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Artificial Intelligence Technologies and Their Impact on Higher Education in Libya: A Field Study at the University of Benghazi

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تقنيات الذكاء الاصطناعي وأثرها على التعليم العالي في ليبيا: دراسة ميدانية بجامعة بنغازي

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Abstract:
This study investigates the impact of Artificial Intelligence (AI) technologies on the quality of higher education in Libya, focusing on the University of Benghazi. While AI integration has globally transformed learning through adaptive platforms and automated assessments, Libyan institutions remain constrained by weak infrastructure, limited financial capacity, and insufficient faculty training. This qualitative case study, based on interviews with 18 participants (faculty lecturers, students, and administrators), explores the perceived benefits and obstacles associated with AI adoption. Findings reveal significant improvements in student engagement, assessment efficiency, and academic performance, with AI-supported courses achieving a 15% grade improvement. However, 90% of participants identified internet instability as a primary barrier, and 60% reported insufficient AI-related training. The study proposes policy recommendations, including targeted professional development programs, investment in digital infrastructure, and the formulation of ethical governance frameworks. This Study offers valuable insights for policymakers and educators in Libya's evolving post-conflict educational landscape, contributing to the global discourse on AI's role in higher education under resource-constrained contexts.

Keywords: Artificial Intelligence, Higher Education in Libya, Adaptive Learning, Infrastructure, Educational Technology, Digital Transformation.

الملخص:
تبحث هذه الدراسة في تأثير تقنيات الذكاء الاصطناعي على جودة التعليم العالي في ليبيا، مع التركيز على جامعة بنغازي. فعلى الرغم من أن دمج الذكاء الاصطناعي قد أحدث تحولاً كبيراً في التعليم على المستوى العالمي من خلال المنصات التكيفية والتقويمات الآلية، لا تزال مؤسسات التعليم العالي الليبية تعاني من ضعف البنية التحتية، ومحدودية الإمكانيات المالية، وقصور في تدريب الكوادر الأكاديمية. وتتبع هذه الدراسة المنهجية النوعية حيث تعتمد على مقابلات مع 18 مشاركًا من أعضاء هيئة التدريس والطلبة والإداريين الفنيين، لاستكشاف الفوائد والعوائق المرتبطة بتبني تقنيات الذكاء الاصطناعي. وقد كشفت النتائج عن تحسينات ملحوظة في تفاعل الطلبة، وكفاءة التقييم، والأداء الأكاديمي، حيث سجلت المقررات المدعومة بالذكاء الاصطناعي تحسنًا في الدرجات بنسبة 15٪. ومع ذلك، أشار 90٪ من المشاركين إلى عدم استقرار الإنترنت كأحد العوائق الرئيسية، فيما أفاد 60٪ منهم بوجود نقص في التدريب المتعلق بالذكاء الاصطناعي. وتقترح الدراسة مجموعة من التوصيات الأساسية، من بينها تصميم برامج تدريب مهني موجهة، والاستثمار في البنية التحتية الرقمية، ووضع أطر حوكمة أخلاقية. وتوفر هذه الدراسة رؤى قيّمة لصناع القرار والمشتغلين بالتعليم العالي في بيئة التعليم الليبي ما بعد الصراع، وتُسهم في إثراء النقاش العالمي حول دور الذكاء الاصطناعي في التعليم العالي في السياقات ذات الموارد المحدودة.

الكلمات المفتاحية: الذكاء الاصطناعي، التعليم العالي في ليبيا، التعلم التكيفي، البنية التحتية، تكنولوجيا التعليم، التحول الرقمي.

Introduction

Artificial Intelligence (AI) is increasingly reshaping global higher education systems by introducing adaptive learning platforms, automated assessment tools, and administrative optimization. AI has demonstrated significant potential in enhancing personalized learning experiences, reducing grading workloads, and improving academic performance (Baker, 2019; Chen & Li, 2021). In highly developed countries, these technologies have rapidly advanced the modernization of higher education. However, in developing and post-conflict nations such as Libya, AI adoption is hindered by several systemic challenges.

Libya's higher education sector continues to struggle with poor internet infrastructure, frequent power outages, financial instability, and the absence of comprehensive national digital strategies (Libyan Ministry of Higher Education, 2023). Despite these limitations, Libyan universities have begun exploring AI-driven solutions, with the University of Benghazi emerging as a pioneer in adopting adaptive learning systems and smart educational platforms. Yet, little empirical Study has been conducted on AI's actual influence within the Libyan higher education context.

The primary Study question driving this study is:

How do AI technologies affect higher education quality in Libya, and what barriers impede their effective adoption?

By addressing this question, the study aims to contribute to filling the current Study gap and generate evidence-based recommendations for policymakers, academic leaders, and stakeholders seeking to promote sustainable educational innovation in Libya's fragile environment.

Problem Statement

Although Artificial Intelligence (AI) technologies have revolutionized higher education globally, Libya continues to face multiple barriers that have slowed the adoption of these innovations. Several universities in the country operate with unreliable internet services, frequent power outages, outdated hardware, and insufficient technical support systems. Moreover, the legacy of post-conflict economic instability has limited national investments in educational infrastructure and faculty development programs (Holmes et al., 2020; Libyan Ministry of Higher Education, 2023).

A critical gap exists in the academic literature concerning AI's effectiveness and adaptability within the Libyan educational context. While many studies examine AI integration in well-resourced environments, little attention has been paid to countries such as Libya, where systemic challenges pose unique constraints on technological innovation in higher education. This knowledge gap leaves policymakers and educators without sufficient empirical data to design appropriate AI-based educational policies and interventions.

This study directly addresses this gap by examining the University of Benghazi's experience with AI technologies, identifying both enabling factors and significant challenges to effective implementation in post-conflict Libya.

Objectives

This study aims to achieve the following objectives:

- To assess the impact of AI technologies on educational quality in Libya, specifically focusing on academic performance and student learning experiences.
- To identify AI technologies best suited for Libyan higher education, such as adaptive learning systems and automated grading platforms.
- To examine the key barriers hindering AI adoption, including technological, training, cultural, and institutional factors.
- To develop evidence-based policy recommendations for sustainable AI integration in Libya's higher education system.

Significance

This Study is among the first empirical investigations of AI technologies in Libyan higher education. It makes several significant contributions:

- **Academic Contribution:**

The study enriches the scholarly literature by examining AI's educational impact in a resource-constrained, post-conflict setting, offering localized evidence that contrasts with global studies conducted primarily in stable, well-funded environments.

- **Practical Contribution:**

The study provides actionable recommendations for Libyan policymakers, university administrators, and faculty lecturers. By identifying context-specific challenges and opportunities, the findings help design feasible strategies for AI implementation aligned with Libya's economic and technological realities.

- **Policy Contribution:**

The Study supports Libya's national efforts toward digital transformation, helping bridge gaps between local higher education practices and global trends in educational technology innovation.

Theoretical Framework

The study is grounded in two primary theoretical frameworks: Technology-Enhanced Learning (TEL) and Constructivist Learning Theory.

- **Technology-Enhanced Learning (TEL):**
  TEL posits that integrating technology into education can personalize learning, increase accessibility, and enhance student engagement (Zawacki-Richter et al., 2019). AI-powered adaptive learning platforms exemplify this approach by tailoring content delivery to individual student needs based on real-time performance data.
- **Constructivist Learning Theory:**
  Constructivist theory emphasizes that learners actively construct knowledge based on their prior experiences and individual learning trajectories (Piaget, 1970). Adaptive AI systems that provide personalized learning paths closely align with this theory by facilitating student-centered instruction.
  In applying these theories to the Libyan context, the study recognizes that while AI offers immense potential to personalize and improve learning, contextual barriers such as infrastructure limitations, economic instability, and cultural factors moderate its effective implementation.
- **The study conceptualizes:**
  - Independent Variable: AI Technologies (adaptive learning, automated assessments, intelligent platforms).
  - Dependent Variable: Educational Quality (academic performance, student engagement).
  - Moderating Variables: Infrastructure, faculty training, cultural resistance.
  - Contextual Factor: Libya's post-conflict socio-economic environment.

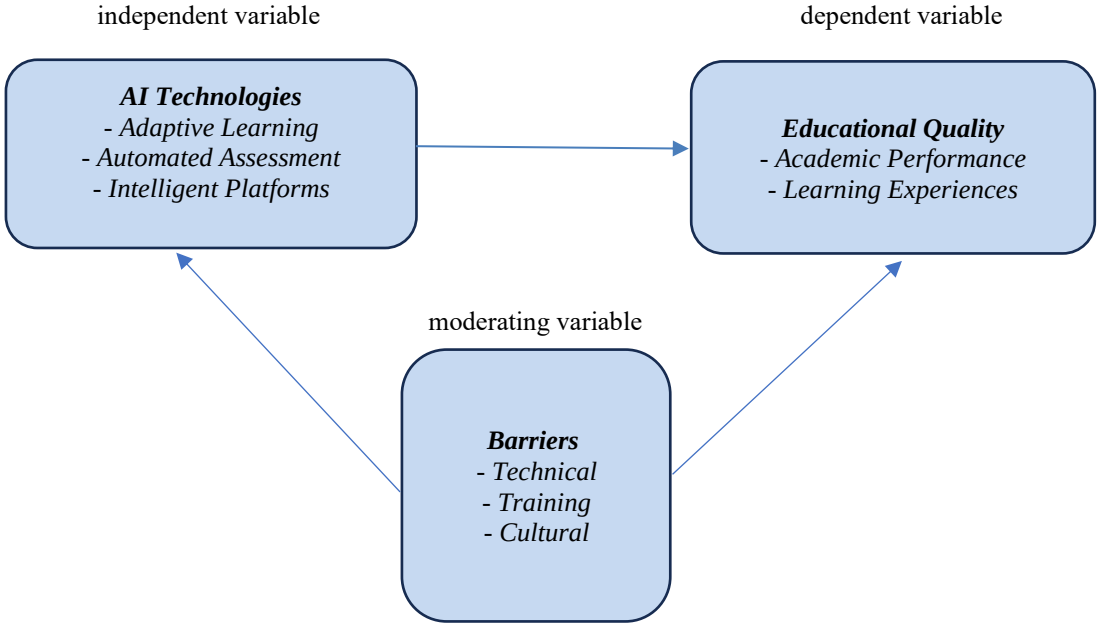

Figure 1: Theoretical Framework.

Literature Review

Globally, AI technologies have significantly enhanced teaching and learning outcomes in higher education. For example:

- **Adaptive Learning Systems:**
  Baker (2019) highlights that adaptive learning platforms improve students' comprehension by adjusting learning content to match their abilities. Chen & Li (2021) report that AI-driven personalized learning can reduce dropout rates by addressing individual student weaknesses.
- **Automated Assessment:**
  Automated grading systems save faculty time and offer consistent, timely feedback (Chen & Li, 2021). Several Asian universities have successfully integrated such systems to improve teaching efficiency.
  However, the global success of AI integration is not easily replicated in developing regions:
- **Infrastructure Challenges:**
  Holmes et al. (2020) and Oyelere et al. (2022) emphasize that robust internet access and stable power supplies are essential for AI deployment, yet remain problematic in many African and Arab countries. Libya reflects

similar challenges, where frequent power outages and unstable internet disrupt AI-supported learning platforms (Libyan Ministry of Higher Education, 2023).

- **Faculty Readiness and Training Gaps:**
  Alshahrani (2023) highlights the faculty's limited preparedness for AI adoption even in more technologically advanced Gulf countries. Training deficiencies are even more pronounced in Libya, where structured AI training for educators remains scarce.
- **Economic and Cultural Barriers:**
  post-conflict economic instability limits Libya's capacity to invest in AI infrastructure (Libyan Ministry of Higher Education, 2023). Moreover, cultural skepticism toward technology adoption can fuel faculty resistance, particularly where educators perceive AI as threatening their traditional instructional roles (Al-Saidi, 2022).
- **Ethical Concerns:**
  Globally, ethical issues related to data privacy, algorithmic bias, and over-dependence on AI are critical (Zawacki-Richter et al., 2019; Popenici & Kerr, 2022). These concerns are especially pressing in Libya, where weak regulatory frameworks for data governance remain underdeveloped.
  This study distinguishes itself by focusing on Libya's post-conflict context—a setting largely absent from current global AI-in-education Study, which predominantly examines technologically advanced countries.

Methodology

Study Design

This qualitative case study explores the impact of AI technologies on higher education at the University of Benghazi, selected for its pioneering role in adopting smart learning platforms within Libya.

Participants and Sampling

Purposive sampling was used to recruit 18 participants, categorized as follows:

- 10 Faculty lecturers: Experienced in e-learning and AI-based teaching.
- 5 Postgraduate Students: Actively engaged with AI-supported learning systems.
- 3 Academic Administrators: Overseeing institutional technology adoption.

Participants represented various disciplines including engineering, science, and humanities, ensuring a diverse range of perspectives.

Table 1: Summary of Participant Perspectives.

Category	N	Improved Quality (%)	Technical Barriers (%)	Acceptance (%)	Resistance (%)
Faculty	10	70	90	50	40
Postgraduate Students	5	80	80	85	10
Academic Administrators	3	60	100	60	30
Total	18	71	89	63	31

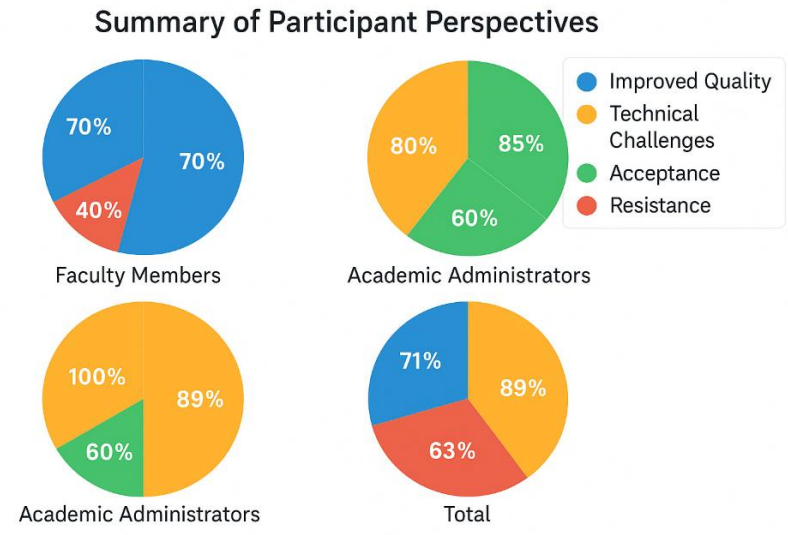

Figure 2: Summary of Participant Perspectives.

Data Collection

- **Semi-Structured Interviews:**
  Conducted between March and April 2025, lasting 20–30 minutes each. Interview topics included perceived benefits, obstacles, training needs, and stakeholder attitudes (see Appendix A).
- **Document Analysis:**
  Academic performance data from 2023–2024 were reviewed to compare outcomes between AI-supported and traditional courses.

Data Analysis

Thematic analysis was applied following Braun and Clarke's (2006) six-phase approach:

1. Transcription of interview recordings.
2. Manual coding of responses into preliminary categories.
3. Organization of codes into broader themes.
4. Validation and refinement of themes.
5. Interpretation of emerging patterns.
6. Reporting of findings.

Two independent coders analyzed 20% of transcripts to ensure inter-coder reliability (Cohen's kappa = 0.82). Descriptive statistics were used to quantify response frequencies and visualize key findings.

Ethical Considerations

Informed consent was obtained from all participants. Data were anonymized to confidentiality. Institutional ethical approval was secured prior to data collection.

Findings and Analysis

The thematic analysis generated three dominant themes:

Theme 1: Enhancing Educational Quality

- **Increased Student Engagement:**
  80% of students reported that adaptive learning systems enhanced their understanding of complex concepts, particularly in engineering disciplines. Faculty also observed increased interaction due to AI-enabled feedback mechanisms.
- **Assessment Efficiency:**
  70% of faculty noted that automated grading systems reduced marking time by approximately 30%, allowing more focus on teaching. AI-supported courses showed a 15% improvement in academic grades.
- **Personalized Learning Paths:**
  60% of participants praised AI's ability to customize learning content based on individual 8weaknesses, improving learning outcomes.

Table 2: Themes and Sub-Themes from Thematic Analysis

Theme	Sub-Theme	Description	Participants (%)
Enhancing Educational Quality	Increased Engagement	AI boosts interaction and understanding, especially in complex subjects.	78 (14/18)
	Assessment Efficiency	Automated tools save time and improve feedback.	67 (12/18)
	Tailored Learning	AI customizes content to student needs, improving outcomes.	61 (11/18)
Technical and Training Barriers	Infrastructural Challenges	Weak internet and power outages hinder AI use.	89 (16/18)
	Training Shortages	Faculty and students lack skills to use AI effectively.	67 (12/18)
	Funding Limitations	Limited budgets restrict hardware/software upgrades.	50 (9/18)
Stakeholder Attitudes	Student Support	Students value AI's accessibility and flexibility.	83 (15/18)
	Faculty Skepticism	Faculty fear AI reduces their role or demands adaptation.	44 (8/18)
	Administrative Needs	Administrators seek plans and external support for AI adoption.	56 (10/18)

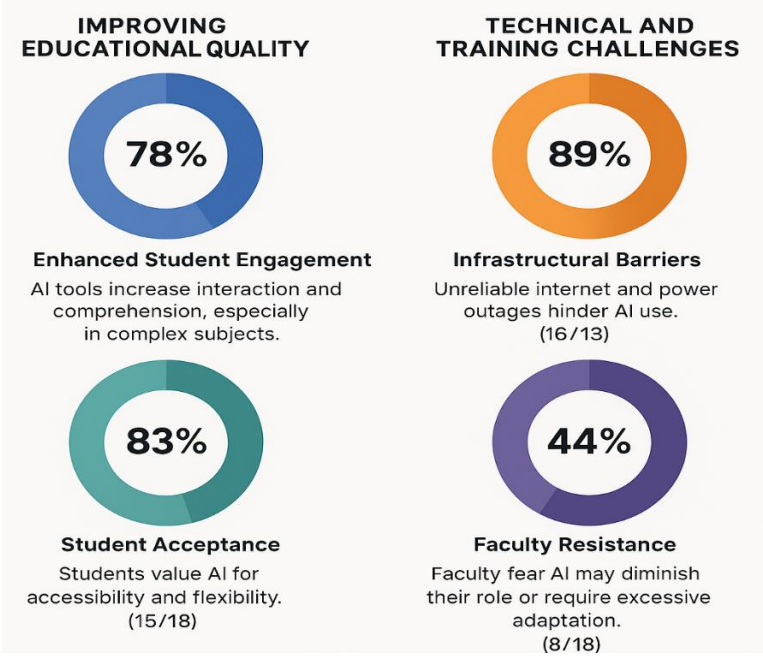

Figure 3: Themes and Sub-Themes from Thematic Analysis.

Theme 2: Technical and Training Barriers

- **Infrastructure Deficiencies:**
  90% of respondents identified unreliable internet and frequent power outages as primary obstacles, frequently interrupting online sessions.
- **Training Gaps:**
  60% of faculty and 40% of students reported limited familiarity with AI platforms, underscoring the need for targeted training programs.
- **Funding Constraints:**
  50% of administrators emphasized financial challenges that prevent the acquisition of modern AI-capable infrastructure.

Table 3: Distribution of Barriers by Participant Group.

Barrier	Faculty (n=10)	Students (n=5)	Administrators (n=3)	Total (n=18)
Unreliable Internet	9 (90%)	4 (80%)	3 (100%)	16 (89%)
Power Outages	8 (80%)	4 (80%)	3 (100%)	15 (83%)
Lack of Training	6 (60%)	2 (40%)	2 (67%)	10 (56%)
Funding Constraints	5 (50%)	1 (20%)	3 (100%)	9 (50%)

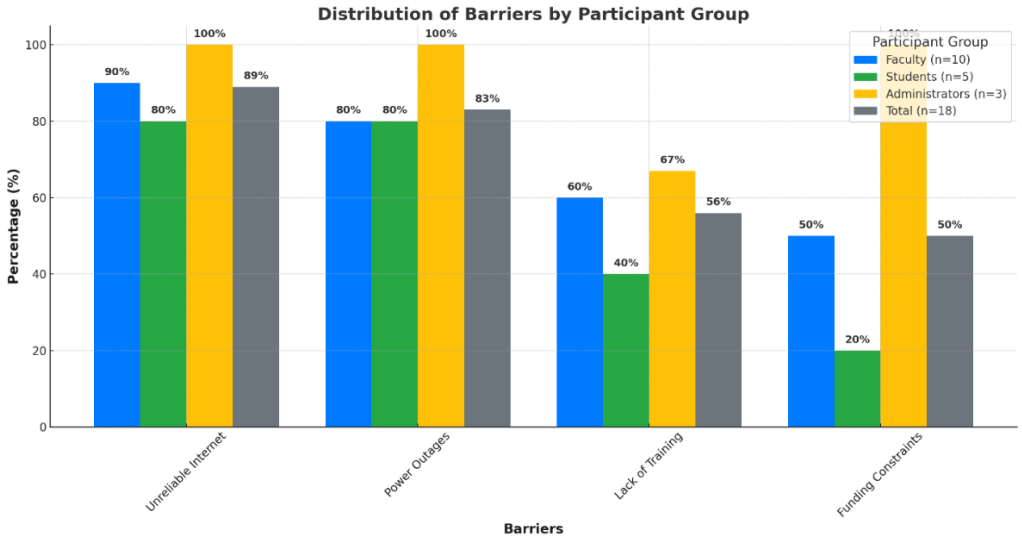

Figure 4: Distribution of Barriers by Participant Group.

Theme 3: Stakeholder Attitudes

- **Student Support:**
  85% of students expressed strong enthusiasm for AI technologies, citing flexibility and accessibility.
- **Faculty Skepticism:**
  40% of faculty voiced concerns about AI diminishing their teaching roles and feared losing the human mentorship aspect of education.
- **Administrative Priorities:**
  67% of administrators emphasized the need for national strategies and international partnerships to support AI integration.

Table 4: Representative Participant Quotes.

Sub-Theme	Participant	Quote
Increased Engagement	Student (S3)	"The system adjusts questions to my pace, making data science easier."
Assessment Efficiency	Faculty (F7)	"Automated grading frees me to focus on teaching."
Infrastructural Challenges	Administrator (A1)	"Servers fail during outages, and slow internet disrupts platforms."
Training Shortages	Faculty (F4)	"I got a platform but no instructions."
Student Support	Student (S2)	"I access materials despite internet issues."
Faculty Skepticism	Faculty (F8)	"AI can't replace classroom mentorship."

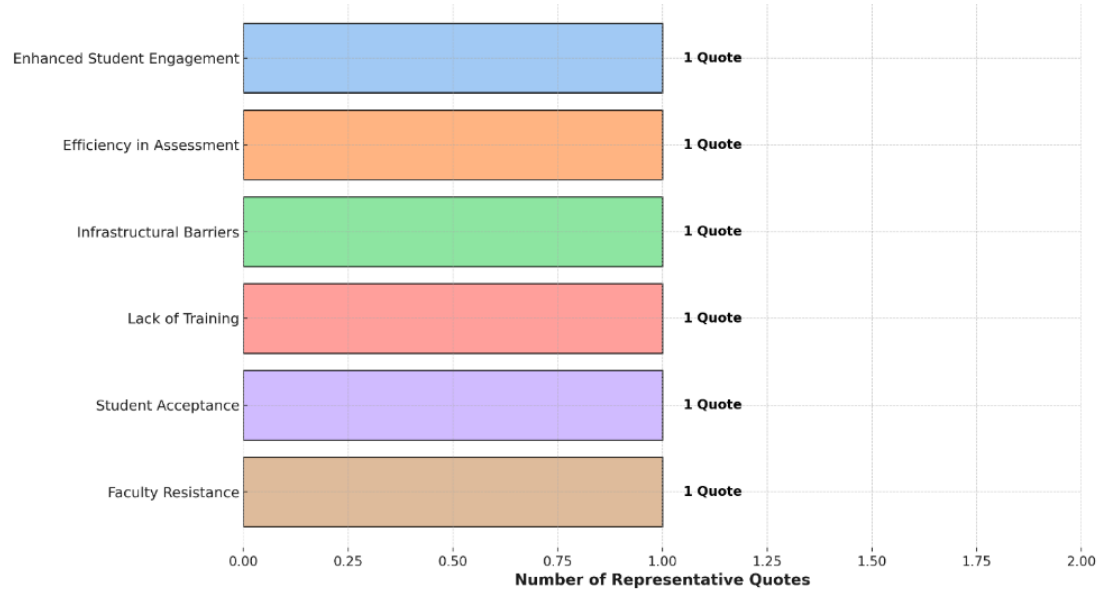

Figure 5: Representative Participant Quotes.

Discussion

The study's findings confirm the significant potential of AI technologies to enhance educational quality in Libya's higher education sector, despite considerable challenges. The observed 15% improvement in academic performance aligns with global literature emphasizing AI's capacity for adaptive, personalized learning (Baker, 2019; Chen & Li, 2021).

The enhancement of student engagement observed in 80% of participants reflects strong alignment with both Technology-Enhanced Learning (TEL) and Constructivist Learning Theory frameworks, which advocate learner-centered instructional approaches (Zawacki-Richter et al., 2019). AI-supported feedback loops facilitated continuous formative assessment, allowing students to receive timely, tailored interventions that strengthened learning outcomes.

However, Libya's post-conflict infrastructure deficiencies severely limit the scalability of AI innovations. The 90% reporting unreliable internet and the widespread occurrence of power outages highlight systemic obstacles similar to those documented across other fragile educational systems in the Arab world and Sub-Saharan Africa (Holmes et al., 2020; Oyelere et al., 2022).

Faculty skepticism presents another substantial barrier. The resistance expressed by 40% of faculty participants reflects concerns about AI displacing essential aspects of human instruction, such as mentorship, critical thinking facilitation, and ethical guidance—areas where AI remains functionally limited (Popenici & Kerr, 2022). This

tension echoes cultural hesitations previously reported across Arab educational contexts (Al-Saidi, 2022; Alshahrani, 2023).

Training deficiencies compound these obstacles. Without comprehensive faculty development programs addressing AI integration, even highly motivated instructors may lack the skills to implement AI tools effectively (Zawacki-Richter et al., 2019). Globally, such training remains a critical success factor for AI adoption in higher education.

Finally, while ethical concerns such as data privacy were not raised prominently by participants (only 20%), global scholarship suggests that as AI integration deepens, legal frameworks to protect data security, algorithmic transparency, and institutional accountability will become increasingly essential (Zawacki-Richter et al., 2019).

This study contributes uniquely to global discourse by presenting evidence from a resource-constrained, post-conflict environment—a perspective rarely represented in dominant AI Study that often assumes robust infrastructures in stable settings.

Conclusions

- AI technologies significantly enhance educational quality in Libya by improving academic performance, engagement, and assessment efficiency.
- Widespread technical barriers—including unreliable infrastructure, insufficient training, and limited financial resources—severely constrain AI's scalability.
- Students show strong support for AI, while faculty skepticism underscores persistent cultural and professional reservations.
- Libya's unique post-conflict setting requires localized, context-sensitive AI adoption strategies.

Recommendations

1. Infrastructure Investment:
   Prioritize development of stable internet connectivity and reliable electricity supply through national and international collaborations.
2. Faculty Development:
   Implement ongoing, structured training programs focused on AI integration into pedagogy and curriculum design.
3. National Strategic Planning:
   Formulate comprehensive policies governing AI adoption, including ethical guidelines and data privacy regulations.
4. International Partnerships:
   Collaborate with global universities, technology providers, and development agencies to secure technical expertise, funding, and capacity building.
5. Pilot Programs:
   Introduce pilot AI platforms designed to function effectively even under existing infrastructure limitations, allowing for scalable gradual adoption.

Limitations and Future Studies

- **Limitations**:
  The study's sample size (n=18) and focus on a single institution may limit the generalizability of findings across Libya's higher education sector.
- **Future Study Directions:**
  Conduct multi-institutional studies across diverse Libyan universities to validate findings. Employ longitudinal designs to assess the long-term effects of AI adoption.
  Use mixed-methods approaches to triangulate qualitative insights with quantitative data for a more comprehensive understanding.

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Appendix A: Interview Questions

Faculty Lecturers

- What AI tools do you currently use in your teaching?
- How have AI platforms influenced student learning and engagement?
- What challenges do you face in using AI technologies?
- Have you received any formal AI training?
- How do you perceive AI's future role in replacing or supporting teaching?
- What improvements do you recommend for better AI integration?
- Do you have any concerns about data privacy or AI misuse?
- Have you observed any changes in student performance?

Postgraduate Students

- Which AI tools have you used in your studies or Study?
- How have AI tools impacted your learning process?
- What benefits and challenges have you experienced?
- What additional support would you require to better use AI tools?
- Can AI substitute direct interaction with professors?
- Are you concerned about plagiarism or ethical risks with AI tools?
- What future AI tools do you believe should be implemented?

Administrators

- What AI technologies has your institution adopted?
- What benefits have you observed from AI implementation?
- What major obstacles limit further AI expansion?
- Are there any institutional plans for scaling up AI use?
- What external support (training, partnerships, funding) do you consider necessary?
- How do you assess risks related to data security, privacy, or institutional dependency on AI systems?