

Blended Learning Enhanced by Artificial Intelligence in Palestinian Public Primary Schools During Crises and Exceptional Circumstances: Perspectives and Aspirations

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Abstract: Objective: This study aimed to identify the role of blended learning supported by artificial intelligence in government schools for the lower primary stage in Palestine, considering the challenges imposed by crises and exceptional circumstances, from the perspective of a group of educators. **Methodology:** A descriptive survey methodology with a qualitative phenomenological approach was used to understand the essence of the phenomenon. The study involved six primary-level teachers, three educational supervisors, and one curriculum expert. Data was collected through interviews, which served as the primary tool to answer the study's questions. **Key Findings:** The study reached several important findings regarding the needs that must be provided to improve the integration of artificial intelligence, including training of educational personnel to incorporate artificial intelligence in development of blended education in Palestine, enhancing the educational environment to facilitate the use of artificial intelligence, and creating programs aimed at integrating artificial intelligence into blended education in Palestine. Furthermore, the study identified challenges in applying artificial intelligence in blended education, including inadequate infrastructure represented by weak internet connectivity, frequent power outages, and insufficient access to appropriate technical devices for students and teachers. It also identified deficiencies in teachers' modern technical skills and their proficiency with blended education tools. **Conclusions:** This study contributes to this field by focusing specifically on the Palestinian context during crises, providing practical insights from a diverse group of educators in the primary stage for grades (1-4). **Recommendations:** The study presented several key recommendations, most importantly: establishing an integrated technical infrastructure and sustainable financial support, in addition to implementing ongoing training programs for teachers that emphasize the use artificial intelligence tools in education.

Keywords: Blended Learning, Artificial Intelligence (AI), Lower Primary Level, Crises, and Exceptional Circumstances

التعلم المدمج المدعوم بالذكاء الاصطناعي في المدارس الحكومية للمرحلة الأساسية في فلسطين في ظل الأزمات والظروف الاستثنائية: رؤى وتطلعات

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المخلص: الهدف: هدفت الدراسة إلى تحديد دور التعلم المدمج المدعوم بالذكاء الاصطناعي في المدارس الحكومية للمرحلة الأساسية الأولى في فلسطين، في ظل التحديات التي تفرضها الأزمات والظروف الاستثنائية، من وجهة نظر مجموعة من التربويين. **المنهجية:** تم استخدام المنهج الوصفي المسحي بمنحى نوعياً فينومينولوجياً لفهم جوهر الظاهرة، وشارك في الدراسة ستة معلمين من المرحلة الأساسية، وثلاثة مشرفين تربويين، وخبير مناهج واحد. تم جمع البيانات من خلال المقابلات، والتي شكلت الأداة الأساسية للإجابة على أسئلة الدراسة. **النتائج:** توصلت الدراسة إلى عدة نتائج مهمة فيما يتعلق بالاحتياجات التي يجب توفيرها لتحسين دمج الذكاء الاصطناعي، تضمنت: تدريب الكوادر التعليمية لدمج الذكاء الاصطناعي في تطوير التعليم المدمج في فلسطين، وتعزيز البيئة التعليمية لتسهيل استخدام الذكاء الاصطناعي، وإنشاء برامج تهدف إلى دمج الذكاء الاصطناعي في التعليم المدمج في فلسطين. بالإضافة إلى ذلك، حددت الدراسة تحديات تطبيق الذكاء الاصطناعي في التعليم المدمج تضمنت: البنية التحتية غير الملائمة التي تمثلت بضعف الاتصال بالإنترنت، وانقطاع التيار الكهربائي المتكرر، وعدم وجود وصول كافٍ للأجهزة التقنية المناسبة للطلاب والمعلمين. وأوجه القصور في مهارات المعلمين التقنية الحديثة وإتقانهم لأدوات التعليم المدمج. **الاستنتاجات:** تساهم هذه الدراسة بشكل فريد في هذا المجال من خلال التركيز تحديداً على السياق الفلسطيني خلال الأزمات، وتقديم رؤى عملية من مجموعة متنوعة من التربويين في المرحلة الأساسية للصفوف الأولى (1-4). **التوصيات:** أوصت الدراسة بعدد من التوصيات أهمها: إنشاء بنية تحتية متكاملة ودعم مالي مستدام، بالإضافة إلى تنفيذ برامج تدريب مستمرة للمعلمين تركز على استخدام أدوات الذكاء الاصطناعي في التعليم.

الكلمات المفتاحية: التعلم المدمج، الذكاء الاصطناعي، المرحلة الأساسية الأولى، الأزمات، والظروف الاستثنائية

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Introduction

With rapid technological advancement and global communication, it is important to consider how these developments impact various forms of education, including face-to-face, distance, interactive, blended, or fully online modalities. These raise questions about the effectiveness and the future of education.

E-learning provides opportunities yet to encounter obstacles including infrastructure limitations, limited availability of advanced devices and equipment, and the ongoing need to train human resources. Additional challenges involve technical requirements, including curriculum development, innovative teaching methods, and the provision of essential tools and technologies such as video presentations, software, and databases.

In response to these challenges, blended learning has emerged as a model that combines the advantages of e-learning and traditional instruction. It effectively integrates technology into education by merging direct and self-directed learning, leveraging digital tools while maintaining the essential human roles in the process (Marshood & Masheikh, 2017).

The world is also witnessing rapid developments in artificial intelligence (AI), one of the most significant achievements of the Fourth Industrial Revolution. Since its inception in 1956, AI, which aims to simulate human capabilities, has evolved from simple technologies to integrated systems with independent capacities, allowing machines to acquire human-like traits such as creativity, thinking, and learning. AI is distinguished by its ability to perform complex tasks efficiently and accurately at a low cost (Jawabreh & Itmazi, 2025).

The definitions of AI vary due to its evolving nature. It is viewed either as a means of simulating human thinking or as a scientific discipline focused on developing software

capable of advanced cognitive tasks (Jawabreh & Itmazi, 2025). Al-Waridat (2024) defined AI as a set of technologies that mimic human cognition to enhance learning, while Zhang (2024) described it as a mechanism that extends human intelligence, enabling machines to adapt to dynamic environments by analyzing data and improving performance.

AI plays an important role in enhancing learning and teaching by providing personalized experiences and detailed analytics, enriching interactions between learners and educational systems (Jawabreh & Itmazi, 2025). It also improves cognitive functions such as thinking, experiential learning, language acquisition, and decision making (Ramadan, 2024).

Despite these advancements, Palestinian education still faces major challenges in implementing blended learning and AI technologies. Limited infrastructure, inadequate curricula, and ongoing economic and political hardships have made their adoption a necessity rather than a choice.

Primary education is a crucial stage that shapes students' knowledge, skills, and attitudes. In response to current challenges in Palestine, public schools have adopted blended learning. Drawing on the researchers' experience in education and administration, this study investigates the application of AI in blended learning for lower primary grades in Palestinian public schools during crises, highlighting insights from teachers, supervisors, and curriculum experts.

Problem Statement and Research Questions: Given the rapid technological advancements and the growing shift towards blended learning, it is important to explore the integration of contemporary technologies into education. AI has emerged as an important tool that can improve educational quality and support educational functions, particularly

during crises and exceptional circumstances. Studies show that AI use at the elementary level yields valuable outcomes, as noted by both Ramadan (2024) and Zhang (2024).

Palestinian education faces numerous challenges, including poor infrastructure and insufficient teaching and learning materials, which hinder learning processes and impede students' and teachers' abilities to adapt to changing circumstances. Recurring wars and economic hardship have made blended learning a necessity, not a choice. Educational researchers have noticed a decline in blended learning quality in primary grades 1 through 4, prompting them to search for solutions. Integrating AI in educational processes, especially at the primary level, has become essential to ensure the continuation and quality of education.

This study focuses on addressing two critical issues: how to effectively integrate AI into education, and the challenges and potential solutions related to its implementation in Palestinian public schools. It also aims to explore educators' perspectives on the areas in which AI may enhance educational processes. The researchers' interest stems from their doctoral studies, which introduced them to modern instructional models that can be utilized in blended learning and deepened their understanding of integrating new technology in the educational process.

Research Questions: The study seeks to answer the following questions:

1. In what ways is AI utilized in blended learning in Palestine?
2. What are the challenges facing AI use in blended learning?
3. What are educators' recommendations to effectively utilize AI to enhance blended learning in Palestine?
4. What criteria must be met to successfully implement educators' recommendations for

effective AI integration into blended learning in Palestine?

Research Objectives: This study aims to examine how AI is utilized in blended learning in Palestine, identify the challenges hindering its use, explore educators' recommendations for enhancing blended learning through AI, and investigate the requirements for applying these recommendations.

Significance of the Research: The significance of this study lies in its theoretical and practical dimensions. Theoretically, it enriches educational literature on AI and blended learning in the context of crises and exceptional circumstances. Although studies in these individual concepts exist, there is a clear lack of studies combining both fields and applying them to the unique Palestinian context, especially in the early primary stage. This study presents a comprehensive theoretical framework that seeks to deepen understanding and support future research in this area.

Practically, this study offers actionable insights and a realistic picture of blended learning and AI applications. By gathering the professional opinions of teachers, educational supervisors, and curriculum experts, it identifies key challenges and offers suggestions to improve educational policies in Palestinian public schools. These include enhancing technological infrastructure, teacher professional development, and adapting curricula and programs that integrate AI and blended learning to support education during crises and increase the resilience of Palestinian education at the lower primary level. The results may serve as a starting point for future collaborations between the Ministry of Education, civil society organizations, the private sector, and international donor organizations to support projects integrating AI in blended learning in Palestine.

Research Limitations

Geographical limitations: This study is limited to public schools in Palestine.

Time limitations: This study is confined to the 2024-2025 academic year.

Subject- matter limitations: This study focuses exclusively on the use of AI in blended learning.

Sample limitations: This study relied on a purposive sample of 10 participants working in public primary education in Palestine. The small sample size is consistent with the qualitative phenomenological approach, which prioritizes in-depth understanding over statistical generalization. Efforts were made to diversify the sample of participants in terms of qualifications, experiences, and geographic locations. The results should be interpreted with this limitation in mind.

Theoretical Literature and Previous Studies

Blended Learning: It has gained prominence due to the incorporation of technology in education, enhancing quality and accessibility. It fosters engagement and acts as a substitute for traditional education, arising from overcrowded classrooms, diminishing standards, and disruptions such as the COVID-19 pandemic. Blended learning employs technological technologies to establish adaptable and sustainable educational systems that address modern requirements.

The Concept of Blended Learning: Blended learning is identified as an expansion of e-learning by fusing computer-based with face-to-face teaching (Al-Subaie & Al-Qabati, 2019), combining traditional classroom instruction with Internet-based learning (Al-Faqi, 2011). This method effectively incorporates various instructional strategies supporting multiple learning styles (Al-Zahmi, 2024). It allows frequent teacher-student interaction through multimedia elements, maximizes class time, boosts engagement, and

reduces paperwork through electronic resources. Blended learning provides diverse resources while lowering costs and development timelines, prioritizing interactive approaches that achieve better educational outcomes.

Blended Learning Models: Abu Khairan (2021) identifies three blended learning categories: skill-driven that guides professionals through independent research and interactions, attitude-driven that facilitates behavior change, and competency-driven that cultivates specific competencies through performance support tools.

McKenna et al. (2020) describe multiple models. The inverse chapter model involves students interacting with online resources before class. The online model is solely digital. The face-to-face blended model enhances direct instruction with online activities. The self-integration model supports e-learning across courses.

Mansour (2022) examines five primary models. Flipped teaching introduces concepts electronically while the classroom is used for problem-solving. Blended delivery offers flexible digital or face-to-face options. Flex involves electronic delivery of practical and theoretical elements. Complementary blending combines conventional digital engagement. E-training provides online activities with instant reviews and dual-format content access.

Al Faqi (2011) describes Khan's model as an eight-dimensional blended learning framework. The institutional dimension encompasses school preparation, equipment, and teacher education. The educational dimension involves captivating content, emphasizing games, and videos. The technical dimension includes interactive applications like Kahoot and smart boards. The interface design dimension ensures user-friendly, clear layout. The assessment dimension uses interactive

tools to measure student advancement. The management dimension employs digital systems planning activities and monitoring progress. The resource support dimension provides materials via videos, e-books, and interactive activities. The ethical dimension addresses student privacy, data protection, and ethical values.

Challenges of Applying Blended Learning: Shaheen (2020) observed that blended learning faces multiple obstacles including unclear definitions, doubts about effectiveness, evaluation challenges, and instructional design issues in uniting pedagogy with content. Al-Habash and Al-Sulaiman (2023) identified human obstacles such as teachers' technical limitations and resistance to change, alongside technical obstacles including inadequate infrastructure and communication network problems. Additional challenges encompass administrative obstacles involving limited planning, social resistance from stakeholders, and economic constraints related to high costs of devices, software, and teacher training combined with limited available resources.

Artificial Intelligence in Education

Definition of Educational AI: AI in education uses technologies that simulate human cognition to enhance learning (Al-Waridat, 2024). By analyzing data, it extends human intelligence and optimizes educational processes through machine learning and neural networks (Zhang, 2024; Ramadan, 2024). AI also supports personalized learning, provides instant feedback, and improves communication through intelligent conversational systems (Zhang, 2024).

Advanced AI applications in education include personalized learning that adjusts content to individual needs, tools for recognizing educational developments and providing timely assistance, educational robots

promoting student participation, and AI-based games enhancing technical skills and critical thinking. Assessment capabilities encompass facial recognition for attendance, automated performance evaluation, pronunciation correction, activity tracking, and assignment reviews (Aravantinos et al., 2024).

Advantages of Integrating AI into the Educational Process: AI helps students develop autonomy, technical skills, and personalized learning (Peng et al., 2023). Through adaptive content and real-time feedback, it enhances motivation, communication, and school management (Zhang, 2024; Ramadan, 2024). It also improves instructional quality, broadens learning opportunities, fosters programming skills, and increases students' motivation through AI-based educational games (Aravantinos et al., 2024).

Challenges of Using AI in Education: Zhang (2024) identifies four primary challenges associated with the integration of AI in education: the necessity for technical skill development hindered by inadequate training and exorbitant costs; detrimental effects of excessive AI use on student motivation and independent thought; ethical concerns regarding data privacy and security; and health repercussions, notably vision issues from extended screen exposure.

Similarly, Aravantinos et al. (2024) point to an additional challenge: the absence of curricula designed to integrate AI into the educational process. Peng et al. (2023) highlight the critical need for a balanced approach to technology use in education, cautioning that too much technological support may harm learning outcomes

Al-Waridat (2024) identifies several challenges to implement AI in primary schools, including teachers' resistance to change, difficulties in evaluating AI effectiveness, and

poor coordination among educational entities. Additionally, issues such as the digital divide among students, unequal access to technology, and the necessity for continual program updates in line with rapid AI advancements are highlighted.

Different research studies have examined the effects that blended learning has on education. Al-Ali and Al-Anzi (2022) studied blended learning's academic benefits for middle school female students, finding barriers to implementation were not related to teaching experience but to teachers' perception of blending learning. Jallad et al. (2020) examined the opinions of Qalqilya educators toward blended learning and identifying obstacles. Male educators with master's degrees demonstrated superior adaption. Certain studies investigate blended learning with AI methodologies. Al-Waridat's 2024 qualitative research on AI-related experiences in inclusive education systems revealed moderate results in practitioner acceptance and professional training about AI usage.

Studies on the use of AI in education reveal both benefits and drawbacks of technology. A Ravantinos et al. (2024) reviewed AI tool creation, elementary education integration, and evaluation in STEM, language, and arts. Badawi (2022) analyzed AI adoption challenges due to insufficient training and poor infrastructure. Ramadan (2020) found positive attitudes towards AI integration in Arabic language education, despite technical and security concerns. Zhang (2024) studied Chinese primary school English as a Foreign Language (EFL) teachers' perceptions of AI teaching assistants. Results showed AI increased motivation and made feedback automation easier, but challenges with technical proficiencies, ethical issues, and health hazards were noted.

Peng et al. (2023) found that student performance in blended learning environments depends on technology understanding, autonomy, and equipment quality. Students reacted negatively to schools focusing on teacher safety and technical skill development. Abu Zaid (2022) found that e-portfolio development was most effective when blended learning with AI helped kindergarten teachers develop better skills, enhancing classroom engagement and student academic learning. This study is like the research of Al-Waridat (2024) and Zhang (2024) in that it addresses AI in education and emphasizes the primary stage, but it differs from them in its methodology. This study adopts a qualitative phenomenological approach, whereas Al-Waridat employed a descriptive-analytical method. It also resonates with Jallad et al. (2020) in its use of interviews as a tool to gather data and its targeting of teachers and educational supervisors as the study sample.

This study stands out from previous studies in its integration of both blended learning and AI within the context of crises and exceptional circumstances in Palestine. Studies that have explored blended learning, such as Al-Zahmi (2024) and Al-Faqi (2011), focused primarily on theoretical examples or applications in stable learning environments, limiting the applicability of their findings in crisis contexts. This study also stands out by exploring future visions and aspirations from a comprehensive perspective that combines the perspectives of teachers, supervisors, and educational experts. It is also unique in its in-depth qualitative perspective that aims to understand the lived experiences of participants within the specific Palestinian context.

Research Methodology: The researchers of this study adopted the philosophy of social constructivism through a qualitative methodology using the phenomenological inquiry approach, one of the qualitative

research strategies that aims to describe the meaning of a phenomenon as experienced by individuals (Creswell, 2018). Creswell adds that phenomenological research requires in-depth interviews and the examination of personal narratives to discover the meanings individuals attach to their experiences. This qualitative approach is well-justified, as it explores the personal, lived experiences of educators, including teachers, supervisors, and educational experts, to gain a deeper understanding of their visions and aspirations around blended learning supported by AI for basic primary education in Palestine.

Study Sample: Ten educators were selected for this study using a purposive sampling

Table (1) below provides an overview of the participants' background and relevant professional details.

Specialization	Highest Obtained Degree	Quantity	Job Title
Science Curriculum	PhD	1	Educational Specialist in Curriculum and Instruction
English Language Teaching Methods	Masters	3	Educational Coordinator
Arabic Language (Supervision of Primary Level)	Bachelors		
Mathematics (Supervision of Primary Level)	Bachelors		
English Language Teaching Methods	Bachelors	6	Teacher
Elementary Education	Bachelors		
Mathematics	Bachelors		
Elementary Education	Bachelors		
Religious Education	Bachelors		
English Language Teaching Methods	Masters		

The Context: The research took place in Palestine, where investigators studied public schools under the authority of the Palestinian Ministry of Education. Palestinian public schools employ a blended learning system that merges online and classroom education. Study participants included teachers who have implemented blended learning in their classrooms and supervisors who have overseen the educational process and the execution of this approach at the primary level.

The study utilized two types of individual interviews: direct (face-to-face) interviews and

method, a strategy in which specific individuals are chosen to obtain relevant and important information (Maxwell, 2009). Selection criteria for participants included having no less than five years of educational experience, familiarity with e-learning, especially during the COVID-19 pandemic and under the rare political and economic conditions in Palestine, and current involvement in primary grades 1-4 from different geographical locations. The selected participants reflected varying qualifications and experiences. Although the sample size is limited, it is appropriate given the nature of the qualitative phenomenological methodology.

telephone interviews with a sample of supervisors and teachers. Additionally, an education expert with curriculum experience was interviewed in person.

The participants' expertise and knowledge significantly enriched the research data. The teachers possess specialized certificates in primary education and have diverse and extensive experience in the field. Among the supervisors, two have backgrounds in teaching and supervising at the primary level, while the third has experience supervising across various educational stages.

Research Tools: This research employed semi-structured interviews as the primary tool for data collection. Some were conducted in person while others were done via audio recording, lasting between 30 to 50 minutes for each participant, which allowed participants to accurately express their experiences in detail.

The interview tool comprised three main dimensions:

Dimension I: Targeted female teaching professionals to investigate their technological experiences, training needs, integration strategies, and their recommendations for improvement.

Dimension II: Targeted educational supervisors to evaluate blended education reality while investigating AI application areas, defining developmental requirements, and solving encountered problems.

Dimension III: Targeted pedagogical experts, focusing on their understanding of blended education in comparison with worldwide practices. It outlines the appropriate AI applications and basic system requirements and presents future development expectations, together with problem solutions and proposed answers.

Validity and Reliability: Face validity was employed to ensure the validity of the study instrument, namely, the interview questions. These questions were presented to a panel of experts in education and educational technology to assess their relevance and clarity. Based on their feedback, necessary edits were made, and a mock interview was conducted to confirm that the questions were appropriate and well-designed to elicit a deep understanding of participants' experiences.

To increase reliability and minimize potential biases, the following measures were taken:

- The researchers documented their previous assumptions about the topic, discussed them

amongst themselves, and maintained awareness of them during all stages of the research.

- All interviews were analyzed by three of the researchers independently. Data coding and interpretations were reviewed and compared to ensure consistency in the analysis.
- Member checking was conducted by sharing the analysis results with the participants to verify the accuracy of the interpretations in reflecting their lived experiences.
- Data was collected from multiple sources, including teachers, supervisors, and educational experts.
- Detailed documentation of the data collection and analysis procedures was maintained. Additionally, interview questions were carefully designed to be unbiased to avoid leaning participants towards specific answers, as described at the beginning of this section.

Data Collection Procedures: Preparatory Phase: This involved the development and evaluation of the interview tool, conducting a pilot interview to assess the clarity of the questions, and identifying potential participants based on selection criteria.

Implementation of Interviews: Interviews were conducted through two methods: in-person and via telephone, each lasting 30 to 50 minutes. Audio recordings were made with prior consent, and notes were taken during the interviews.

Data Documentation: This includes transferring audio recordings and drafting preliminary analytical notes.

Data Analysis: Analysis Steps: Preliminary reading of data, open coding, category identification, and extraction of central themes.

Analysis Procedure: Thematic Analysis based on the steps outlined by Braun and Clarke:

- In-depth reading of data.
- Initial coding
- Topic identification
- Review and revision of topics
- Definition and designation of topics
- Writing the final report

Continuous analysis occurred throughout data collection, involving ongoing comparisons of interviews and evaluations of analysis results.

Ethical Considerations

- Obtaining informed consent from participants
- Ensuring confidentiality and privacy
- Secure storage of data
- Allowing participants to withdraw at any time

Study Procedures: Researchers performed the study according to the following methodology:

- Thoroughly reviewed previous research and educational literature related to the research subject.
- Developed a research instrument that included questions for interviews with elementary teachers, pedagogical supervisors, and pedagogical experts.
- The research instrument was validated through a review by qualified experts to check both its quality and connection to the study objectives.
- Direct and telephone interview sessions served to collect data.
- Each participant granted permission in advance through telephone contact before the researcher started the interview process.
- The researcher documented interviews and made notes before analyzing data to identify codes and categories that related the information to research questions.

- The research analyst creates the final analysis report by reworking the first analysis before recording its findings.

Findings and Discussion

A categorical (objective) data analysis was performed by researchers through multiple reviews of study sample responses. Researchers developed the answers through several steps that included coding the responses before experts and educators validated the findings.

Research Question 1: How can AI be effectively integrated into the Palestinian educational framework?

Respondents identified different fundamental aspects as described below.

Curriculum Development: Teaching institutions should use AI features to instruct students about contemporary technological practices through updated content. One expert stated, "Our team is now integrating technology concepts into the curriculum and building public policies."

Specialized Human Resources: Technical training requires institutions to develop educational programs that build their abilities to work with AI systems in teaching. As an expert stated, "The workforce needs to contain qualified teachers possessing modern technology skills together with AI expertise." A supervisor confirmed, who said, "AI systems can determine individual teacher requirements, then match those needs to appropriate training programs."

Technical Infrastructure: Schools need better educational and internet technologies and comprehensive platforms. Teachers declared, "We need modern devices in the classroom as the educational environment demands computers and internet access among fundamental tools."

Student Creativity Enhancement: AI tools drive students to produce educational

content through their ability to generate stories, videos, and images. One teacher stated, "AI helps me motivate students to present illustrated stories and interactively display content. AI tools guide independent learning that helps students explore knowledge beyond memorization. As one supervisor confirmed, "To support self-learning, platforms like Duolingo and Photo Math can be activated to solve mathematical problems."

Advanced Assessment Tools: AI tools for performance assessments generate specific evaluations for student learning outcomes. A supervisor noted, "AI systems enhance the process of evaluating teacher work activities by reducing workload and simplifying data organization processes." Teachers reported that AI enables students to receive personalized performance feedback and instantaneous, ongoing feedback across their academic work.

Student Motivation: Students demonstrate higher motivation when learning through smart technology because it presents educational content as comics and interactive games that keep studies entertaining. A teacher stated, "It can help me motivate students by displaying illustrated stories and simple games. Digital rewards are one advanced way to boost student participation." Another teacher stated, "Smart technology helps me provide digital rewards and incentive points to students."

Individual Differences: AI allows personalized educational tasks based on student understanding and capabilities. A teacher noted, "It can help in providing different activities according to each student's level." AI understands student groups through educational level assessment, allowing it to distribute appropriate material to each group. Another teacher explained, "AI helps me classify students according to their levels."

This study supports Zhang's (2024) position that AI provides prompt feedback for self-

guided learning and Aravantinos et al.'s (2024) findings highlighting the need to create educational games incorporating AI for improving technical abilities and critical thinking. Research outcomes verify previous theoretical papers explaining how AI enhances educational material and students' technical competencies. This research introduces an innovative viewpoint through curriculum development according to primary school demands within Palestinian educational settings.

Research Question 2: What challenges hinder the implementation of AI in blended learning environments?

The research findings about AI implementation challenges in Palestinian blended education exhibited these key aspects:

Inadequate Infrastructure: Teachers reported that subpar internet connections, and intermittent power interruptions, make teacher-student interaction difficult. The inadequate availability of suitable technical tools worsens the situation because teachers and students demonstrate different technical readiness. One teacher noted, "Weak internet connectivity combined with difficult device management requires attention as a major challenge in my teaching tasks." One supervisor stated, "My evaluation of blended education is that it delivers limited success because of regular power interruptions and inadequate internet connectivity throughout most areas."

Technical Skills: The blended teaching environment becomes difficult as educators demonstrate insufficient knowledge of modern technology and blended learning resources, while students show varying technological expertise. Insufficient monitoring capability occurs due to the knowledge gap, resulting in suboptimal resolution of technical issues. A teacher stated, "Technical expertise deficiencies along with challenging parent

communicative needs stand out as the most substantial distance learning obstacles." One expert noted, "Teachers have difficulties with engagement because of differences between generations when participating in development work and learning to adapt to artificial systems." supervisors identified: "Educational barriers are often the result of insufficient technological expertise among teachers, which impede both technology use and the solution of implementation problems."

Challenges of Managing the Educational Process: Multiple obstacles became apparent, including:

- Class time management becomes challenging when using technology to guarantee all students participate successfully. One teacher stated, "For me, managing technology for effective time utilization becomes problematic while sustaining engagement and participation of every student."
- Maintaining student attention is more challenging during screen time, especially with home distractions. A supervisor noted, "It is difficult to maintain students' focus for a long time on screens, especially since there are distractions at home."
- Differences in student skills function as the largest challenge. One teacher stated, "The biggest challenge is the varying levels of students in using technology and the difficulty of following up with each of them according to their needs and skills."

Social, Economic, and Political Challenges: Research indicates that many families face financial challenges purchasing computers or smartphones for their students. Teachers observed that the financial burden on families is significant. An expert explained, "The existing economic restrictions coupled with conditions on financial assistance exacerbated by geopolitical events that

originate from military occupation create major obstacles for implementing educational frameworks." Inadequate parent involvement in blended learning and insufficient support create major social issues. One teacher expressed, "It is difficult to communicate with parents [when engaged in] distance learning."

The discussion regarding this question focused on essential areas requiring solutions.

1. Infrastructure improvement requires joint internet network development with the Ministry of Communications and resolving power outages. One supervisor declared, "We would establish a step-by-step infrastructure modernization plan jointly with the Ministry of Communications." Underprivileged students should be provided with technical devices through support from a school foundation in partnership with the private sector and local community resources. The supervisor expressed the need to create "a school support fund for student computers and technical supplies," and noted "community learning centers in remote areas should have necessary technologies at their disposal." An expert stated, "Financial support is available for committed actions that many nations are willing to back to accelerate infrastructure development."
2. Schools can improve technical competence through educational programs teaching blended learning tools to teachers and provide detailed training activities. A supervisor underscored: "The necessity of establishing comprehensive training initiatives which aim to build teachers' technical competencies." The supervisor advised it is important to "provide a simplified guide for teachers and students on how to deal with technical problems". Another supervisor recommended "specialized teams should be deployed

within educational directorates to provide continuous technical support.”

3. Improving blended learning quality requires activities expanding between electronic and traditional approaches that eliminate boredom while keeping students actively involved. One teacher reported, “Brief interactive activities combined with lesson splitting into snippets throughout the day using breaks has proven effective.” Another teacher noted the need to “develop interactive digital educational content designed specifically for primary-level students.” One supervisor suggested “creating a unified educational platform that supports work without an internet connection.” Another supervisor proposed “forming partnerships with telecommunications companies to provide specialized internet packages for teachers and students.” One expert emphasized the need to “rebuild a productive educational system in the West Bank and Gaza and eliminate educational losses.”
4. Teachers can keep continual communication with parents via WhatsApp and other educational platforms. One teacher suggested “holding regular meetings with parents to follow up on students' progress and provide support.”

The findings support the human and technical barriers that Shaheen (2020) identified in blended learning. The research findings match the main thesis by Jallad et al. (2020), documenting computer access problems, as well as analysis Aravatinos et al. (2024) about the absence of AI-specific curricula contributing to implementation barriers. The present research provides an extensive study of obstacles in the Palestinian context and applicable solutions adapted to regional conditions while operating during challenging economic and political times. The

study presents an integrated approach to combat these challenges by strengthening infrastructure, developing technical abilities, and establishing community ties to improve the quality of blended learning.

Research Question 3: What recommendations do educators suggest for utilizing AI to enhance integrated education in Palestine?

Educators shared key insights regarding AI use, as summarized below.

Using Expertise and Experience: An education expert explained that analyzing international happenings in technology integration for education was essential. He said, “We cannot develop the curriculum without studying other countries' methods and their experiences integrating technology.” He emphasized consulting specialists with relevant expertise, remarking, “Experts should be involved throughout the integration process. However, in Palestine, there are currently no specialists in curriculum development related to AI; instead, we have technology activists.”

Implementing Programs for AI in Blended Education in Palestine: The significance of utilizing AI software in blended education was underscored by a teacher who remarked, “I primarily use technology for reading and writing,” while another added, “I incorporate technology to display photos and videos.” Supervisors reinforced this, stating, “Inclusive education is currently implemented through the Thames platform, which provides model quotas for its usage.” The expert stressed the necessity of programs engaging students, saying, “We seek programs that allow students to create content, films, and images.”

Training Educational Staff to Utilize AI in Integrated Education Development in Palestine: Emphasizing the training significance, the expert remarked, “Teachers will undoubtedly receive training in the use of

AI-based activities and methods." One teacher said, "I propose a gradual and intensive approach to teacher training." Another noted, "The technical development of teachers' skills has become an urgent necessity." Additionally, it was stated, "AI is a powerful tool to enhance teachers' roles and improve their performance," and "Some teachers express a desire for training workshops to effectively utilize AI." There is an urgent need to develop teachers and provide training on platforms such as Zoom and Microsoft Teams.

Developing Standards for AI in Education: Educational experts underlined the need for precise standards to add AI into curriculum content. "We need standards and frameworks for AI use in educational settings," stated one expert. Teachers agreed on the importance of interactive digital curricula with integrated intelligent educational systems, describing it as "essential." One teacher stated that they plan to convert the current curriculum to a digital format, despite reservations, because they understood it was necessary.

Improving Infrastructure to Support AI Integration: A review of the educational environment's preparedness for AI integration revealed infrastructure needs based on interview participants' input. One education expert declared, "A robust technical structure with strong Internet networks and integrated educational platforms represents one of the most important proposed measures [to support AI integration]." Teachers stressed the need for essential technological equipment in classrooms since traditional education methods will need to blend with digital practices. The teacher explained that technological enhancement must occur because integrated education will dominate the future. Another teacher stated that educational resources must be varied, and teachers must create digital material adapted for early education stages. Executive staff expressed that they require

more reliable Internet connections with faster speeds and noted that educational institutions should be supplied with smart devices. A supervisor advocated "providing modern educational program-equipped portable computers to teachers."

The research outcomes match Khan's Blended Education Model (Al Faqi, 2011) showing that effective integrated education depends on its institutional, technical, and educational aspects. Additionally, they resonate with Al-Waridat's (2024) study highlighting the necessity of teacher training in utilizing AI applications and Zhang's (2024) research advocating for adequate teacher training and technical support. Furthermore, they correspond with the Badawi study (2022), stressing the importance of incorporating programming AI culture. Notably, the current findings prioritize infrastructure development within the Palestinian context, given the unique circumstances and challenges faced by Palestinian schools.

Research Question 4: What criteria must be met to successfully implement educators' recommendations for utilizing AI to enhance blended learning in Palestine?

Their answers focused on the following:

Establishing Technical Infrastructure and Financial Support: The expert explained, "I believe one of the most important requirements is the existence of a robust technological infrastructure, with strong internet connections and integrated educational platforms." Supervisors reinforced this, with one saying, "We need to provide ready-to-use educational platforms for teachers to exchange experiences." Another supervisor added, "We need to establish a support fund in collaboration with community organizations to fund infrastructure development."

Using AI to Develop Training and Supervision Programs for Teachers: The

expert stated, “We need to train staff, so they are qualified to use modern technologies and Aligence.” All teachers emphasized this area’s importance. One teacher with limited experience explained, “I need basic training on how to use technological tools and AI in education.” Another teacher with moderate experience said, “I need training on how to use modern technologies and how to integrate them into student learning.” Teachers from the primary education level suggested various levels of training, with one saying, “I need training on how to use basic educational platforms,” and another mentioning the need for “advanced training on how to design interactive content.”

Receiving support from Administrators and Community Members: This requirement recognizes the importance of higher education authorities and the availability of a dedicated budget to support AI use in schools. The educational expert explained that “to modify and advance local curricula, the Ministry of Education needs approval from politicians to update textbooks.” There is also a need for collaboration with and guidance from parents, considered a crucial social requirement to implement the recommendations. One teacher emphasized this, stressing the importance of “involving parents in supporting the digital transformation process,” with another stating that it could be beneficial to “create a guide for parents on how to monitor the process.”

These findings align with Badawi’s (2022) study emphasizing the importance of enriching teacher training and fostering a culture where AI is a fundamental requirement in the learning process. They also correspond with Abu Zaid’s (2022) study on the necessity of integrating blended learning with AI into teacher training programs. The results are consistent with Khan’s model (Al-Faqi, 2011) confirming the importance of providing adequate infrastructure and institutional support. What

sets out the findings of this study apart is its emphasis on administrative and social requirements, particularly the role of parents and the local community in supporting digital transformation.

Considering the above results, it can be concluded that the findings of this study offer a comprehensive vision for how to utilize AI to enhance blended learning in Palestinian public schools. This aligns with theoretical literature, reinforcing the importance of the various dimensions of Khan’s blended learning model (Al-Faqi, 2011). It also intersects with the results of several previous studies, such as those by Al-Waridat (2024) and Zhang (2024), which emphasize the importance of teacher training and developing their technical skills. This study stands out for providing a holistic approach that considers the unique Palestinian context, focusing on the challenges of weak infrastructure and exceptional conditions. It offers practical solutions that combine curriculum development, staff training, infrastructure improvement, and community involvement. The findings emphasize the need to adopt an integrative approach that considers the technological, educational, and social dimensions in developing AI-supported blended learning in Palestine.

Recommendations

Based on the findings of this study, the researchers offer the following, listed in order of priority:

- Provide comprehensive technological infrastructure and sustainable financial support. This is a top priority and a fundamental prerequisite for implementing AI initiatives in education. This can be achieved through establishing a support fund in collaboration with local and international community organizations and forming a partnership between the Ministry of Education and the Ministry of

Communications to provide subsidized internet services to schools. A pilot project can be launched in selected schools in different regions, with gradual expansion. Community learning centers equipped with the necessary technologies could be established in remote areas.

- Develop continuous training programs for teachers and supervisors focusing on AI tools in blended learning and form professional learning communities for sharing experiences and successful practices. This recommendation is second in priority, as the infrastructure cannot be utilized without competent teachers. Implemented via the National Educational Training Institute in collaboration with Palestinian university education faculties. Training sessions should consider different levels of teacher experience and offer incentives for participants.
- Establish a national team to develop AI-based educational content. This involves designing interactive programs for early primary grades in Arabic, developing a national platform providing content access during internet outages, and integrating AI applications in current curricula. Implementation would involve Palestinian universities and local and international technology companies developing content, initially focusing on core subjects (Arabic, math, and science). This recommendation can be made concurrently with the second recommendation (teacher training).
- Engage parents and the local community through awareness campaigns and training programs, educating parents on supporting their children in AI-enhanced blended learning, and protecting them while using the internet and technology. Additionally, parents can be encouraged to offer financial support for these initiatives and present

feedback to improve the program. Implementation can be achieved through periodic awareness workshops and a simplified guide for parents.

- Considering this study's findings and limitations, we recommend conducting more research using a mixed-methods approach targeting a larger sample of teachers, supervisors, and stakeholders across different Palestinian governorates to provide comprehensive understanding of AI use in blended learning. Moreover, experimental studies could assess the effectiveness of proposed training programs in developing teacher skills in utilizing AI. A case study could also be conducted on pioneering schools that successfully integrated AI technologies under exceptional circumstances, analyzing factors that led to their success and their potential for replication in other schools.

Disclosure Statement

The authors declare that they have no relevant or material financial interests that relate to the research described in this paper

- **Ethical approval and consent to participate:** Informed consent was obtained from all participants prior to data collection. No formal ethical approval from an institutional review board was required for this study.
- **Availability of data and materials:** The datasets generated and analyzed during the current study are not available due to privacy and ethical considerations.
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