance (Ali et al, 2024).

Knowledge Acquisition and Application: It can extract knowledge from data and apply what it has learned to solve the presented issues, even with incomplete data (Ali et al, 2024).

Several key factors drive the increasing interest in AI:

Creating Organised Knowledge Databases: AI develops structured knowledge bases that, in turn, ensure efficient information storage and prevent knowledge loss or leakage (Ali et al, 2024).

Mechanisation and Immunity to Human Emotion: AI systems deliver consistent performance because they lack the human factors that cause fatigue or burnout. Instead, they present a constant element of efficiency (Ali et al, 2024).

Solving Complex Problems: It can identify complex problems and propose and process solutions in a timely and appropriate manner (Ali et al, 2024).

Increasing Efficiency and Productivity: It performs routine tasks, which allows specialists to devote time to more complex and creative tasks (Ruslan & Youssef, 2024).

Supporting Decision-Making: It is an accurate tool that provides predictions and information that aid informed decision-making across many fields (Ruslan & Youssef, 2024).

These features present AI as a powerful agent in advancing higher education by offering novel solutions to current problems and enhancing the quality of academic and administrative processes .

The Positive Impacts of Artificial Intelligence on Education

Artificial Intelligence is transforming the education field, bringing many positive results that, in turn, improve the quality of education and make the learning process more effective and personalised. The most notable of these benefits are:

Delivering Personalised Learning: AI brings personalised learning experiences to life, tailored to each student's individual needs based on their learning style and comprehension speed. This also allows for presenting different material that better reaches each student's ability and thus caters to diverse student populations (Ali et al, 2024).

Automating Academic Work: AI can perform a great deal of the routine work that educators do, including grading assignments and tests and providing instant feedback to students. As a result, teachers save a significant amount of time that they can use for other crucial tasks, such as creating course materials and enhancing the quality of their interactions with students (Ruslan & Youssef, 2024).

Continuous Assessment and Progress Tracking AI have at its disposal a robust set of tools for continuous assessment of student performance and very accurate progress tracking. These systems' analysis of performance data is used to identify students' strengths and weaknesses and to propose solutions to improve their performance (Omar et al, 2024; Ruslan & Youssef, 2024).

Providing Smart Platforms for Remote Learning. In the age of remote learning, the introduction of AI has enabled smart educational platforms that enhance interaction, making distance learning more engaging and accessible. These platforms also offer chatbots that provide instant support to students and answer their queries (Al-Zahrani & Alasmari, 2025).

Expanding Opportunities for Collaboration and Communication AI plays a role in developing interactive learning environments that, in turn, increase students' access to collaboration and communication with peers and with academic material (Ali et al, 2024).

Preventing Academic Dropout: AI technologies can analyse student data to identify at-risk students, enabling early intervention and appropriate support to prevent dropout (Alahwal et al., 2025).

Promoting Learner Autonomy: AI supports personalised learning, allowing students to take charge of their development and choose the resources that best fit them (Ali et al., 2024).

Better Management of Classrooms and Educational Institutions: AI improves classroom management and administrative operations in higher education institutions by automating routine tasks and securing data storage (Ruslan & Youssef, 2024).

Supporting Students with Special Needs: AI offers specialised programs that cater to students with disabilities, making it easier for them to access information and fully participate in class (Ali et al, 2024).

Also, what is brought out by these points is that AI is more than just a technical tool but a trigger for positive transformation in the field of education, which improves the quality of the learning experience for staff and students and, at the same time, improves the performance of the educational system as a whole (Alahwal et al, 2025).

Artificial Intelligence Applications in Higher Education

AI uses a wide range of applications in higher education, ranging from tools that support the direct instructional process to those that improve institutional administration. These applications are put in place to transform present teaching models and, in turn, raise the overall efficiency of the educational system (Ali et al, 2024). These applications include:

Personalised and Adaptive Learning AI can tailor educational content, and, in turn, the learning rate is adjusted to best fit each student's individual needs. By analysing how each student learns best, their strengths, what they struggle with, and their level of engagement, AI can present highly personalised learning paths, provide instant feedback, and direct students to the right educational resources (Ali et al, 2024). This, in turn, improves learning outcomes and reduces educational gaps.

AI may automate administrative tasks, reducing the time educators spend on administrative work and allowing them to put that energy into teaching and communicating with their students. This includes taking roll, tracking progress, grading everyday assessments, and also putting together class schedules (Ruslan & Youssef, 2024).

Language and Mathematics Education AI in language education is seen in spell checkers, translation tools, and interactive conversations, which puts students in native-speaking environments (Ali et al, 2024). They also play a role in math education by presenting interactive problems, giving personal explanations, and identifying common student mistakes (Ruslan & Youssef, 2024).

AI, which powers today's virtual assistants, has brought educational tools that answer student questions, provide academic support, and offer virtual tutoring. In the field of educational robotics, they create interactive and engaging learning environments, particularly in STEM fields. They also foster student innovation and can be used in class for assistance, in the lab for interactive experiments, or even as a virtual teacher (Ali et al, 2024).

Intelligent Tutoring Systems (ITS). These platforms offer individualised, step-by-step lessons for each student, tailored to their level of comprehension and progress. They may also provide more in-depth explanations, practice problems, or even modify the study path based on how the student is progressing, thereby creating a highly personalised and effective learning experience (Ruslan & Youssef, 2024).

AI for Assessment and Evaluation. This also includes evaluating students' performance on homework and tests and providing instant, continuous feedback. AI can accurately and quickly analyse student responses, identify the most frequently repeated errors, and provide in-depth reports to teachers on how students perform (Ali et al, 2024).

Predictive Analytics AI uses the analysis of large sets of student data to identify trends and predict future performance. Educational institutions may use these analytics to identify which students are at risk of leaving or who lack what they need to succeed, enabling early intervention (Alahwal et al, 2025).

Support for Administrative Decision-Making

At present, AI provides an array of very useful tools that administrative leadership can use to base their decisions on accurate, up-to-date information. It also analyses key performance indicators and offers recommendations to improve quality and efficiency across many areas of university administration (Ruslan & Youssef, 2024).

Curriculum Development

AI plays a role that curriculum designers can use to study labour market trends, identify in-demand skills, and design curricula that, in turn, meet those requirements. It is also a tool they use to present curriculum updates based on the latest developments in each field (Al-Zahrani & Alasmari, 2025)

What we see in these applications is that AI is not just a support but a strategic partner, transforming higher education into a more efficient, personalised, and student- and labour-market-need-responsive environment (Demaidi, 2023).

The Need for Advanced AI Applications in Higher Education

The world is at a stage of fast technological growth, which in turn makes it a great requirement for higher education to adopt AI tools, which some may see as a luxury, but we see as a must. In the rapid pace of scientific and technological growth, we see higher education institutions at a crossroads, poised to take bold, determined steps in the use of educational technology (Ali et al, 2024). This is a result of what we see in many fields:

Keeping Pace with Labour Market Demands. The modern workforce requires graduates with advanced technology and AI skills. Higher education institutions must ensure they put knowledge in students' hands that will help them

keep up with these changes, which, in turn, requires us to bring AI into the curriculum and pedagogy (Ali et al, 2024).

Bridging the Gap Between Traditional and Modern Education. Many higher education institutions still use what we may term as traditional teaching methods, which do not, in fact, fit into the digital age. AI steps in to close that gap; it provides current educational tools and platforms, which in turn improve interaction and personalised learning (Kuleto et al, 2021).

Enhancing the Efficiency of Educational and Administrative Processes. AI, in many cases, is a game-changer for educational and administrative functions, as it performs routine tasks, analyses data, and supports decision-making. This, in turn, saves time and effort, which can be devoted to other aspects of the educational process (Ruslan & Youssef, 2024).

Fostering Scientific Research and Innovation, AI has at its disposal powerful tools such as big data analysis, modelling, and simulation, which, in turn, improve researchers' ability to generate new knowledge and tackle complex problems (Alahwal et al, 2025).

Responding to Future Challenges: The failure of higher education institutions to adopt AI technology widens the gap between those ahead and those behind, thereby risking the quality of educational output and their competitive standing at home and abroad (Ali et al, 2024).

Also, it is not a choice but a strategic requirement for the growth and pre-eminence of this field that we see AI deployed in higher education. Also, it plays a role in increasing student engagement, improving performance, and developing 21st-century skills such as critical thinking and problem-solving (Ali et al., 2024). However, to see these benefits, we must identify the issues at hand and plan strategically to ensure the proper and ethical use of these technologies .

Reality of Libyan Education and the Potential for AI Integration

Like many other Arab countries, Libya is in the early stages of adopting and implementing AI in its higher education (Omar et al, 2024; Al-Zahrani & Alasmari, 2025). Although awareness of these technologies is increasing, practical implementation remains limited and riddled with issues. From a few studies that address this issue in the Libyan context and reports from similar Arab cases, we get a peek into the present state of affairs. From our review, we note that the reality of AI in Libyan higher education is characterised by the following:

1. **Growing Awareness of AI's Importance.** In line with a growing trend, academic and official entities in Libyan higher education report increased interest in AI and its role in educational development, indicating a positive stage of adoption of these technologies (Kuleto et al, 2021).
2. **Limited and Focused Applications** In some institutions, we see single or narrow-scale AI implementations, which are often personal ventures or small research projects and not part of a wide-scale national strategy or integrated institutional plan (Alahwal et al, 2025).
3. **Weak Infrastructure.** The technological sector in Libyan higher education faces significant challenges. This includes poor-quality internet access, outdated equipment, and a lack of advanced digital platforms required to support AI (Ruslan & Youssef, 2024; Makhzoum, 2024).
4. **Shortage of Qualified Personnel** Libya reports a large deficit in human resources specialised in AI, including faculty capable of both teaching and developing these fields. Furthermore, there is a lack of technical personnel to support and maintain intelligent systems (Makhzoum, 2024; Demaidi, 2023).
5. **Absence of Legislative and Regulatory Frameworks** A significant gap currently exists in the legislation and regulation of AI in Libyan higher education. This gap may impede the growth of these technologies and raise ethical and legal issues (Al-Zahrani & Alasmari, 2025).
6. **Economic and Political Challenges** Due partly to persistent economic and political issues, Libyan higher education institutions have faced difficulties in investing in new technology, infrastructure development, and human resources (UNESCO,2024).

Potential for AI Integration in Libyan Education

AI-enabled learning platforms provide access to education for students in remote or conflict-affected areas that do not have access to traditional universities or faculties. They also play a role in the continuous education of adults and professionals (Omar et al, 2024; UNESCO,2024).

Curriculum Development AI is a tool that analyses educational data to identify issues in current curricula and propose solutions that align with labour market needs and technological advancements. It may also be used to design interactive and engaging educational content (Al-Zahrani & Alasmari, 2025).

Teacher Training and Professional Development: AI today is a resource that puts tailored training programs at teachers' disposal, helping them develop their instructional skills, learn to use the latest technology, and implement personalised learning strategies in their classrooms (Ali et al, 2024).

Decision Support: By analysing large datasets, including student performance reports, AI can provide valuable insights to Ministry of Education officials and educational institutions. This, in turn, is used to make informed decisions that improve educational quality and ensure better resource allocation (Ruslan & Youssef, 2024).

Current Libyan Initiatives Although in the early stages, the application of AI in Libyan education is progressing, which is very positive. For instance, we see some studies investigating the use of AI in accounting education programs at Libyan universities (Makhzoum, 2024). We are also seeing the growth of Libyan-based academies focused on robotics and AI education, which is a sign of strong interest in these technologies (Alloush et al, 2025). While these initiatives do have their issues, they serve as a foundation for expanding AI applications in Libyan education on a wider scale.

AI's role in Libyan education is beyond a technical issue; it is a strategic opportunity to restructure and develop a system that meets the needs of future generations and puts the country's development on a sustainable path.

A Proposed Roadmap for Integrating Artificial Intelligence into the Libyan Educational System

Based on a study of the proposed theoretical frameworks for AI in education, we examined the state of Libyan education and key Arab models that inform this research. This effort puts forth a multi-stage plan for AI's role in the Libyan educational system (Demaïdi, 2023). This plan is designed to achieve full and inclusive transformation while taking into account the local setting and addressing the issues at hand.

Phase One: Capacity Building and Infrastructure Development

This stage lays the foundation for all future projects. Without robust infrastructure and quality personnel, the results of AI integration will be minimised (Al-Zahrani & Alasmari, 2025; Demaïdi, 2023).

Developing Technological Infrastructure Integrating AI requires a robust and reliable digital infrastructure, which includes:

Expanding High-Speed Internet Access: Internet connectivity must be made available to all educational institutions, including remote-area universities and faculties. This is to be achieved through partnerships with telecommunications companies and the implementation of incentive policies for communication infrastructure investment (Al-Zahrani & Alasmari, 2025; Demaïdi, 2023).

Providing Necessary Equipment: Higher education institutions should be equipped with state-of-the-art computers, robust internal networks, and interactive tools (such as smartboards) for AI applications. International organisations and donors may be approached to cover some of these costs (Ali et al, 2024).

Establishing Secure and Reliable Data Centres: To house and process the large-scale educational data generated by AI applications, advanced data centres must be established, ensuring data security and privacy (Ruslan & Youssef, 2024).

Training Teachers, Administrators, and Students. Human resource capital is the key to any technology-based change (Ali et al, 2024). Thus, we must design in-depth and continuous training programs which include all relevant parties:

Teachers: Train teachers in the fundamentals of AI, how to integrate its tools into the classroom such as adaptive learning platforms and smart assessment tools, and in developing skills for designing AI-supported educational activities (Ali et al, 2024).

Administrators: educational officials with the skills to implement and direct AI integration into school systems, and to use the data presented by AI for better administrative and educational decision-making (Ruslan & Youssef, 2024).

Students: Integrate them into the world of AI, how to use its applications, and also develop the critical thinking and self-learning skills that these technologies promote.

Establishing a Legislative and Regulatory Framework To ensure AI is used properly and ethically in education, we must have regulations in place that define and regulate (Al-Zahrani & Alasmari, 2025).

Data Privacy and Security: Protect students' and staff data from unauthorised access.

AI Ethics: Set out principles to ensure AI is used fairly, transparently, and responsibly, and aim to avoid bias in algorithms (UNESCO, n.d).

Quality Standards: Develop quality criteria for educational AI applications which will improve their performance and reliability (Ali et al., 2024).

Phase Two: Pilot Projects and Initial Implementation

Following the foundation's laying, this stage is where we implement AI on a small scale to assess performance and identify best practices before scaling up (Omar et al, 2024; Demaïdi, 2023).

Launch of Pilot Projects in Selected universities and faculties: A few schools and universities will be chosen as pilot models. In certain areas, we will apply AI solutions, which include:

Adaptive Learning Platforms: Use of personalised digital resources which present educational material in specialised fields for students (e.g., math and science) (Ali et al., 2024).

Intelligent Assessment Tools: Using AI tools for test grading and real-time feedback to students (Ali et al., 2024).

Virtual Assistants: Providing students with access to virtual assistants who will answer their questions and provide academic support.

Development of AI-Supported Educational Content: Efforts will be made to introduce and adapt educational materials that incorporate AI elements, such as interactive lessons, simulations, and educational games (Al-Zahrani & Alasmari, 2025).

Impact Evaluation and Data Collection: Data from the pilot projects will be collected to determine the impact of AI on learning outcomes, student engagement, and to identify issues with practical implementation. We will conduct an in-depth study that includes academic, technical, and social aspects (Alzahrani, 2022).

Phase Three: Scaling and Generalisation

Based on the success of pilot projects and the lessons learned from them, this stage aims to implement AI at a large scale within the Libyan educational system (Demaidi, 2023).

Scaling Successful Experiments: The rollout of what worked in the pilot will include more universities and faculties in Libya. This requires in-depth resource planning, continuous staff training, and the right technical support.

Integration of AI into Curricula: AI should be a core element of what is taught at all grade levels, not a separate subject, but a tool which enhances what is learned in every field. AI and data science topics should also be included in the curricula, and the use of AI tools in research and creative projects should be encouraged (Ali et al, 2024).

Establishment of AI Research and Development Centres in Education: To see continuous growth in AI research and development, specialised centres in education should be founded. These will conduct applied research, develop solutions tailored to the Libyan context, and propose solutions for educational institutions (Alahwal et al, 2025).

Challenges and Recommendations

This is a call for strong political will and resource allocation, as well as for very close cooperation among the government, educational institutions, the private sector, and civil society (Al-Zahrani & Alasmari, 2025).

Challenges

Funding and Infrastructure Deficiencies: The underinvestment in technological infrastructure (internet, devices, and data centres) is a significant challenge in Libya. Securing the necessary funds for AI development and implementation is a large-scale issue (Al-Zahrani & Alasmari, 2025). The current, largely outdated technical infrastructure acts as a barrier to the widespread use of AI. Many higher education institutions in the developing world, including those in Libya, report issues in this area, which affects the adoption and implementation methods of AI solutions (Makhzoum, 2024).

Resistance to Change: Some teachers and administrators resist AI, driven by their attachment to traditional methods. This resistance also stems from a fear of the unknown, a lack of technical knowledge, or job insecurity (Ali et al, 2024).

Shortage of Specialised Skills: Libya lacks specialised talent in AI and data science at both the developer and user levels, hindering the development of local solutions and the effective training of educational staff (Demaidi, 2023).

Privacy and Ethical Issues: The role of AI in education has raised concerns about student data privacy, including its collection, storage, and use. There are also concerns about algorithmic bias, over-reliance on technology, and its effect on human interaction in the educational setting (Ali et al, 2024).

Digital Divide: Discrepancies in access to technology and the internet across different regions in Libya may exacerbate the digital divide, thus augmenting educational inequalities between students (Al-Zahrani & Alasmari, 2025; UNESCO, 2024).

Cybersecurity and Privacy: AI systems process large volumes of student and personal information, posing a significant risk of cyberattacks and data breaches. Strong policies and procedures are needed to prevent misuse of this information (Ruslan & Youssef, 2024).

Legislative and Regulatory Aspects: A gap exists in the laws and regulations governing the use of AI in education. This void leads to legal and ethical issues related to accountability, intellectual property, and algorithmic bias (Al-Zahrani & Alasmari, 2025).

Data Quality: AI performance depends on the quality of the data used for its training. If the data is inaccurate or biased, the system's outputs will also be flawed, which affects the reliability of the applications (Ali et al, 2024). Addressing these issues requires a coordinated effort from governments, educational institutions, and the private sector to create a supportive environment for the successful and accountable implementation of AI in higher education (Demaidi, 2023).

Recommendations

To overcome the issues and fully realise the potential of AI in Libyan education, we put forth the following recommendations:

Strategic Partnerships: The Libyan government should form associations with local and international technology companies, educational institutions, and non-governmental organisations. These associations will provide key

funding and technical support to develop innovative solutions (Demaïdi, 2023). Libya should also reach out to neighbouring and international Arab states and organisations to exchange ideas, develop joint training programs, and secure the required technical and financial support for AI in education (UNESCO, n.d.).

Investment in Research and Development. Allocating budgets to research and development in educational AI is essential. Universities and research centres should conduct applied research to develop solutions tailored to the Libyan context and its unique issues (Alahwal et al, 2025).

Capacity and Infrastructure Building Intensive and Continuous Training: Provide in-depth, ongoing training for teachers, administrators, and students. Programs should focus on developing digital skills and understanding AI applications and their practical use. This may include workshops, online courses, and specialised certification programs (Ali et al, 2024).

Technological Infrastructure Development: Invest in higher education technological infrastructure, including high-speed internet, modern IT equipment, and advanced digital platforms that support AI (Al-Zahrani & Alasmari, 2025).

Curriculum Integration: Review and update higher education curricula to include AI concepts and applications. This will prepare students for their future careers, which will increasingly involve the use of these technologies (Ali et al, 2024).

Awareness and Legal Frameworks

National Awareness Campaigns: Roll out national-scale awareness programs that inform all members of society about the value of AI in education, its benefits, and its role in a better future for future generations. These programs can help to reduce resistance to change and foster a supportive environment for innovation (Demaïdi, 2023).

Developing Legislative and Regulatory Frameworks: Develop a comprehensive legal and ethical framework that addresses security, privacy, intellectual property, and ethical considerations in the implementation of AI in education. This framework must be flexible and forward-looking to accommodate future technological growth (Al-Zahrani & Alasmari, 2025).

Adopting these suggestions will ensure Libyan higher education excels in the AI revolution. This is a chance for them to improve quality, see better results, compete globally, and play a key role in developing a knowledge-based economy in Libya (Ruslan & Youssef, 2024).

Conclusion

This research report finds that Artificial Intelligence (AI) is a key driver of large-scale positive change in Libya's education sector (Ali et al, 2024). AI offers innovative solutions to the current structural deficiencies of the educational system, improving its quality, enhancing the performance of both academic and administrative processes, and enabling tailored learning that meets each student's unique needs (Ruslan & Youssef, 2024). AI holds significant potential to drive a positive shift across all areas, from personalising the learning experience and assessment to improving decision-making and support.

Currently, the adoption of AI in Libyan higher education is very limited. These issues underscore the need for significant input from all relevant parties to successfully implement these promising tools (Al-Zahrani & Alasmari, 2025).

The proposed multi-stage roadmap, encompassing capacity building, infrastructure development, pilot projects, initial implementation, and scaling, provides a structured framework for integrating AI into Libyan education (Demaïdi, 2023). However, successful execution requires addressing persistent challenges, including a lack of funding, resistance to change, weak technical infrastructure, a shortage of skilled human resources, and the absence of clear legislative and regulatory structures (Makhzoum, 2024; Omar et al., 2024). By forming effective partnerships, investing in R&D, promoting regional and international cooperation, running awareness campaigns, and establishing a robust legal and ethical structure, Libya may overcome these issues.

Ultimately, implementing AI in Libyan education is beyond a mere technical issue; it is a strategic investment in the future of the next generation (Alahwal et al, 2025). This investment ensures a prosperous and sustainable educational future contributing directly to establishing a knowledge-based society and a digital economy in Libya.

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