



Education and artificial intelligence in Lebanon: observational analysis of workshops

Formación de futuros docentes e inteligencia artificial en el contexto del Líbano

Tala Safi Fawaz

Universitat Rovira i Virgili
Tarragona, Spain

<https://orcid.org/0009-0005-0983-3265> | tala.fawaz@estudiants.urv.cat

Beatriz Lores-Gómez

Universitat Jaume I
Castellón, Spain

<https://orcid.org/0000-0001-8487-5960> | blores@uji.es

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Abstract

Artificial Intelligence (AI) is rapidly transforming industries and redefining the future of work and daily life. In the educational context, AI is revolutionizing learning by allowing personalized experiences, automating administrative tasks, and offering data-driven insights based on student performance, behaviours, and engagement to support student success. This article provides a detailed analysis of six workshops centered on artificial intelligence (AI) and the training of future teachers in Lebanon. Conducted as a participant observation study, it investigates the goals, teaching methods, and outcomes of these workshops, evaluating their potential to shape education in Lebanon. The article explores the role of AI in education, emphasizing the necessity of equipping future teachers with the skills to use AI tools to optimize students' performance and introduce innovative strategies to enhance the learning experience. The findings highlight a growing awareness of the importance of AI integration in educational practices. However, the study also uncovers significant challenges, such as difficulties in implementing AI within existing educational frameworks and the scalability of these technologies across different schools and regions. Despite these obstacles, the article underscores the critical role of AI in transforming education and the need for strategic efforts to address the implementation barriers to ensure broader adoption and long-term success in the sector.

Keywords

Artificial intelligence; education; teacher training; digital competence; workshops.

Resumen

La IA desempeña un papel cada vez más importante en la sociedad actual, transformando sectores, mejorando la toma de decisiones y remodelando el futuro del trabajo y la vida cotidiana. En el contexto educativo, la IA está revolucionando el aprendizaje al proporcionar experiencias personalizadas, automatizar las tareas administrativas y ofrecer información basada en datos sobre el rendimiento, el comportamiento y el compromiso de los estudiantes para contribuir a su éxito. Este artículo ofrece un análisis detallado de seis talleres centrados en la formación de futuros docentes sobre Inteligencia Artificial (IA) en el Líbano. Realizado como un estudio de observación participante, investiga los objetivos, métodos de enseñanza y resultados de estos talleres, evaluando su potencial para dar forma a la educación en dicho país. El artículo explora el papel de la IA en la educación, haciendo hincapié en la necesidad de dotar a los futuros profesores de las habilidades necesarias para utilizar las herramientas de IA con el fin de optimizar el rendimiento de los estudiantes e introducir estrategias innovadoras para mejorar la experiencia de aprendizaje. Los resultados ponen de relieve una creciente concienciación sobre la importancia de la integración de la IA en las prácticas educativas. Sin embargo, el estudio también subrata importantes retos, como las dificultades para implantar la IA en los marcos educativos existentes y la escalabilidad de estas tecnologías en diferentes escuelas y regiones. A pesar de estos obstáculos, el artículo subraya el papel fundamental de la IA en la transformación de la educación y la necesidad de realizar esfuerzos estratégicos para hacer frente a las barreras de implantación y garantizar una mayor difusión de la IA en la educación.

Palabras clave

Inteligencia artificial; educación; formación del profesorado; competencia digital; cursos de formación.

1. Introduction

The integration of artificial intelligence (AI) into different sectors has significantly affected modern society, and education is not an exemption (Vlasova et al., 2019). AI's capacity to convert teaching strategies, personalize learning encounters, and improve educational results makes it a critical area of focus for teachers around the world (De La Higuera, 2019). Within the setting of Lebanon, a nation navigating various educational, social, and economic challenges, the adoption of AI in teaching holds the guarantee of addressing some of these issues by upgrading the quality of education and planning students for a technologically advanced future (Al-Zyoud, 2020).

Effective AI integration in education depends on teachers' readiness to utilize AI tools, which requires training, resources, and support (Altinay et al., 2024). This brings to light the significant need for comprehensive training programs for future instructors, guaranteeing they have the necessary skills and information to harness AI's potential within the classroom (Altinay et al., 2024; Saz-Pérez & Pizà-Mir, 2024). The training of future teachers in AI is not just about familiarizing them with innovation; it includes equipping them with the capacity to integrate AI into pedagogical methodologies, cultivating critical thinking, creativity, ensuring ethical application, and flexibility among students (Schiff, 2021).

The educational setting in Lebanon presents specific particularities in terms of challenges and opportunities for the integration of AI in teacher training (Kharroubi et al., 2024). The general picture regarding education framework has confronted critical obstacles, including political flimsiness, economic troubles, and a lack of resources (Riera-Negre & Mut-Amengual, 2024). Despite these challenges, there's a growing recognition of the need to modernize instruction, and AI could offer a pathway to accomplishing this objective. The country's commitment to improving education is evident within the increasing number of activities like conferences and training, aimed at incorporating innovation into teaching practices. However, these initiatives remain fragmented, and there is still a lack of unified policy or curricular frameworks to support the sustained integration of AI in teacher education.

For all that has been said, it is necessary to continue delving into the Lebanese context and how the training of future teachers in AI is being carried out. Therefore, this article aims to recognize the structure of the training in AI, the duration of the courses, and the specific competencies being developed to ensure teachers are equipped to integrate AI in the classroom. In addition, the article will explore the resources available to educators, the challenges faced in implementing AI-focused training, and the overall impact such programs could have on teaching methodologies and student learning outcomes.

Therefore, the primary objective of this article is to analyse the situation of AI in the training of future teachers in Lebanon. To do so, an observation of six workshops on AI and the training of future teachers in Lebanon will be carried out.

2. Framework

The integration of Artificial Intelligence (AI) in education has significantly transformed teaching methodologies, emphasizing the urgent need for future educators to develop AI competencies. Teacher training programs must equip educators with the knowledge and practical skills to harness AI as a tool for enhancing student learning, personalizing instruction, and streamlining classroom management. By focusing on both theory and application, these programs can ensure that educators are well-prepared to integrate AI effectively into their teaching practices, thereby fostering educational advancement.

AI-focused teacher training programs aim to enable educators to incorporate AI tools effectively, emphasizing critical thinking, creativity, and ethical decision-making (Altinay et al., 2024). Teachers must understand AI's applications in education, such as personalized learning, automated assessments, and real-time feedback systems (Schiff, 2021). To achieve this, educators need to develop digital competencies that allow them to use tools like adaptive learning systems, intelligent tutoring platforms, and content-creation software to address diverse learning needs (Altinay et al., 2024). Equally important is the promotion of ethical AI practices within these programs, ensuring educators are aware of critical issues such as data privacy, algorithmic bias, and transparency (Lozano & Blanco Fontao, 2023). Additionally, teacher training must foster a mindset of lifelong learning, encouraging adaptability and continuous professional growth in this rapidly evolving technological landscape (Joshi et al., 2021).

To design effective AI training programs, it is crucial to balance theory and practice, combining foundational lectures with hands-on experiences and peer-to-peer collaboration (UNESCO. Education sector, 2019). Additionally, training content must be contextually relevant, addressing the specific challenges and opportunities within a given educational system. For instance, Lebanese workshops tailored their discussions to local resource constraints and ethical considerations, ensuring their practical applicability (Kharroubi et al., 2024). However, AI training cannot be a one-time effort; continuous professional development through online courses, mentoring, and AI resource centers is essential for helping teachers refine their skills and stay updated with advancements (Doumat et al., 2022).

AI training programs in developing contexts like Lebanon face challenges due to limited funding and infrastructure, restricting access to advanced tools and reducing effectiveness (Riera-Negre & Mut-Amengual, 2024). The transition to AI-driven teaching is challenging, requiring new technical skills and a cultural shift in education delivery (Al-Zyoud, 2020). Ethical considerations further complicate the adoption of AI in classrooms. As Schiff (2021) emphasizes, ensuring data protection, algorithmic fairness, and transparency in AI applications is essential, requiring educators to receive robust training in ethical practices. Addressing these challenges demands collaborative efforts between governments, educational institutions, and technology providers to create accessible, resource-rich, and sustainable training programs.

Despite these obstacles, AI-focused training presents a range of opportunities to enhance teacher preparation and educational outcomes. Expanding accessibility through online platforms and AI-powered virtual training environments can make professional development more inclusive, especially for teachers in resource-constrained settings (Joshi et al., 2021). Moreover, integrating AI tools across disciplines, such as mathematics, science, and languages, can encourage a holistic understanding of the technology among students while promoting interdisciplinary learning (De La Higuera, 2019). Training programs can also demonstrate how AI tools like Canva AI and Copilot streamline administrative tasks, allowing educators to allocate more time to student-centered and interactive teaching methods.

In conclusion, teacher training programs focused on AI must build comprehensive digital competencies, foster ethical awareness, and enable the practical application of AI tools in educational settings. By addressing challenges such as limited resources and ethical concerns while leveraging opportunities for innovation, these programs can empower educators to prepare students for a technology-driven future. Continued investment in research, professional development, and collaborative partnerships is essential to maximizing the transformative potential of AI in education.

3. Methodology

This section outlines the approach taken to analyse the AI workshops aimed at training future teachers in Lebanon. The study employs a participant observation methodology, which allows the researcher to access interactions in a social context and yield systematic records of these interactions in various forms and contexts (Simpson & Tuson, 2003). Observations enable the researcher to gather data on the

physical setting, human setting, interactional setting, and program setting (Morrison, 1993).

The researcher took an observer-as-participant role, maintaining transparency while balancing engagement and objectivity. This approach allowed her to remain unobtrusive while balancing participation and detachment, ensuring objective and reliable data collection (Cohen et al., 2018)

The observer attended all six workshops, taking detailed notes on session flow, AI topic presentation, and facilitator-participant interactions. Observations focused on content clarity, participant engagement, teaching effectiveness, and challenges in understanding or applying the material.

A standardized observation template was used to record data on workshop structure, participant reactions, and unexpected issues.

The observer's dual role as both a participant and a researcher allowed for a deeper understanding of the workshop dynamics. However, care was taken to minimize the observer's influence on the natural interactions of the group, as emphasized by Musante (2015). This involved maintaining a balance between active participation and critical detachment, ensuring that the data collected remained objective and equitable.

To ensure a richer understanding of participants' engagement and the context of implementation, representative excerpts from field notes—such as participants' questions, behaviors, or informal feedback—were also recorded and analyzed.

3.1. Workshop selection criteria

The six workshops analyzed were selected based on location (all held in Beirut), theme (AI in education), duration (at least one full day), target audience (educators and future teachers), and content diversity (covering both foundational concepts and practical applications). These criteria ensured their relevance and representativeness for the study.

3.2. Description of workshop participants and observers

The workshops involved a diverse group of participants, including:

- Future teachers from various educational backgrounds (e.g., primary, secondary, and higher education).
- Educators with varying levels of experience, ranging from novice to experienced teachers.
- Participants with differing levels of familiarity with AI, from complete beginners to those with some prior knowledge.

The observer was a trained researcher with expertise in both education and AI, ensuring a deep understanding of the workshop content and dynamics. The observer's background allowed for informed insights into the effectiveness of the training and the challenges faced by participants. To maintain objectivity, the observer refrained from actively influencing the workshops and focused on documenting interactions and outcomes.

The analysis of the selected workshops was conducted using a multifaceted qualitative approach, which included documentary analysis of materials provided during the sessions, such as presentations, handouts, and recorded content. These materials were analyzed alongside the observation notes to triangulate the data and ensure a comprehensive understanding of the workshops.

More specifically, documents, presentations, and handouts distributed during the workshops were analyzed to understand the content and pedagogical approaches used. These materials provided insights into the workshop's objectives and structure. In addition, observations of workshop sessions were recorded to capture real-time data on teaching methods and participant engagement. These notes complemented the analysis of workshop materials and feedback.

Thematic analysis was conducted manually, following Braun and Clarke's (2006) method. The process involved familiarization with the data, initial code generation, theme development, and iterative refinement. Codes such as "hands-on interaction," "ethical concerns," and "resource constraints" were grouped into broader themes aligned with the study objectives. Although no qualitative analysis software was used, coding reliability was strengthened through discussions with a peer researcher to ensure intersubjective agreement and minimize bias.

Thematic analysis was used to identify recurring patterns and themes in the data, such as the effectiveness of hands-on activities, the challenges of integrating AI into teaching practices, and the ethical concerns raised by participants. This approach allowed for a detailed and subtle understanding of the workshops' strengths and weaknesses.

The study abides to ethical research practices, including obtaining informed consent from workshop organizers and participants. In compliance with Lebanon's data protection laws, particularly Law No. 81/2018 on Electronic Transactions and Personal Data Protection (Lebanese Republic, 2018), the observer's role was clearly communicated to all stakeholders, and steps were taken to ensure the anonymity and confidentiality of participants' data.

The results of this analysis are presented in the following sections, focusing on the general description of the workshops, the approach to AI training, topics covered, and the overall findings and effectiveness evaluation.

3.3. Sample

The following table provides a brief description of each workshop celebrated in Beirut (Lebanon)(see Table 1).

3.4. Analysed variables

The following table represents the key variables analysed in this study(see Table 2).

4. Results

This results section analyzes the workshops, covering their descriptions, topics, methodologies, participant engagement, impact on teaching, and key challenges and

Table 1. Brief description of each workshop

Workshop Name	Hours	Brief Summary	Location	Attendees	Professional profile
Workshop A: Empowering Educators with AI Tools	3 hours	Explored various AI tools to enhance educational practices, including tools for diverse learning styles.	University Classroom, Beirut	25-30	Participants included future teachers, experienced educators, and instructional designers. Presenters were AI specialists and educational technologists.
Workshop B: Enhancing Learning Strategies with AI	3 hours	Focused on using AI tools to activate and improve student learning experiences across different contexts.	Auditorium, Beirut	30-35	Attendees were primarily educators from primary and secondary schools. Speakers included AI researchers and curriculum developers.
Workshop C: AI Ethics in Education	3 hours	Examined ethical issues in AI integration, covering data privacy, algorithmic bias, and transparency.	Conference Room, Beirut	20-25	Participants included policymakers, educators, and AI ethicists. Presenters were experts in AI ethics and data protection.
Workshop D: Practical Applications of AI in Education	4 hours	Provided hands-on experience with AI tools designed for teaching, personalized learning, and content creation.	University Lab, Beirut	15-20	Attendees were future teachers and instructional technologists. Presenters included AI tool developers and educational consultants.
Workshop E: Integrating AI in Education	4 hours	Covered AI applications for personalized learning, assessment, classroom management, and student engagement.	Seminar Room, Beirut	25-30	Participants included educators from higher education institutions. Speakers were AI integration specialists and educational policymakers.
Workshop F: Professionalism in AI Tools	8 hours	Focused on AI tools to enhance professional productivity, creativity, and efficiency in educational contexts.	Training Center, Beirut	40-45	Attendees were educators, administrators, and educational consultants. Presenters included AI tool developers, productivity experts, and professional trainers.

Table 2. Key aspects

Key Aspect	Focus of the Analysis
Topics covered within the Workshops	To distinguish the main topics and points addressed during the workshops, including the types of AI technologies presented, the academic approaches examined, and the practical applications demonstrated.
Methodologies Utilized	To investigate the teaching strategies used in the workshops, such as hands-on exercises, collaborative learning, and the use of real-world cases to illustrate AI concepts.
Participant Engagement and Feedback	To assess the level of engagement and feedback from participants, examining their experiences and perceptions to gain insights into the effectiveness of the workshops and identify areas for improvement.
Impact on Future Teaching Practices	To evaluate how the workshops impact participants' views on AI in education and their preparedness to incorporate AI tools into their future teaching practices.
Challenges and Opportunities	To examine the challenges faced during the workshops, such as resource limitations, and explores the opportunities that arise from integrating AI into teacher training programs in Lebanon.

opportunities. As an observer, the workshops clearly established an environment where educators could engage with AI tools through practical experience. However, it was also clear that some participants struggled to connect theoretical concepts with practical applications, highlighting an issue that future programs could solve.

For instance, during Workshop A, one participant noted: "I understand the theory, but I need more examples to know how to apply this with my students."

From our perspective, the workshops did put in an effort to solve practical educational issues, particularly in the context of developing countries like Lebanon. Participants appreciated this focus, but it was also noted that a lack of follow up support and resources was raised in the discussions. This indicates the necessity of stronger and more comprehensive training programs.

Several attendees expressed interest in post-workshop mentoring or access to online materials for continued learning.

A more diverse group of participants, including those with more or less technical knowledge, is another positive feature of the workshops. Though this diversity gave greater richness to the discussions, it also made it more difficult to tailor content to suit everyone's needs.

This challenge was especially noticeable during Workshop D, where more technically advanced content caused confusion for those with limited digital experience.

Overall, the workshops provided a valuable platform for exploring AI in education, but they also revealed areas for improvement, such as the need for more comprehensive training, ethical guidance, and collaborative efforts. The value of peer collaboration was emphasized by multiple participants, who suggested forming networks for continued exchange and support.

4.1. Analysis of the workshops

The six workshops attended offered a wide range of experiences into integrating Artificial Intelligence (AI) into educational practices and professional situations. Each workshop had targets and employed different techniques to impart information and viable skills. This analysis examines each workshop's general description, focus on AI training, and the topics secured, giving a comprehensive overview of their commitments to understanding AI's role in education and proficient advancement.

To start with, a general description of the chosen workshops will be provided, presenting the main topics and strategies covered:

Workshop A: Enabling Teachers with AI Tools provided an in-depth investigation of different AI tools aimed at upgrading educational practices. This workshop highlighted demonstrations of tools such as Gamma.app, Mentimeter, Smallppt, Rask.ai, Ezdubs, ClassPoint, and AI plagiarism checkers like Copyleaks, Turnitin, and Grammarly. The session's objectives included familiarizing future teachers and current teachers with these apparatuses and discussing methodologies to accommodate different learning styles through innovation. The workshop was organized around both theoretical presentations and practical shows, permitting members to engage directly with the devices and understand their applications in instructive settings. The workshop was held in a university classroom, which fostered a collaborative environment, with approximately 25-30 participants. The smaller group size allowed for more personalized attention, and participants appreciated the hands-on activities. One attendee commented during a group exercise, "I never thought I'd use something like ClassPoint this easily. This is way more intuitive than I imagined." However, some attendees noted that the classroom setting felt somewhat restrictive compared to more dynamic learning environments. As one participant mentioned informally, "It's hard to get into a creative mindset when you're stuck in a traditional lecture hall."

Workshop B: Upgrading Learning Methodologies with AI centered on using AI tools to actuate and improve students' learning encounters. The session secured a run of tools, counting Replica, Mapify, BrainStory, AskThee, Microsoft Designer, ChatMind, Idea Generator, StudyWise, Goblin.Tools, and iAsk. The primary objective was to illustrate how these instruments can advance active learning over different

educational settings. The workshop's structure included interactive demonstrations and discourses, providing participants with practical insights into how AI can be utilized to create engaging and successful learning encounters. This workshop was conducted in an auditorium, with 30-35 participants. The open space encouraged lively discussions, but some participants felt that the larger group size made it harder to ask questions or receive individual support. Despite this, the energy in the room was high, and participants seemed enthusiastic about the practical demonstrations.

Workshop C: AI Ethics in Education dove into the ethical measurements of integrating AI into educational situations. This three-hour workshop brought together teachers, policymakers, and AI specialists to discuss critical topics such as data protection, algorithmic bias, and transparency in AI decision-making forms. The workshop included expert presentations and interactive discourses, allowing members to investigate procedures for addressing moral issues and creating responsible AI practices that guarantee fairness and responsibility in education. Held in a conference room, this workshop had a more formal atmosphere, with 20-25 attendees. The setting was conducive to deep discussions, and participants appeared highly engaged. However, some attendees mentioned that the formal environment made them feel less comfortable sharing personal experiences or concerns. As one participant quietly noted after a session, "I wanted to share an issue we faced at school with AI, but I felt it wasn't the right setting."

Another participant, however, remarked during the final Q&A: "It's the first time I've seen a clear breakdown of data bias in Arabic-language AI tools. That was very eye-opening."

Workshop D: Practical Applications of AI in Education advertised a comprehensive overview of AI instruments and platforms planned particularly for educational use. Spanning four hours, this workshop combined theoretical experiences with hands-on experience. Members, counting educators, instructional designers, and technologists, engaged in practical exercises involving AI-driven applications such as adaptive learning frameworks, intelligent tutoring platforms, and automated substance creation tools. The session emphasized the viable implementation of AI concepts to upgrade teaching techniques, personalize student learning encounters, and streamline educational forms. This workshop took place in a university lab, which provided a hands-on, interactive environment for the 15-20 participants. The lab setting was ideal for experimenting with AI tools, and participants seemed to enjoy the practical, exploratory nature of the session. However, the technical nature of the workshop required a higher level of prior knowledge, which some participants found challenging.

Workshop E: Integrating AI in Education provided a thorough investigation of how AI can revolutionize instructive hones. This four-hour workshop secured an introduction to AI, its significance in instruction, and practical applications in personalized learning, evaluation, and classroom administration. Key AI tools like Mindmap, Curipod, ClassPoint, Magic School, Copilot, ChatGPT, and Tome were illustrated. Participants engaged in hands-on exercises to understand how these instruments can be utilized to personalize substance, automate appraisals, manage classroom exercises, and

improve student engagement. The session also addressed challenges in AI integration, such as data protection concerns and technical challenges. Held in a seminar room, this workshop had a balanced mix of theory and practice, with 25-30 attendees. The setting allowed for both group discussions and individual work, and participants seemed comfortable sharing their thoughts and experiences. The facilitators created a welcoming atmosphere, which encouraged active participation. One teacher-in-training enthusiastically noted, "Now I finally understand how ChatGPT can help with differentiated instruction. It's not just for writing essays!"

Another participant reflected during a coffee break, "I wish we had more of these sessions at our university. We're learning how to actually use these tools, not just hearing about them."

Workshop F: Professionalism in AI Tools advertised an in-depth look at AI apparatuses outlined to upgrade professional productivity and creativity. This eight-hour session featured demonstrations and hands-on exercises with instruments such as Diffit, Copilot, Thinglink, Canva AI, Wakelet, and Gamma. The workshop centered on how these devices can streamline tasks, improve content creation, and boost effectiveness in both professional and educational settings. Participants explored each tool's functionalities and applications, gaining experiences into how AI can upgrade professional practices and efficiency. Conducted in a training center, this workshop was the longest session, with 40-45 attendees. The training center provided a professional yet relaxed environment, which was well-suited for the workshop's focus on productivity and creativity. Participants appreciated the informal setting, which allowed for networking and collaboration. However, the length of the session was tiring for some attendees, and a few mentioned that they would have preferred shorter, more focused segments. One commented near the end, "I liked the tools, but this should have been split into two days—my attention faded after hour six."

4.2. Key aspects

After analyzing each of the workshops through participant observation, the information is organized according to the analysis variables stipulated for the study. This analysis highlights the differences and similarities between the workshops, providing a clearer understanding of their unique contributions and shared themes.

4.2.1. Topics covered inside the workshops

The workshops explored various AI applications in education, focusing on enhancing teaching and learning. Workshops A and B concentrated on practical tools for personalized learning, with Workshop A covering Gamma.app and Mentimeter, and Workshop B exploring Replica and BrainStory. Workshops D and E expanded on AI applications, including intelligent teaching systems and automated content creation, with Workshop E also addressing challenges like data protection. Workshop C uniquely focused on ethical issues, such as algorithmic bias and transparency. Workshop F, in contrast, emphasized AI for professional productivity rather than classroom use. Despite their differences, all workshops shared the goal of improving education through AI, with ethical considerations present in most sessions.

4.2.2. Methodologies utilized

The workshops utilized a mix of strategies that combined theoretical discourses with practical, hands-on exercises. Workshops A and B were well received, with attendees appreciating the interactive nature of the activities and the hands-on experience with AI tools. Workshops D and E earned recognition for effectively blending theory with practice; however, some participants in Workshop E expressed the need for more time to delve into ethical discussions. Workshop C received positive remarks for its strong emphasis on ethical considerations, particularly the discussions surrounding data privacy and algorithmic bias. Although Workshop F was engaging, some participants noted that its focus on productivity tools for professionals made it less directly applicable to classroom instruction.

4.2.3. Participant engagement and feedback

Engagement within the workshops was reliably high, with members actively involved in both the dialogs and practical exercises. Workshops A and B received positive feedback for their hands-on approach, as participants appreciated the opportunity to engage directly with AI tools. Workshops D and E were praised for balancing theoretical concepts with practical application; however, some attendees in Workshop E noted the need for more time to explore ethical considerations. Workshop C was well received for its focus on ethical issues, with discussions on data privacy and algorithmic bias being particularly valued by participants. While Workshop F was engaging, some attendees felt its focus on productivity tools for professionals made it less directly applicable to classroom teaching. Generally, the interactive format cultivated a positive learning environment and expanded participants' confidence in utilizing AI.

4.2.4. Impact on future teaching practices

The workshops had a noteworthy impact on participants' readiness to integrate AI into their teaching practices. Workshops A and B proved highly effective in enhancing confidence in the use of AI tools for personalized learning, as numerous participants intend to utilize tools such as Gamma.app and Mentimeter in their classrooms. Workshops D and E offered hands-on skills for incorporating AI into education, while attendees of Workshop D showed enthusiasm for utilizing adaptive learning technologies and smart tutoring systems. Workshop C, though not primarily centered on practical tools, highlighted ethical issues, prompting participants to critically assess data privacy and bias in AI applications. While Workshop F is not directly tied to classroom instruction, it encouraged attendees to investigate AI tools for professional activities such as content development and efficiency. The workshops encouraged teachers to experiment with AI in their classrooms, highlighting how these innovations can upgrade both teaching methodologies and student results.

4.2.5. Challenges and opportunities

Despite positive outcomes, several challenges emerged. Workshops A and B highlighted limited resources in underfunded schools as a barrier to AI use. Workshops D and

E revealed difficulties in integrating AI with traditional teaching. Workshop C stressed the need for more training on ethical issues like data privacy and bias. Workshop F addressed AI's role in professional efficiency but noted unequal access to tools. Still, all workshops acknowledged AI's potential to enhance education, and with proper support, these barriers can be overcome to create more effective learning experiences.

5. Discussion

The investigation of the six workshops on AI training for future instructors uncovered several key findings. These workshops aimed to equip teachers with the vital skills and information to integrate AI into their teaching practices, giving profitable experiences into different approaches and techniques.

5.1. Key discoveries on the training of future teachers in AI

The workshops offered a comprehensive exploration of AI tools and their educational applications. Workshops A and E, for example, provided practical demonstrations of tools like Gamma.app, Mentimeter, and ChatGPT, showcasing their potential to transform teaching strategies. Moreover, Workshop C delved into the ethical measurements of AI in education, addressing basic issues like data protection and algorithmic bias, as supported by Ismail et al. (2024). This focus on morals emphasized the need for responsible AI practices to guarantee decency and transparency in instructive settings.

A critical emphasis across Workshops D and E was on hands-on encounter with AI apparatuses, which illustrated their viable applications in adaptive learning frameworks, intelligent tutoring platforms, and automated content creation. This practical approach was crucial in helping members understand how to actualize AI instruments viably in real-world educational scenarios, aligned with Aljemely's study findings (2024). Workshop F expanded the discussion to AI tools benefits for professional efficiency and creativity, highlighting their value for both educators and other professionals beyond the classroom. This broader application shows that AI training should not be limited to pedagogy alone but should also prepare teachers for administrative and interdisciplinary innovation.

5.2. Commonalities and differences between the workshops

The workshops shared a common objective of upgrading educational practices through AI. They all centered on familiarizing members with different AI apparatuses, giving hands-on encounters, and examining the potential benefits of AI in education, as supported by Umanets et al. (2024). Each session aimed to progress participants' understanding of AI applications and how to integrate these innovations into their teaching practices.

However, the workshops varied significantly in their focuses and techniques. Workshops A and B concentrated on practical applications and tool demonstrations, while Workshop C zeroed in on the ethical implications of AI. Workshops D and E offered in-depth practical training with a solid emphasis on real-world applications.

In contrast, Workshop F investigated AI's impact on professional productivity in a broader setting, giving insights into how AI instruments might improve effectiveness and creativity beyond educational settings.

5.3. Effectiveness evaluation

Members across the workshops communicated high levels of engagement and fulfilment. The practical demonstrations and hands-on exercises were particularly valued, as they encouraged a more profound understanding of how to apply AI devices effectively, a finding that resonates with Aparicio-Gómez et al. (2024). Workshops D and E, in particular, received positive feedback for their focus on practical applications and interactive sessions, which provided significant experiences and illustrated real-world relevance.

Feedback also highlighted the interest in the ethical discussions from Workshop C. Members recognized the significance of addressing ethical considerations within the integration of AI into education. However, there was a consensus that more time may have been allocated to exploring the practical implications of these ethical issues in greater depth, as argued by The World Bank (2024).

The workshops were seen to have a critical impact on teacher training. Members noted that the information gained would help them in integrating AI into their teaching practices more effectively. The practical skills acquired were seen as specifically applicable to improving classroom experiences and improving student engagement.

Despite the valuable experiences provided, members recognized the need for ongoing support and training to guarantee successful AI integration. There was a clear emphasis on the need for persistent professional improvement and assets to remain updated with the quickly evolving field of AI.

5.4. Relevance of the findings for teacher training in Lebanon

The findings from the workshops highlight the unique challenges and opportunities for AI integration in Lebanon's educational system. For example, the workshops revealed that while educators are eager to adopt AI tools, they face significant resource limitations, such as limited access to technology and training. These challenges are particularly acute in Lebanon, where economic instability and infrastructure gaps further complicate the adoption of AI in education. The workshops' focus on practical applications and hands-on involvement is especially pertinent to the Lebanese setting. In a nation where innovative integration in instruction is developing, providing teachers with practical aptitudes that can be straightforwardly applied in the classroom is essential. The workshops emphasized the use of AI tools like Gamma.app and ChatGPT, which are specifically significant to improving teaching strategies and student engagement. This adjusts with existing literature that stresses the significance of practical, hands-on training in viably integrating technology into education (Lindner et al., 2019).

Besides, Workshop C's focus on AI ethics addresses a critical aspect of AI integration that's frequently neglected. The ethical measurements of AI, counting data

security and algorithmic bias, are significant in guaranteeing that AI applications in instruction are reasonable and straightforward. This angle is especially critical for Lebanon, where ethical contemplations in technology use are progressively becoming a priority (Elmansi & Qoura, 2023). The accentuation on developing responsible AI practices adjusts with the broader need for ethical systems in educational innovation, as highlighted by researchers like (Lozano & Blanco Fontao, 2023), who advocate for incorporating ethical training into instructive technology programs.

5.5. Comparison with approaches in other nations or regions

When comparing the workshops in Lebanon to approaches in other nations, a few key differences develop. In numerous regions, AI training for teachers tends to focus more on theoretical information and basic familiarity with tools. For instance, in nations like the United States and the United Kingdom, AI training programs frequently incorporate a significant component of theoretical instruction, with a focus on understanding the essentials of AI and its potential applications (UNESCO. Education sector, 2019). These programs may give foundational information but frequently lack the profundity of practical, hands-on experience that was a trademark of the Lebanese workshops.

In contrast, the workshops in Lebanon illustrated a solid accentuation on viable applications and ethical contemplations. This approach is reliable with recent literature pushing for a more integrated model of AI training that combines theoretical information with practical abilities (Schiff, 2021). By consolidating interactive demonstrations and real-world scenarios, Lebanese workshops provided educators with a more holistic understanding of how AI devices can be connected in educational settings.

However, it is additionally worth noticing that some countries have created more advanced and organized programs for integrating AI into teacher preparing. For example, in nations like China and South Korea, there are established programs and resources that offer progressing support and professional improvement for educators (Doumat et al., 2022). These programs regularly incorporate continuous training and support, which helps teachers remain updated with technological progressions and integrate AI viably into their teaching practices.

Lebanon may benefit from receiving similar approaches by creating more structured training programs that offer continuous support and professional advancement. This could include creating dedicated AI training centers, advertising online courses, and giving continuous professional advancement opportunities to keep teachers educated about the most recent advancements in AI and its applications in education. As highlighted by Joshi et al. (2021), continuous professional improvement is significant for guaranteeing that teachers can viably integrate new innovations into their teaching practices and adjust to advancing educational needs.

5.6. Challenges and opportunities

Challenges include limited resources, infrastructure gaps, and economic instability, which hinder AI adoption in Lebanon.

Another challenge is the need for ongoing professional development to keep educators informed about the latest advancements in AI and best practices. While the workshops highlighted the importance of continuous training, it was noted that such training is often lacking in many educational settings. Without regular professional development, educators may struggle to stay updated with rapidly evolving AI technologies and their applications in education, which can affect their ability to effectively integrate AI tools into their teaching methods.

Ethical concerns also pose a significant challenge. Addressing issues such as data privacy, algorithmic bias, and transparency in AI applications is crucial for responsible AI integration. The workshops emphasized the importance of equipping educators to handle these ethical issues but ensuring that educators have the necessary knowledge and resources to address these concerns remains a challenge. Developing comprehensive strategies and providing adequate training on AI ethics are essential for ensuring that AI tools are used responsibly and fairly in educational settings.

Despite these challenges, there are notable opportunities to enhance the training and integration of AI in education. One key opportunity is the development of more comprehensive training programs that blend theoretical knowledge with practical skills. The workshops analyzed in this study can serve as a model for creating structured and engaging training sessions. By incorporating both theoretical and hands-on components, training programs can better equip educators to integrate AI tools into their teaching practices effectively. This approach can help educators understand not only the functionalities of AI tools but also their practical applications in real-world educational contexts.

Another opportunity lies in fostering collaboration and support among educational institutions, technology providers, and policymakers. Building partnerships can help address resource limitations and create a more supportive environment for AI integration. Such collaborations can facilitate access to essential resources, tools, and expertise, making it easier for educational institutions to implement AI technologies. By working together, stakeholders can develop and share resources, support infrastructure development, and ensure that educators receive the necessary training and support to effectively use AI in their teaching.

Additionally, focusing on AI ethics within teacher training programs presents a valuable opportunity. Incorporating discussions on ethical considerations into training can help educators develop a responsible approach to using AI in education. Providing guidance on issues such as data privacy, algorithmic bias, and fairness can ensure that AI tools are employed in a manner that is both effective and ethical. By integrating ethical training into teacher development programs, educators can be better prepared to navigate the complexities of AI applications and uphold high standards of transparency and responsibility in their use of technology.

Overall, addressing these challenges and leveraging the identified opportunities can significantly enhance the effectiveness of AI integration in education. By developing robust training programs, fostering collaboration, and emphasizing ethical considerations, educational institutions can better support educators in adopting AI tools

and technologies, ultimately leading to more effective and responsible use of AI in educational settings.

In comparing the topics covered, it is evident that while some workshops focused on specific applications of AI in education (Workshops A, B, D, E), others addressed broader issues such as AI ethics (Workshop C) and professional productivity (Workshop F). Each workshop provided valuable insights into different aspects of AI integration, contributing to a comprehensive understanding of AI's potential in both educational and professional contexts.

In summary, the six workshops offered a rich array of perspectives on AI in education and professional development. From practical applications and ethical considerations to enhancing learning strategies and professional productivity, each workshop provided valuable knowledge and hands-on experience, reflecting the diverse ways AI can be leveraged to improve educational and professional practices.

6. Conclusion

The workshops provided valuable insights into the integration of AI into educational practices, highlighting the importance of practical applications, ethical considerations, and ongoing professional development. The findings indicate that the workshops were effective in enhancing participants' understanding of AI tools and their applications, with a strong emphasis on hands-on experience and real-world relevance. This aligns with the results, indicating that participants appreciated experiential learning while also recognizing deficiencies in theoretical understanding and continuous support. The feedback from participants underscored the positive impact of the workshops on teacher training, while also highlighting the need for continuous support and resources. These observations directly inform the recommendations below, ensuring they are grounded in the workshop outcomes.

The challenges identified in the results—such as resource limitations and ethical concerns, emphasize the need for targeted interventions and collaborative efforts. The discoveries and recommendations displayed in this article will be of interest to teachers, policymakers, and partners involved within the future of education in Lebanon and beyond.

Limitations include the small sample size and potential biases due to the researcher's background.

However, to advance the field, future research must prioritize longitudinal studies that evaluate the sustained impact of AI training on both teaching practices and student outcomes. Additionally, systematic investigations comparing diverse training methodologies will be crucial for identifying best practices tailored to various educational contexts. Exploring scalable models for continuous professional development in AI, as well as the role of institutional and policy support in facilitating AI integration, will further ensure that teacher education evolves in step with rapid technological advancements. These directions are vital to fully harness the transformative potential of AI in education and to address the practical challenges revealed by the current study.

After analyzing the six workshops, below are areas of improvement and recommendations for workshop organizers and educational policymakers:

1. **Develop Comprehensive Training Programs:** Workshop organizers should consider creating more structured and comprehensive training programs that include both theoretical and practical components. This recommendation is directly tied to the results, which highlighted participants' desire for a more balanced approach to AI training. Ongoing support and resources should be provided to ensure educators can effectively integrate AI into their teaching practices.
2. **Promote Collaboration:** Encourage collaboration between educational institutions, technology providers, and policymakers to address resource limitations and create a supportive environment for AI integration. This suggestion responds to the results, which identified resource constraints as a major barrier to AI adoption. Partnerships can help facilitate access to tools, resources, and expertise.
3. **Address Ethical Concerns:** Incorporate discussions on AI ethics into training programs to ensure that educators are equipped to handle ethical issues related to AI. This recommendation reflects the ethical concerns raised by participants during the workshops. Providing guidance on responsible AI practices can promote fairness and transparency in educational applications.

By implementing these recommendations, educational stakeholders can enhance the effectiveness of AI training programs and support the successful integration of AI into education, ultimately improving teaching practices and student outcomes. These steps are essential for addressing the challenges identified in the results and realizing the full potential of AI in education.

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Biography

Tala Fawaz is a PhD student in Educational Technology at Universitat Rovira i Virgili (URV), Spain. Her doctoral research focuses on the integration of Artificial Intelligence (AI) in teacher education, with a particular emphasis on preparing pre-service teachers in Lebanon to use AI responsibly and effectively in their classrooms. Her broader research interests include digital literacy, educational policy, and the role of emerging technologies in shaping future teaching and learning practices.

She holds two Master's degrees in Educational Technology—a Research Master's and a Professional Master's—as well as a Bachelor's degree in Social Studies & Arts Teaching from the Lebanese University. With more than eight years of experience in education, she has worked in various roles, including Social Studies Coordinator, Instructional Technology Trainer, and Educational Technology Facilitator. In these capacities, she has contributed to curriculum development, teacher training, and the promotion of technology-enhanced learning across different educational settings.

Tala has also actively participated in international and regional conferences, where she has shared insights from her research and engaged in discussions on the future of education. Her work bridges research and practice, aiming to foster innovation, equity, and evidence-based improvements in teacher education.

Beatriz Lores-Gómez: Accredited as *Contratada Doctora* by ANECA (2024). PhD in Communication Sciences with the distinction of *Sobresaliente Cum Laude* (Highest Honors).

She currently teaches at several universities: at Universitat Jaume I (Castellón), where she lectures in Didactics of Spanish and Catalan Language and Literature in the Primary and Early Childhood Education degrees, and also supervises rural teaching practicum and undergraduate dissertations (TFG)(2022–present). At Universitat Rovira i Virgili (Tarragona), she participates in the Interuniversity Master's in Educational Technology (e-learning and knowledge management), supervises master's theses (TFM), undergraduate dissertations (TFG), and doctoral theses in the PhD Program in Educational Technology, and is a member of the ARGET research group (2018–present).

At the Universidad Europea, she collaborates in the Master's in Teaching Innovation and in the Primary and Early Childhood Education degrees. At the Universidad Internacional de Valencia, she lectures and supervises undergraduate dissertations in Early Childhood Education.

She has carried out research stays at the National University of Patagonia San Juan Bosco (2023, Erasmus K-12 scholarship) and at Universitat Rovira i Virgili (2018). Her research and publications focus on digital educational technology, digital teaching competence, educational innovation, and the didactics of language and literature.

She is currently pursuing a Degree in Primary Education (VIU, 2024-2026). Previously, she simultaneously completed a degree in Advertising and Public Relations (2004-2009) and a degree in Journalism (2005-2010) at Universidad CEU Cardenal Herrera. She obtained a Master's in Secondary Teacher Training, specializing in Business (UV, 2010), and studied under an Erasmus grant at Växjö Universitet (Sweden, 2007-2008). She holds C1 level certificates in English and Valencian, as well as official teaching accreditation in both languages.