Integration of AI in Basic Education: An Opportunity or a Threat? A Case Study of Al Makassed Association Schools in Beirut

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Abstract

Artificial Intelligence (AI) is rapidly influencing global education systems, offering opportunities in personalized learning, instructional efficiency, and school management. This study explores the extent of AI integration, stakeholder perceptions, and critical implementation factors within basic education (K–9) across seven schools affiliated to Al Makassed Association in Beirut, Lebanon. A mixed-methods design was employed, combining quantitative survey data from 124 participants, including administrators (n = 16), and teachers (n = 108), with qualitative input from a focus group discussion with ICT coordinators (n = 6), open-ended survey responses, and document analysis.

Stakeholders collectively recognized AI's potential to enhance differentiation, engagement, and formative assessment, particularly at upper primary and intermediate levels. However, concerns were raised about student overdependence on AI, data privacy, misinformation, and the ethical use of technology. Teachers also expressed a need for stronger technical support and targeted training.

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The study concludes that successful AI implementation requires bridging the gap between leadership vision and classroom practice. Key enablers include infrastructure readiness, ethical policy frameworks, and sustained, role-specific professional development. These findings offer actionable insights for education leaders, policymakers, and curriculum developers seeking to integrate AI tools responsibly and equitably within developing contexts like Lebanon.

Keywords: Artificial Intelligence, Basic Education, Teacher Perceptions, AI Integration, Educational Leadership

1. Introduction

1.1. Background of the Study

The global rise in Artificial Intelligence (AI) applications has extended to the field of education, promising innovative teaching and learning practices. In basic education, particularly for students in grades K–9, AI tools offer customized learning experiences, assessment automation, and classroom management support. Yet, the integration of AI remains controversial, with ongoing debates about its long-term impact on pedagogy, teacher-student relationships, and educational equity (Gewertz, 2024). This paper investigates AI integration in the context of basic education in Lebanon, focusing specifically on the case of seven of Al Makassed Association schools located in Beirut, a network serving diverse communities.

Despite the growing availability of AI-powered educational tools, limited research exists on how these technologies are integrated into basic education settings in Lebanon (Shuayb et al., 2024). Most existing literature emphasizes higher education or general technology tool adoption without particular focus on AI or foundational schooling stages (UNESCO, 2023). Furthermore, little is known about how local schools perceive, adopt, and adapt AI innovations, especially within Lebanon's complex socio-economic and infrastructural context (Momdjian, Manegre, & Gutiérrez-Colón Plana, 2024).

1.2. Significance of the Study

This study is significant for several reasons. First, it contributes to the scarce body of research exploring AI integration in Lebanese basic education, filling an important knowledge gap. Second, it offers practical insights for school leaders, policymakers, and educators on effective and ethical AI implementation tailored to local realities. Third, by capturing the voices of practitioners actively

navigating AI adoption, this research provides grounded perspectives that can inform future planning, professional development, and policy formulation. Finally, the findings can guide equitable AI integration that supports quality education amidst Lebanon's unique challenges.

2. Problem Statement, Objectives, and Research Questions

2.1. Problem Statement

Despite the growing availability of AI-powered educational tools globally, their integration into basic education settings in Lebanon remains significantly under-researched. Existing literature primarily concentrates on higher education or general technology integration, often overlooking the foundational stages of education and the specific socio-economic realities of developing or crisis-affected countries (Holmes et al., 2022; Luckin et al., 2016). This results in a critical knowledge gap regarding how educators and administrators in K–9 schools perceive, adopt, and adapt AI tools in practice.

In resource-constrained and socio-economically diverse environments like Lebanon, schools face infrastructural limitations, unstable governance, and digital inequalities that shape their engagement with emerging technologies (UNESCO, 2021; World Bank, 2022). Without a nuanced understanding of these contextual factors, efforts to integrate AI in basic education risk being ineffective or ethically problematic.

Moreover, limited access to professional development and the absence of clear policies for AI use in classrooms hinder effective and equitable adoption (Zawacki-Richter et al., 2019; Spector et al., 2020). Therefore, this study explores the opportunities, challenges, and support systems related to AI integration in K–9 classrooms within the Makassed Association schools in Beirut, Lebanon, to inform policy, practice, and future research.

2.2. Objectives of the Study

This study aims to:

1. To examine the perceived opportunities and challenges of AI integration among educators and administrators.
2. To identify the support systems and policies required for effective and ethical AI adoption in basic education.

2.3. Research Questions

The study seeks to answer the following questions:

1. What opportunities do school leaders, teachers, and ICT coordinators perceive in using AI to enhance teaching, learning, and school management in basic education?
2. What challenges or risks do stakeholders associate with the use of AI in K–9 educational settings?
3. What factors are crucial for the effective implementation of AI tools in these schools?

2.4. Hypotheses

To address the research questions, the following hypotheses have been developed to be tested within the study's scope.

H1: Educators, ICT coordinators, and school leaders in Lebanese K–9 schools perceive AI integration as a valuable tool for enhancing teaching, learning, and school management.

H2: Stakeholders associate ethical, pedagogical, and operational risks with AI adoption, particularly in socio-economically constrained school environments.

H3: Effective AI implementation in basic education requires adequate infrastructure, teacher training, and clear policy guidance.

3. Literature Review

AI in education involves tools and systems capable of performing tasks such as personalized instruction, predictive analytics, and natural language processing. Research also indicates that AI can foster personalized learning, enable early identification of learning difficulties, and reduce teachers' administrative load (Toyokawa et al., 2023). However, concerns remain around data privacy, algorithmic bias, and digital overdependence (Chinta et al., 2024). In Lebanon, digital education is growing, yet AI integration remains fragmented, often limited by infrastructure and training (El Masri & Tarhini, 2022). To better understand the current state and potential of AI in foundational schooling, it is essential first to clarify what constitutes AI in basic education and explore the specific technologies and challenges associated with its adoption at the K–9 level.

3.1. Artificial Intelligence in Basic Education: Definitions and Scope

Artificial Intelligence (AI) in education broadly refers to the application of computer systems or machines capable of performing tasks traditionally requiring human cognitive functions, such as learning, reasoning, problem-solving, language understanding, and decision-making (Luckin et al., 2016; Holmes et al., 2019). In the context of basic education (K–9), AI encompasses a diverse array of

technologies designed to support and enhance teaching and learning processes, including intelligent tutoring systems (ITS), adaptive learning platforms, chatbots, automated assessment tools, plagiarism detection software, and speech-to-text applications (Chen et al., 2020; Zawacki-Richter et al., 2019).

These AI tools are increasingly integrated into popular learning management systems (LMS) such as Google Classroom, Microsoft Teams, and Moodle, which serve as centralized hubs for content delivery, student interaction, and data collection. Additionally, AI-powered subject-specific applications like Duolingo for language learning, Khan Academy for mathematics and sciences, and Sora for reading have gained traction worldwide, offering learners personalized experiences tailored to their proficiency levels and learning pace (Luckin et al., 2016; Holmes et al., 2019).

At their core, AI systems rely on data-driven algorithms that analyze large volumes of learner-generated data, including responses, engagement metrics, and behavioral patterns, to provide instant feedback, adjust instructional content, and recommend personalized learning pathways. In K–9 settings, this capacity enables differentiated instruction in key subject areas such as reading, mathematics, sciences, and second language acquisition (Chen et al., 2020). For example, intelligent tutoring systems can scaffold student understanding by dynamically modifying task difficulty based on real-time performance, thereby supporting mastery learning and cognitive skill development (VanLehn, 2011).

Despite the growing global interest in AI in education, its adoption in the early and middle years of schooling remains comparatively limited relative to higher education contexts (Zawacki-Richter et al., 2019; Holmes et al., 2019). This discrepancy is attributable to several factors. First, there is heightened ethical sensitivity around the use of AI with young learners, particularly concerning data privacy, consent, and the protection of minors (Williamson & Eynon, 2020). Educational stakeholders often prioritize human-centered pedagogies emphasizing social interaction, empathy, and developmental appropriateness, which many fear may be undermined by technology-heavy approaches at foundational stages (Selwyn, 2019).

Second, in many developing regions, including Lebanon, AI is often conceptually mixed with general information and communication technology (ICT) use, making it challenging to accurately distinguish between basic digital tools and genuinely AI-driven applications (Makki et al., 2023). This conflation complicates the assessment of AI's current penetration and potential in local K–9 classrooms. Many Lebanese teachers and administrators associate AI primarily with rudimentary tools such as PowerPoint presentations, Zoom video conferencing, or simple computer-based drills, rather than advanced adaptive learning platforms or intelligent tutoring systems (AUB, 2023).

Furthermore, infrastructural challenges, including limited internet access, power instability, and scarce availability of localized Arabic AI applications, pose barriers to effective AI integration in Lebanese basic education (El-Hage, 2023; Ayyash et al., 2022). These technological constraints are accentuated by insufficient teacher training and a lack of national strategic frameworks explicitly targeting AI, which restricts the systematic exploration and scaling of AI innovations in K–9 schools (Makki et al., 2023).

Building on this conceptual foundation and contextual understanding, the following sections will critically examine the current perceptions, adoption patterns, and implementation challenges of AI integration within Lebanese basic education.

3.2. Opportunities of AI Integration in K–9 Classrooms

The integration of AI into basic education (K–9) presents a wide range of pedagogical and operational opportunities that can significantly enhance both teaching and learning experiences. These opportunities align with broader educational paradigms such as constructivist learning theories, universal design for learning, and data-informed instruction, providing educators with tools that support personalization, efficiency, and early intervention (Zawacki-Richter et al., 2019; Holmes et al., 2019).

3.2.1. Personalized and Adaptive Learning

Perhaps the most widely cited benefit of AI in education is its capacity for personalized learning. AI-powered platforms can adapt content, pacing, and scaffolding to meet the individual learning needs of students, offering tailored feedback and targeted support (Luckin et al., 2016). This model aligns with the principles of learner-centered instruction, in which the teacher acts as a facilitator rather than a sole knowledge provider. AI systems, such as Squirrel AI, Smart Sparrow, and Century Tech, use machine learning algorithms to track student progress in real-time and adjust learning tasks accordingly (Holmes et al., 2019).

In early and middle grades, this is particularly important for students with learning differences, notably those acquiring a second language or learners who struggle with the pace of traditional classroom instruction. By providing customized learning pathways, AI can promote greater inclusion and equity in the classroom (Baker et al., 2022). Additionally, adaptive AI can serve as a digital teaching assistant

for overburdened teachers, thereby enabling them to devote more attention to students who require direct support.

In Lebanon, where classrooms—particularly in public schools—are often overcrowded and under-resourced, the promise of AI for differentiated instruction is especially needed. Ayyash et al. (2022) suggest that adaptive technologies can mitigate the effects of large class sizes by automating routine instruction and offering individualized practice opportunities. While implementation is still in its beginnings, several private and NGO-supported schools have begun to explore such tools in limited pilot projects (UNESCO, 2023).

3.2.2. AI-Driven Assessment and Feedback

Another promising domain for AI integration is assessment and feedback. AI can assist in automating formative and summative evaluations, particularly for closed-ended questions like multiple choice, but also increasingly for open-ended responses through natural language processing (NLP) and machine scoring engines. Tools such as Gradescope and Turnitin's Revision Assistant use AI to analyze patterns in student writing, offer rubric-aligned feedback, and suggest areas for improvement (Holmes et al., 2019; Zawacki-Richter et al., 2019).

Automated assessment systems promote consistency in grading, reduce the subjective bias inherent in human marking, and allow teachers to focus more on instructional planning and student engagement (Heffernan & Heffernan, 2014). Furthermore, real-time analytics provide teachers with dashboards that visualize student misconceptions, skill gaps, and performance trends—enabling data-driven instruction (Eickelmann et al., 2020).

In Lebanon, where teacher workloads are often high and formative assessment practices underdeveloped due to time constraints, AI-based assessment tools can offer significant efficiency gains (El Masri & Tarhini, 2022). According to a 2023 policy brief by the American University of Beirut, Lebanese teachers—especially in multilingual environments—often struggle to offer timely and personalized feedback due to class size and curriculum density. AI systems, when implemented appropriately, can help bridge this gap and enhance instructional responsiveness.

3.2.3. Classroom Management and Administrative Efficiency

AI also holds considerable promises to reorganize administrative and classroom management tasks. Tools equipped with predictive analytics can forecast student attendance, flag behavioral patterns, and provide early warning signs for disengagement or academic risk (Cheng et al., 2025). Some platforms incorporate emotion-detection algorithms and voice recognition technologies that help teachers monitor student well-being and emotional engagement, supporting the integration of socio-emotional learning (SEL) into daily instruction (Yadegaridehkordi et al., 2019). These tools may be particularly helpful in basic education environments, where younger students often require constant monitoring and emotional regulation support. While the ethical implications of such tools demand further examination, their potential to support behavioral intervention, attendance tracking, and student engagement analysis cannot be ignored.

In Lebanon, where school administrators often lack robust data systems, AI can assist in tasks such as scheduling, student recordkeeping, lesson planning, and resource allocation—freeing up valuable human capital (Makki, Khoury, & Bou Malhab, 2023). Reports by El-Hage (2023) and Ayyash et al. (2022) highlight that Lebanese schools spend substantial time on paperwork and manual data entry, processes that could be digitized and streamlined through AI-based solutions, especially in networks where administrative burdens are shared across campuses.

3.2.4. Support for Educational Resilience

Artificial Intelligence (AI) technologies hold significant potential to strengthen educational resilience, particularly in crisis-affected and fragile settings where learning continuity is regularly disrupted. In countries like Lebanon, where the education system has faced overlapping emergencies—including economic collapse, political unrest, infrastructure decay, the COVID-19 pandemic, and the prolonged Syrian refugee crisis—the ability to maintain learning processes under pressure is a national priority (UNESCO, 2021; AUB, 2023). AI offers a suite of digital solutions that can mitigate these disruptions by automating instructional support, enabling self-paced learning, and providing real-time data to inform decision-making.

AI-powered distance learning platforms are especially valuable in scenarios where in-person schooling is interrupted. These platforms can deliver tailored instruction asynchronously, which is crucial in regions facing frequent power outages, mobility restrictions, or school closures. For example, AI-based

adaptive learning systems such as Knewton or Smart Sparrow can adjust content difficulty based on student interaction, thereby promoting autonomous learning even in the absence of a teacher (Holmes et al., 2019). Additionally, AI-integrated learning management systems (LMS) with predictive analytics capabilities can help schools identify patterns of absenteeism or disengagement early, allowing for timely interventions (Baker et al., 2022).

In Lebanon, these possibilities are particularly relevant. The massive teacher exodus due to inflation and low salaries, coupled with the strain of integrating over 400,000 Syrian refugee children into the formal and non-formal education systems, has created widespread learning inequities (UNICEF, 2022). AI-enhanced mobile platforms can help fill some of these gaps by offering on-demand tutoring, translation tools, and formative assessments to out-of-school children, especially those in underserved areas or refugee camps. Chatbots like Chat GPT and Copilot, for instance, can offer multilingual instructional support and direct learners toward helpful resources in contexts where human teachers are unavailable (UNESCO, 2021).

Organizations such as UNICEF, Ana Aqraa, and the Lebanese Alternative Learning (LAL) initiative have already begun piloting AI-driven mobile learning interventions in non-formal education. Tools like Tabshoura, a platform developed by LAL, incorporate adaptive learning principles to provide offline, gamified content to learners in both Arabic and French. While not fully AI-driven, recent iterations of these tools have begun to include basic personalization algorithms to track learner progress and recommend next steps (LAL, 2023). These efforts reflect growing institutional interest in scalable, low-cost AI solutions that can reach marginalized populations during crises.

Moreover, AI-enabled learning diagnostics can assist humanitarian actors and educational planners in tracking learning losses, identifying recovery priorities, and forecasting resource needs. In a country like Lebanon, where data systems are fragmented and often outdated, the application of AI to collect and analyze student-level data at scale could support more targeted, evidence-based policy responses (Ayyash et al., 2022).

Despite these advantages, scaling AI for resilience requires careful planning. Without adequate digital infrastructure, device availability, and language localization, such tools risk reinforcing existing inequalities. Furthermore, in emergency settings, ethical concerns regarding data security, consent, and transparency are magnified. Thus, AI-based resilience strategies must be accompanied by safeguarding mechanisms, ethical oversight, and culturally responsive design (UNESCO, 2021; Williamson & Eynon, 2020).

While AI holds considerable promise for enhancing educational resilience in Lebanon's crisis-affected context, its implementation also raises critical ethical, pedagogical, and equity challenges that must be carefully addressed to ensure responsible and inclusive integration.

3.3. Risks and Challenges: Ethical, Pedagogical, and Equity Concerns

Despite the transformative potential of AI in education, its integration presents a series of complex risks and challenges that must be acknowledged and addressed, particularly in basic education settings where learners are more vulnerable and teaching relies heavily on relational dynamics. Both globally and locally, concerns about data privacy, algorithmic bias, pedagogical shifts, and digital inequities have emerged as core areas that require examination in educational technology discourse (Williamson & Eynon, 2020; Selwyn, 2019).

This section examines the major risks associated with AI integration in basic education, focusing on data privacy and security, algorithmic bias, pedagogical implications, and issues of equity and access.

3.3.1. Data Privacy and Security

A primary ethical concern is the collection, use, and storage of student data. AI-powered tools often rely on large-scale data mining, including information on student behavior, learning patterns, emotional states, and in some cases, biometric data such as facial recognition or voice inputs. This raises critical questions regarding informed consent, data ownership, and cybersecurity safeguards, which are issues that are not yet fully addressed in most educational systems (Luckin et al., 2016; Holmes et al., 2019).

In Lebanon, these concerns are particularly prominent given the lack of a robust national data protection law governing the use of educational technology. As noted by El-Hage (2023), most Lebanese schools do not have formalized digital governance frameworks or institutional policies for managing sensitive learner data. Furthermore, studies show that many teachers and school leaders are unaware of the ethical and legal implications of using AI tools that process student information (Makki et al., 2023; AUB, 2023). This policy gap creates a high-risk environment in which data could be commercialized, misused, or exposed to security breaches, especially when using foreign-developed applications with unclear privacy standards.

3.3.2. Algorithmic Bias and Lack of Transparency

Another pressing issue is algorithmic bias, where AI systems produce outputs that reflect and reinforce societal inequities. Since these systems are trained on historical or real-time data that often lack

diversity or context sensitivity, they may disseminate stereotypes related to race, gender, language, or learning styles (Selwyn, 2019; Williamson & Eynon, 2020). For example, speech recognition tools may struggle to interpret Arabic dialects or Levantine accents, leading to inaccurate feedback or exclusion from learning platforms. Such outcomes disproportionately affect marginalized or underperforming students, thus exacerbating existing inequalities.

While global literature has called for increased algorithmic transparency and explainability in educational AI design, these concepts remain largely absent from policy discussions in Lebanon. As Ghamrawi et al (2024) points out, very few Lebanese educators receive training in evaluating AI tools for bias, fairness, or cultural relevance. Without awareness and vetting mechanisms, schools risk embedding discriminatory logic into daily instruction, often unknowingly.

3.3.3. Pedagogical Concerns

Beyond ethics, pedagogical risks accompany the rise of AI in the classroom. Critics warn that AI could lead to the de-skilling of teachers, where over-reliance on automated content delivery or assessment systems erodes educators' instructional autonomy and creativity (Zawacki-Richter et al., 2019). In early and middle childhood education, where emotional connection, play-based learning, and student-teacher interaction are foundational, the imposition of rigid, data-driven systems may reduce learning to mechanical processes (Holmes et al., 2019).

In the Lebanese context, this risk is magnified by limited pedagogical training on how to integrate AI meaningfully. Teachers may adopt AI tools without clear instructional purpose, using them as time-saving substitutes rather than supports for differentiated or deeper learning (Makki et al., 2023; Ayyash et al., 2022). Furthermore, although education reforms in Lebanon have begun integrating digital literacy and AI competencies into the curriculum, comprehensive AI-enabled pedagogies remain fragmented, hampered by inconsistent infrastructure and limited training (Education Profiles, 2024).

These tensions create a need for critical digital pedagogy—where educators are empowered not only to use technology but to question its assumptions, assess its impact on learners, and decide when it is pedagogically appropriate to employ AI versus traditional methods (Selwyn, 2019; UNESCO, 2021).

3.3.4. Equity and the Digital Divide

Perhaps the most visible challenge is educational equity. AI integration requires not only tools and software but also reliable internet, updated infrastructure, and continuous technical support. This

creates disparities between well-resourced urban private schools and under-resourced public or rural institutions, many of which lack basic digital readiness (Ayyash et al., 2022; El-Hage, 2023).

In Lebanon, the digital divide is intensified by persistent inequalities in funding, teacher training, and infrastructure. During the COVID-19 pandemic, numerous public school students were excluded from online learning due to device unavailability or lack of connectivity—an issue that continues to affect the potential for AI adoption (UNESCO, 2021). As private institutions experiment with AI tools and form partnerships with tech providers, public schools risk being left further behind, thereby creating a two-tiered education system where only some learners benefit from innovation.

Moreover, language and content localization remain major challenges. Many AI platforms are not designed with Arabic-speaking learners in mind, especially in Lebanon's multilingual context, where students often shift between Arabic, French, and English. Without culturally relevant content and interface accessibility, AI tools may alienate rather than empower learners (Makki et al., 2023)

3.4. Teacher Readiness and Professional Development

Teachers are widely recognized as the linchpin in the successful integration of Artificial Intelligence into classrooms. Literature across educational systems demonstrates that the mere availability of AI tools is insufficient; rather, the adoption and meaningful use of such technologies depend heavily on teachers' self-efficacy, attitudes toward innovation, and their perceived relevance of AI for teaching and learning (Eickelmann et al., 2020). In K–9 settings, this challenge is amplified because generalist teachers often cover multiple subjects and may not have specialized training in technology-enhanced instruction. Therefore, AI integration in basic education requires not only technical competence but also pedagogical adaptability and a shift in teachers' professional identities (Zawacki-Richter et al., 2019).

In the Lebanese educational context, research reveals that teacher preparedness for AI integration is limited and uneven, shaped by factors such as socio-economic inequality, lack of institutional support, and inconsistent access to professional development. Before the COVID-19 pandemic, digital skills among Lebanese teachers were generally underdeveloped, particularly in public and rural schools (Ghamrawi et al, 2024). The pandemic triggered a rapid and often reactive transition to digital learning, which improved basic ICT familiarity but did not foster in-depth engagement with more advanced AI-based tools (Ayyash et al., 2022; Makki et al., 2023). Teachers often equate "educational technology" with video conferencing, digital presentations, and e-content sharing, rather than recognizing AI's potential for real-time learning analytics, intelligent tutoring, or behavioral modeling (El-Hage, 2023).

This superficial engagement with AI tools is partly due to a lack of structured, ongoing professional development (PD) tailored to emerging technologies. Studies show that most teacher training in Lebanon—especially during and post-pandemic—focused on platform navigation like Google Classroom and Zoom, but rarely addressed critical AI concepts such as data ethics, algorithmic bias, or the pedagogical implications of adaptive learning systems (UNESCO, 2021; AUB, 2023). Moreover, many AI- focused PD initiatives are externally funded, short-term, and fragmented, which limits their long-term impact and fails to build sustainable capacity within schools (Momdjian, Manegre, & Gutiérrez-Colón, 2024).

Effective PD for AI integration requires a multifaceted approach that goes beyond technical orientation. Research emphasizes that PD must be ongoing, reflective, and situated within real classroom contexts. It should involve collaborative inquiry, peer mentoring, hands-on experimentation with AI tools, and opportunities for teachers to co-design solutions that respond to the needs of their students (Dede, 2020; Holmes et al., 2019). In addition, training should be aligned with curricular objectives, emphasizing how AI tools can support differentiated instruction, formative assessment, and inclusive learning.

Another critical dimension of teacher readiness is ethical awareness. As AI systems increasingly collect and analyze student data, educators must be equipped to understand and interrogate the implications of their use. Ethical professional development should address how student data is collected, stored, and owned, as well as how algorithmic decisions may reinforce bias and inequality. Without such ethical grounding, teachers risk becoming passive implementers of non-transparent technologies, rather than informed professionals shaping responsible digital futures (Williamson & Eynon, 2020; Selwyn, 2019).

Moreover, teachers in Lebanon report time constraints, curricular overload, and limited decision-making autonomy as key barriers to experimenting with AI tools in their practice (Makki et al., 2023). Addressing teacher readiness therefore also requires system-level reforms, including policy adjustments, school leadership support, and flexible teaching frameworks that encourage innovation.

To foster genuine readiness for AI integration in Lebanon's K–9 classrooms, professional development must be nationally coordinated but locally responsive, embedded in broader educational reform strategies. Teacher education programs in universities should also be updated to include AI literacy, critical digital pedagogy, and interdisciplinary approaches, ensuring that the next generation of educators enters the profession with both the skills and mindsets needed for a digitally mediated world (Harris & Hofer, 2023).

3.5. School Leadership, Infrastructure, and Policy Support

The role of school leadership is widely recognized as a critical factor in the successful integration of AI in education. Studies in the global context demonstrate that schools with visionary leaders who foster a culture of innovation, allocate resources effectively, and provide pedagogical guidance are more likely to adopt emerging technologies meaningfully (Leithwood, Harris, & Hopkins, 2020; Fullan, 2021). Leadership that promotes experimentation, continuous professional development, and inclusive decision-making is essential for cultivating an environment in which AI can be leveraged to improve teaching and learning outcomes (Dede, 2020).

In Lebanon, limited but growing research has begun to explore the relationship between school leadership and digital transformation. According to El Masri and Mansour (2023), Lebanese school leaders often lack formal training in technology leadership, which hinders their ability to guide staff through complex educational innovations. Further studies highlight that leadership in Lebanese private schools tends to be reactive rather than strategic, with principals focusing more on short-term operational concerns than long-term digital planning (Nakhle & Karam, 2022). These tendencies impact not only how AI is adopted but also how sustainable and pedagogically sound its use becomes.
The issue of infrastructure forms another cornerstone of AI readiness. Globally, successful AI integration depends on stable internet connectivity, up-to-date hardware, reliable electricity, cybersecurity systems, and ongoing technical support (Holmes et al., 2019; Luckin et al., 2016). In Lebanon, infrastructural weaknesses—particularly in public and under-resourced private schools—are a major barrier to digital innovation. Research by El-Hage (2023) and Ayyash et al. (2022) underscores that frequent power cuts, outdated devices, and poor internet connection severely limit the use of ICT tools, let alone AI-enhanced platforms. Moreover, inequities across regions and school types contribute to a growing digital divide, where some learners benefit from tech-enhanced environments and others are entirely excluded.

The infrastructure gap is further widened by the absence of a coherent national strategy for AI integration in education. While several countries in the MENA region, such as the UAE and Qatar, have developed comprehensive AI policies that include education as a key pillar, Lebanon currently lacks a formal framework guiding AI integration in schools (UNESCO, 2021). This policy vacuum forces schools to rely on informal, school-led initiatives or external donor projects, resulting in fragmented practices and inconsistent standards. Momdjian et al. (2024) highlight a systemic lack of

support and coherent national-level guidance on digital competencies. This has resulted in a clear mismatch between the schools' needs and the tools available, alongside fragmented efforts and redundancies in educational technology initiatives in Lebanon.

Ethical considerations and data protection are also under-addressed in Lebanese educational policy. As AI tools increasingly collect and process student data, the lack of clear national guidelines on privacy, consent, and algorithmic accountability exposes schools and learners to significant risks (Williamson & Eynon, 2020). Currently, Lebanese educational institutions rely on general IT protocols or vendor-specific terms, rather than sector-specific laws that ensure transparency and fairness in AI usage.

Despite these limitations, some progress is being made. Private universities in Lebanon, such as the American University of Beirut (AUB) and Beirut Arab University (BAU), have initiated research and dialogue on AI in education, suggesting that academic-public partnerships could be a future path for developing a more coherent national AI framework (Makki et al., 2023). Furthermore, non-governmental organizations and international agencies operating in Lebanon, such as UNICEF and UNESCO, have begun piloting AI-related digital learning projects, primarily focused on refugee education and remote learning (UNESCO, 2021). However, these remain limited in scope and are not yet embedded in national reform plans.

The reviewed literature underscores the complexity of AI integration in Lebanese education, revealing significant challenges and growing initiatives in leadership, infrastructure, and policy that warrant deeper examination in future research.

4. Methodology

This study employed a mixed-methods research design, combining quantitative and qualitative approaches to provide a comprehensive understanding of the integration of Artificial Intelligence (AI) in basic education (K–9) within the seven Al Makassed Association schools in Beirut. The mixed-methods approach was selected to leverage the strengths of both data types, enabling a richer, triangulated insight into the practices, perceptions, and contextual factors influencing AI adoption in these schools (Creswell & Plano Clark, 2018).

4.1. Research Design

The study's design consisted of convergent parallel mixed methods, where quantitative and qualitative data were collected synchronously but analyzed separately, then integrated during interpretation to

corroborate findings and identify nuances (Creswell, 2014). This design was appropriate given the exploratory nature of the investigation and the need to capture both measurable trends and in-depth perspectives regarding AI use.

4.2. Participants and Sampling

The participants included three primary stakeholders:

1. Teachers across various grade levels (K–9), who are the primary users of AI tools in the classroom.
2. School administrators, including principals and department heads, who are responsible for institutional strategies, infrastructure, and policy implementation.
3. ICT coordinators, who provide technical support and facilitate AI tool integration.

A stratified purposive sampling strategy ensured representation across the seven schools, balancing factors such as school size and grade distribution. The total sample consisted of 108 teachers, 16 administrators, and 6 ICT coordinators. Participation was voluntary, with ethical approval obtained from the schools and consent secured from all participants.

4.3. Data Collection Methods

Three distinct data collection tools were developed to capture complementary dimensions of AI integration:

1. **Teacher Survey:** A structured questionnaire designed to assess teachers' frequency and types of AI tool usage, attitudes toward AI in education, perceived benefits and challenges, and self-reported readiness and professional development needs. The survey included Likert-scale items, multiple-choice questions, and open-ended prompts to elicit nuanced responses. The instrument was pilot-tested with a small group of teachers outside the sample to ensure clarity and reliability (Cronbach's alpha = 0.87).
2. **Administrator Survey:** This questionnaire targeted school leaders to examine institutional-level factors influencing AI adoption, including strategic priorities, available infrastructure (hardware, software, internet connectivity), policy frameworks, and external partnerships. Questions addressed professional development offerings and monitoring/evaluation practices related to AI.
3. **Focus Group Discussions (FGDs) with ICT Coordinators:** Semi-structured FGDs were conducted to delve deeper into the technical challenges, implementation mechanisms, and support

systems that reinforce AI use. The instrument was pilot-tested with a small group of ICT coordinators outside the sample to ensure clarity and reliability. These discussions explored topics such as infrastructure maintenance, troubleshooting protocols, teacher support strategies, data privacy concerns, and collaboration with technology vendors. FGDs were audio-recorded and transcribed verbatim for analysis.

4.4. Data Analysis

Quantitative survey data were analyzed using descriptive statistics (frequencies, means, standard deviations) to outline general patterns of AI usage and perceptions among teachers and administrators. Additionally, cross-group comparisons (e.g., by school, grade level, teacher experience) were conducted using chi-square tests and ANOVA to detect statistically significant differences in AI integration practices and attitudes.

Qualitative data from open-ended survey responses and FGD transcripts underwent thematic analysis following Braun and Clarke's (2006) six-phase framework. This process involved initial coding, identification of recurring themes related to challenges, enablers, and ethical considerations, and synthesis into coherent categories aligned with the study's research questions.

The triangulation of quantitative and qualitative findings enhanced the validity and credibility of the results by allowing cross-verification and a multifaceted understanding of AI integration in context.

4.5. Ethical Considerations

The study adhered to ethical research standards, including obtaining informed consent, ensuring participant anonymity, and safeguarding data confidentiality. Participants were informed about the study's purpose and their right to withdraw at any time. Data storage also complied with institutional data protection policies.

5. Findings and Discussion

This section presents a detailed analysis and interpretation of findings from two surveys conducted with administrators (n = 16), and teachers (n = 108) and a focus group discussion with ICT coordinators (n = 6) across all seven Al Makassed schools operating in Beirut. The combined quantitative and qualitative data address the four research questions, employing percentages and Likert-scale frequencies to identify trends and differences among stakeholders regarding AI integration

in K–9 education. This mixed-perspective approach reveals both promising advances and notable gaps in practice, which align with existing literature on AI adoption in education.

5.1. Perceived Opportunities of AI in Basic Education

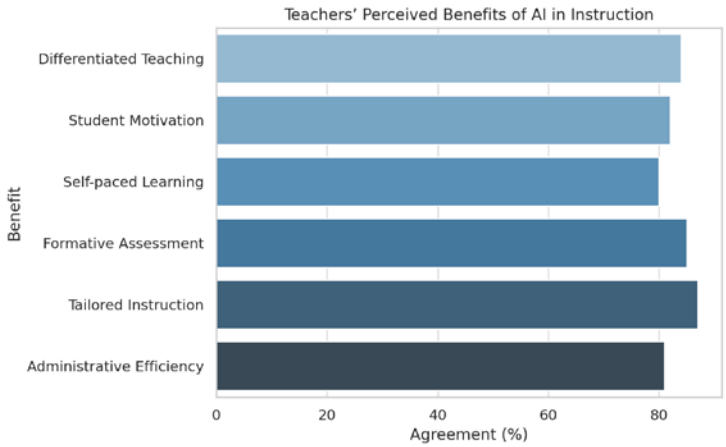
Across all groups, stakeholders acknowledge significant potential benefits of AI to enhance teaching, learning, and school management.

Administrators overwhelmingly affirm AI's positive impact on learning outcomes, evidence-based leadership, teacher productivity, and educational equity. Their confirmation reflects a recognition of AI's capacity to provide data-driven insights and personalized learning pathways, consistent with contemporary educational reform discourse (Luckin et al., 2016).

ICT coordinators display more moderate optimism, with many neutral responses. This cautious stance likely reflects their frontline experience with technical challenges and variability in system implementation, highlighting the importance of reliable infrastructure and coherent strategy for AI success (Sánchez-Prieto et al., 2020).

Teachers provide the strongest positive endorsement of AI's instructional value. 82% agree that AI supports tailored instruction, student motivation, administrative efficiency, formative assessment, differentiated teaching, and self-paced learning. This high level of agreement indicates that teachers perceive AI as a powerful pedagogical enabler when available. However, the earlier noted gap in classroom integration suggests that these benefits are not yet fully realized, which aligns with literature emphasizing the need for sustained support and contextualized training to maximize AI's impact (Zawacki-Richter et al., 2019).

Figure 1: Teachers' Perceived Benefits of AI in Instruction



To conclude, there is broad consensus that AI holds significant educational promise, but unlocking its full potential requires addressing practical barriers that currently limit consistent classroom application. The findings from this section strongly support Hypothesis 1 (H1), as educators, ICT coordinators, and school leaders generally perceive AI integration as valuable for enhancing teaching, learning, and school management. This aligns with Holmes et al. (2022) and Luckin et al. (2016), who emphasize that when AI integration is contextually grounded, it is widely regarded by educators as a means to enhance pedagogy, promote personalized learning, and improve school management practices. The high agreement among teachers (82%) and positive views from administrators affirm this perception.

5.2. Challenges and Risks Associated with AI Use

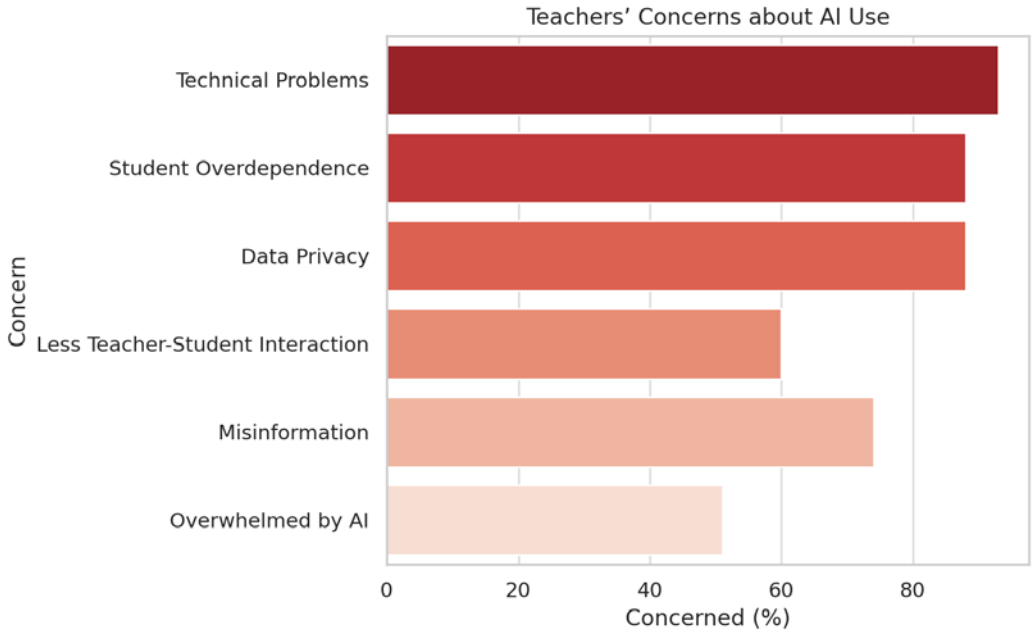
Despite enthusiasm, stakeholders identify numerous ethical, technical, and pedagogical challenges that constrain AI adoption.

Administrators highlight the lack of teacher training, inadequate infrastructure, data privacy concerns, and unclear policies. These barriers are common in educational AI implementations, where governance and ethical frameworks are still evolving (Holmes et al., 2019).

ICT coordinators point to the risks of student overdependence, technical difficulties, limited teacher engagement, and misalignment between leadership and teaching staff priorities. These findings emphasize the complex socio-technical dynamics influencing AI use in schools (Selwyn, 2019).

Teachers express considerable concerns, particularly about students' reliance on AI undermining independent thinking (88%), data privacy (88%), technical problems limiting use (93%), and potential reductions in meaningful teacher-student interaction (60%). The worry about misinformation (74%) and feeling overwhelmed by rapid AI developments (51%) further highlight the precarious balance teachers navigate. These concerns mirror broader debates on AI ethics in education, including risks of deskilling, bias reinforcement, and loss of human-centric pedagogy (Williamson & Eynon, 2020).

Figure 2: Teachers' Concerns about AI Use



In brief, stakeholders agree that while AI offers benefits, significant ethical, technical, and pedagogical challenges must be proactively managed through comprehensive training, infrastructure improvement, and clear policy frameworks.

The concerns expressed by all stakeholder groups about ethical, pedagogical, and operational risks align closely with Hypothesis 2 (H2). This is consistent with Zawacki-Richter et al. (2019) and Holmes et al. (2022), who highlight that AI integration in education can pose significant challenges related to data privacy, algorithmic bias, and the erosion of teacher autonomy, especially in contexts with limited resources and weak policy safeguards. Issues such as data privacy, student overdependence, and reduced teacher-student interaction were prominently noted, highlighting the perceived risks associated with AI adoption, particularly in resource-constrained environments like Lebanese K–9 schools.

Critical Factors for Effective AI Implementation

Across all groups, clear leadership vision, comprehensive teacher training, strong infrastructure, and explicit ethical policies emerge as foundational for successful AI integration.

Administrators and ICT coordinators unanimously agree on the importance of leadership, infrastructure, and ongoing professional support. Teacher readiness is singled out as the most crucial factor, reinforcing the literature's emphasis on capacity-building over technology acquisition alone (Ertmer & Ottenbreit-Leftwich, 2010).

Teachers largely echo these needs, with 84% requesting more training, 81% desiring clearer ethical guidelines, and 89% emphasizing reliable internet and devices. Notably, only 60% feel supported technically, indicating a significant support gap that could undermine adoption efforts.

Collectively, these findings confirm that AI integration demands a holistic ecosystem approach, which balances visionary leadership, infrastructural readiness, pedagogical support, and ethical stewardship, to foster sustainable and equitable use in classrooms (West et al., 2019).

Table 1: Critical Factors for AI Integration by Stakeholder Group

Factor	Teachers Agree (%)	Administrators Agree (%)	ICT Coordinators Agree (%)
Need for Training	84	100	100
Need for Ethical Guidelines	81	100	100
Reliable Internet/Devices	89	100	100
Technical Support Received	60	100	100

The triangulated data reveals a cautiously optimistic but uneven landscape of AI integration in Al Makassed schools. Leadership and ICT teams express confidence in AI's institutional embedding and potential, while teachers recognize AI's instructional advantages but face practical and ethical challenges that limit classroom use. Across all groups, the necessity for aligned vision, robust infrastructure, comprehensive training, and clear policies emerges as a unifying theme.

This multi-stakeholder insight highlights the critical importance of bridging strategic aspirations and classroom realities to ensure AI tools deliver equitable and meaningful educational benefits. These findings echo global trends emphasizing human-centered, context-sensitive approaches to educational AI integration.

This section's findings verify Hypothesis 3 (H3). The critical role of infrastructure, teacher training, and clear ethical guidelines in shaping AI integration perceptions confirms that benefits are closely tied to these factors (H3).

Overall, the findings largely support the proposed hypotheses. Stakeholders value AI for its capacity to enhance education (H1) yet acknowledge substantial risks and challenges that require deliberate management (H2). They also agree that infrastructure, training, and ethical frameworks are foundational for effective use (H3). This reflects the observations of Spector et al. (2020) and OECD (2021), who note that in many education systems, policy development and institutional support mechanisms often lag behind the rapid deployment of AI tools, creating gaps that hinder sustainable and responsible integration. The study confirms that bridging the gap between strategic aspirations and classroom realities is essential for ensuring AI tools deliver equitable, meaningful, and sustainable benefits in basic education.

6. Conclusion and Recommendations

6.1. Conclusion

This study provides a thorough picture of AI integration in K–9 classrooms across Al Makassed schools in Beirut, revealing both promising advancements and notable gaps. While administrators and ICT coordinators express optimism about AI's growing presence and potential to enhance teaching, learning, and management, teachers experience more limited classroom implementation, reflecting an implementation gap.

All stakeholders recognize AI's significant benefits—particularly for personalized learning, instructional differentiation, formative assessment, and school efficiency. Yet, substantial challenges remain, including inadequate teacher training, infrastructure limitations, ethical concerns around data privacy and student autonomy, and technical issues.

From a critical lens, successful AI adoption depends on more than technology availability. It requires a systemic approach that aligns clear leadership vision with ongoing professional development, robust infrastructure, coherent policies, and ethical guidelines. Addressing these factors holistically is essential to translate AI's potential into equitable and sustainable classroom practice.

6.2. Recommendations

Based on the findings, the following recommendations aim to support effective and ethical AI integration in basic education within Al Makassed schools:

1. Strengthen teacher capacity through targeted professional development: Professional development programs should be designed to be continuous, practical, and tailored to teachers'

everyday realities. Such training must go beyond technical skills to include pedagogical strategies for integrating AI meaningfully, as well as addressing ethical considerations related to AI use. Encouraging collaboration among teachers through communities of practice can also enhance knowledge sharing and build collective confidence in AI adoption.

2. **Enhance infrastructure and technical support:** There is an urgent need for sustained investment in hardware and network reliability. Furthermore, establishing responsive and well-staffed technical support teams will help ensure that issues are addressed immediately, which minimizes disruption and frustration for both teachers and students.

3. **Develop clear institutional policies and ethical guidelines:** Schools should therefore establish comprehensive frameworks that define transparent, responsible AI use, protect student information, and promote fairness and inclusivity. Importantly, these policies must be co-created with input from teachers and ICT coordinators to ensure they are practical and embraced by all stakeholders, thus avoiding ambiguity and confusion around AI governance.

4. **Foster leadership alignment and strategic vision:** There is a need for coherent communication and collaboration across school leadership, ICT staff, and teaching teams. Embedding AI integration within the broader school improvement agenda will help ensure that AI initiatives are strategically planned, adequately resourced, and continuously monitored. When leadership provides clear direction while actively involving teachers, the likelihood of meaningful adoption increases significantly.

5. **Monitor and evaluate AI integration continuously:** Establishing systematic feedback mechanisms will allow schools to capture the lived experiences of all stakeholders, identify emerging challenges, and celebrate successes. This data-driven approach supports the continuous refinement of AI practices, helping to scale what works while adapting to evolving needs and contexts. Ongoing evaluation will also foster a culture of reflective practice and accountability around AI use.

6. **Prioritize human-centered approaches:** Technology should be positioned as an enabler that complements and amplifies teachers' expertise rather than a substitute for human interaction. Maintaining a balance that preserves critical thinking, creativity, and meaningful teacher-student relationships will preserve the educational values essential for student development. By focusing on AI as a supportive tool within a nurturing learning environment, schools can harness its benefits without compromising pedagogical integrity.

Implementing these recommendations can help schools integrated in AI integration bridge the gap between AI's promise and realities, thereby fostering inclusive, ethical, and impactful educational innovation.

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