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Understanding Artificial Intelligence Adoption in Primary Education Through a Qualitative Case Study in Cyprus

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Article Title Page

Title:

Understanding Artificial Intelligence Adoption in Primary Education Through a Qualitative Case Study in Cyprus

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Declaration of Interest

The author declares that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Other Declarations

Ethical approval

The study received a favourable ethical opinion from the Cyprus National Bioethics Committee (CNBC), reference number ΕΕΒΚ ΕΠ 2024.01.287, dated 15 October 2024. The research was conducted in accordance with the ethical requirements of the Committee and applicable data protection

legislation, including the General Data Protection Regulation (EU) 2016/679 and relevant national legislation of the Republic of Cyprus.

Consent to participate

Written informed consent was obtained from all participants prior to their participation in the study. Participation was entirely voluntary, and participants were informed about the purpose of the research, the data collection procedures, the confidentiality and protection of their personal data, and their right to withdraw from the study.

Consent to publish

Not applicable. The manuscript does not contain any identifiable personal information or images of the participants. All findings are reported in an anonymised form to protect participants' identities and confidentiality.

Data availability

The datasets generated and/or analysed during the current study are not publicly available due to the confidential and sensitive nature of the qualitative data collected from human participants, as well as the need to protect participants' privacy and anonymity in accordance with ethical considerations and data protection requirements (GDPR), but are available from the corresponding author on reasonable request, subject to ethical and data protection restrictions.

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Abstract

This qualitative case study explores how primary school educators in Cyprus integrate artificial intelligence (AI) into their teaching and professional practice within an education system at an early stage of AI adoption. Data were collected from fifteen educators through semi-structured interviews, concurrent think-aloud protocols, and AI-supported lesson plans. The data were analysed using an expanded Technology Acceptance Model (TAM), incorporating selected constructs from the Unified Theory of Acceptance and Use of Technology (UTAUT) and the AI-TPACK framework to examine individual, organisational, and contextual influences on AI adoption.

Findings indicate that educators integrated AI into lesson planning, instructional differentiation, assessment design, multimedia development, and self-directed professional learning. Although participants demonstrated increasing confidence and professional agency in using AI, sustained implementation depended less on individual willingness than on the availability of organisational, pedagogical, and policy support. Limited infrastructure, fragmented professional development, ethical uncertainty, inconsistent leadership, and the absence of coherent institutional guidance constrained the transition from individual experimentation to systematic classroom integration.

The study contributes to the growing literature on AI in primary education by demonstrating that meaningful AI implementation in early-adoption education systems is shaped by the interaction between teacher agency and institutional conditions rather than by technology acceptance alone. Based on these findings, a five-pillar framework is proposed to support responsible and sustainable AI integration through systemic governance, equitable access, embedded professional learning, curriculum and pedagogical alignment, and stakeholder engagement. While grounded in the Cypriot context, the findings offer insights that may inform AI implementation in comparable education systems.

Keywords: Artificial Intelligence; Primary Education; AI Adoption; Teacher Professional Learning; Educational Technology; Teacher Agency

1. Introduction

Education is undergoing a rapid technological revolution, which is transforming teaching, pedagogical methodologies, and administrative practices. While these developments are opportunities for innovation, and improved learning outcomes, they also intensify educators' workloads, decrease job satisfaction, and increase techno-stress (Gabbiadini et al., 2023). An important component in this progression is Artificial Intelligence (AI), which enables automation, personalized learning and

inclusive learning experiences (Lu et al., 2021). In addition, generative AI shows potential as a teaching organizational assistant and content generator (Bagir et al., 2022).

Research on AI in education has expanded rapidly. However, it is unevenly distributed, across educational sectors. The majority of empirical studies, focuses on higher education contexts, and examines intelligent tutoring systems, learning analytics, and automated feedback (Holmes et al., 2022; OECD, 2021). In contrast, research on primary education remains limited. Existing studies have largely focused on AI literacy, attitudes, or basic AI awareness, with comparatively less attention given to how AI becomes integrated into everyday pedagogical and professional practice within primary education (Holmes et al., 2022). This imbalance highlights a significant gap in the literature, particularly, regarding how AI is used in primary education, within the early stage of AI adoption in national education systems. Despite educators' growing experimentation with AI, for assessment, lesson planning, content generation, and feedback, the integration of AI into everyday classroom practice remains limited (Holmes et al., 2022; Lu et al., 2021). The absence of consistent policy direction, the limited infrastructure, and the fragmented opportunities for teacher professional learning, often challenge systematic adoption.

Within this broader landscape, European initiatives, such as "Digital Education Action Plan 2021-2027" and "Digital Decade 2030", outline objectives related to AI literacy, digital inclusion, and ethical frameworks (European Commission, 2023). However, the implementation varies significantly across countries. Digitally advanced systems, such as those in Estonia, and Finland, have made significant progress in integrating AI into education with research focusing on optimization, innovation, and ethical governance. Consequently, national education systems at an early stage of AI adoption, particularly in primary education, are underrepresented as less attention has been given to foundational challenges such as readiness, skills development, and alignment between policy intentions and classroom practices.

Cyprus constitutes a theoretically informative case because it represents an education system in transition, where teachers are beginning to integrate AI despite the absence of mature policy, curriculum, and organisational support. Such contexts provide valuable opportunities for understanding how AI implementation emerges before institutional structures become fully established. The Cypriot education system is characterised by the coexistence of policy intentions, with limited implementation capacity, and fragmented support structures. Although a National AI Strategy was adopted in 2020 (Deputy Ministry of Research, Innovation and Digital Policy, Cyprus), its policy enactment in education has progressed slowly. An Advisory Committee on AI in Education, along with a dedicated ministerial advisory task force, for policy development, was established only in 2025 (Republic of Cyprus

Governance, 2025). The AI policy was published in October 2025, and primarily addresses secondary education. Primary education remains largely absent from formal AI policy and regulatory frameworks.

This policy gap is further reinforced at the curricular and regulatory levels in primary education. The curriculum has not been updated to include AI, showing that its incorporation into teaching materials remains minimal. As a result, the development of students' digital competence remains limited. Although there is a "Digital Competence" unit within the "New Technologies" module, for Grades E' and ST', its focus is related to programming. The most recent curriculum revision (Ministry of Education, 2024), focuses primarily on existing curriculum competences, including only general references related to the use of digital materials in classroom practice. It does not articulate a coherent technology action plan or provide clearly defined digital competence indicators. Curricular attention to digital skills appears to be concentrated primarily in Grade D, largely in response to the requirements of digitally administered international assessments such as PIRLS and TIMSS. It is also implemented alongside an already overloaded curriculum. Furthermore, existing regulations remain unclear, regarding students' use of digital technologies, in everyday classroom practice, contributing to a persistent misalignment between policy aspirations, curricular provision, and classroom realities.

Empirical evidence, from Cyprus, reflects these challenges. Recent studies, published during the same period, indicate that primary educators demonstrate moderate levels of digital competence and AI literacy, alongside persistent infrastructural, organisational, and professional development constraints (Kasinidou et al., 2025; Karousiou, 2025). In the absence of coherent guidance, AI integration in primary education is largely shaped by individual initiatives and informal practices rather than by systematic support.

In response to this gap, this study examines how primary school educators in Cyprus integrate AI into their professional and pedagogical practice within an education system at an early stage of AI adoption. Rather than examining AI adoption solely as an issue of individual technology acceptance, the study explores how educators' practices are shaped by the interaction between teacher agency, organisational conditions, and emerging policy environments. This perspective responds to growing calls for research that moves beyond individual adoption models to examine the institutional, organisational, and policy conditions that shape meaningful educational technology implementation. In doing so, it contributes to the growing literature by providing a contextualised understanding of AI implementation in early-adoption education systems and by proposing an empirically grounded framework for sustainable AI integration that extends beyond individual adoption to encompass institutional and systemic conditions. The findings provide both theoretical and practical implications

for policy development, teacher professional learning, and curriculum reform in comparable early-adoption education systems.

A preliminary version of this study was previously made available as a preprint (Stylianou & Vrasidas, 2025). The present article represents a substantially revised and expanded version, including a refined theoretical framework, an extended qualitative analysis, a restructured discussion, and the development of a conceptual framework for sustainable AI integration in primary education.

2. Purpose of the Study

This study was initiated in November 2024 and seeks to map the current use of Artificial Intelligence (AI) tools by primary school educators in Cyprus, offering insights into educators' practices, perceptions, and challenges prior to the national rollout of an AI strategy. It addresses the following research questions:

1. How do educators use AI tools in their professional and teaching practices?
2. What barriers and enabling conditions shape the implementation of AI in primary education?

3. Methodology

Research Design and Rationale

This study adopted a qualitative case study design to explore how primary school educators in Cyprus integrate AI tools into their teaching and professional practice during an early phase of national AI adoption. A qualitative approach was considered more appropriate, due to the exploratory nature of the research questions, and the limited empirical evidence currently available from early stage AI adoption education systems. The study aimed to capture educators' perceptions, decision-making processes, and pedagogical interpretations of AI use within their specific institutional and cultural context. A qualitative case study design was selected because it enables an in-depth examination of educational practices within their real-world context while accounting for the institutional, organisational, and cultural factors that shape AI implementation. Such an approach is particularly appropriate for examining emerging educational phenomena in contexts where practices are still evolving and remain insufficiently understood. The case study approach was also appropriate because it enabled examination of AI implementation as a context-dependent process influenced by interactions between educators, schools, and the wider policy environment rather than as an isolated process of individual technology adoption.

Participants and Sampling

Two sampling strategies were combined in this study. Purposive sampling was used to recruit primary school educators who voluntarily would enroll in a professional development initiative focusing on AI tools for teaching. Convenience sampling complemented purposive sampling because participant

recruitment depended on educators' voluntary enrolment in the professional development programme and their availability to complete all phases of the study. Although 24 educators initially enrolled, only 15 completed both the training and the classroom implementation phase, and were therefore included in the final sample. Participant dropout occurred due to time constraints and school-level workload pressures. The final sample included educators with varying years of teaching experience, levels of digital literacy, and geographic locations, enabling the capture of diverse perspectives and patterns of AI use.

Data Collection

Data were collected between mid- November 2024 and April 2025, through three complementary sources designed to capture both reflective and real time dimensions of AI use:

• Pre- and post-use interviews focusing respectively on initial expectations, perceived usefulness, concerns, and subsequent experiences, challenges, and perceived pedagogical value.

• Concurrent think-aloud sessions conducted while educators used AI tools to design instructional materials, allowing access to real-time reasoning and decision-making processes, decisionmaking strategies, and moments of uncertainty or resistance.

• One lesson plan per participant in which AI tools were actively used during classroom instruction, serving as evidence of pedagogical application. The combination of these three data sources enabled methodological triangulation and facilitated comparison between educators' reported beliefs, real-time decision-making processes, and enacted classroom practices.

Data Analysis

Data were analyzed using thematic content analysis, following Bengtsson's (2016) four-step process: decontextualization, recontextualization, categorization, and compilation. This approach allowed for systematic handling of qualitative data while maintaining sensitivity to context. Analysis proceeded in several stages. First, all interview and think-aloud transcripts were read repeatedly to achieve familiarization. Open coding was conducted manually by the lead researcher using printed transcripts and digital spreadsheets. Codes were initially generated inductively, closely reflecting participants' language and expressed experiences. In the second stage, the axial coding (Strauss, 1987) was applied to group related codes and identify relationships between categories. Although initial coding was inductive, emerging categories were subsequently examined in relation to constructs from TAM and complementary organisational and pedagogical frameworks to facilitate interpretation rather than constrain analysis within a predetermined model. This approach enabled interpretation of the empirical patterns through complementary theoretical perspectives, including technology acceptance, pedagogical integration, and organisational influences on AI implementation. Selective coding was then used to refine broader themes across participants and data sources. Themes were iteratively refined

through constant comparison across interviews, think-aloud protocols, and lesson plans until coherent thematic patterns were established across the different data sources. To enhance analytic transparency and rigor, frequency tables were created indicating the number of coded segments per category across data sources. Although the frequency tables were not used for statistical inference, they enhanced analytic transparency by illustrating the relative prominence of themes across the different data sources. The same analytic procedure was applied across all three research questions to ensure methodological coherence.

Trustworthiness

Credibility was strengthened through member checking, with participants reviewing their interviews and think-aloud transcripts for accuracy and clarification (Lincoln & Guba, 1985). Peer debriefing further supported critical reflection. Dependability was enhanced through a detailed audit trail documenting sampling decisions, coding iterations, category development, and analytic memos. Methodological triangulation across interviews, concurrent think-aloud protocols, and lesson plans strengthened confirmability by enabling comparison between participants' reported beliefs, observed decision-making, and classroom implementation (Carter et al., 2014).

Theoretical Framework Integration

The study was primarily based on the Technology Acceptance Model (TAM) (Davis, 1989), which was selected due to its relevance in examining educators' initial engagement with emerging technologies. To address TAM's limitations in capturing organisational and contextual influences on technology adoption, selected constructs from the Unified Theory of Acceptance and Use of Technology (UTAUT), including facilitating conditions, social influence, and leadership support, were incorporated into the analytical framework. In order to examine the pedagogical dimensions of AI integration beyond technology acceptance, constructs from the AI-TPACK framework (Ning et al., 2024) were used to interpret how educators integrated AI-related technological knowledge with pedagogical strategies and subject content. The Concerns-Based Adoption Model (CBAM) (Hall & Hord, 1987) was employed only at the interpretive stage to further contextualize patterns of AI use. While CBAM did not inform the initial coding scheme, educators' practices were subsequently mapped onto CBAM's Levels of Use, to provide additional insight into variation in adoption depth and maturity. Together, TAM, the selected UTAUT constructs, AI-TPACK, and CBAM provided a complementary analytical lens that enabled interpretation of AI implementation across multiple levels, encompassing educators' perceptions, pedagogical practices, organisational conditions, and the broader policy context. This integrated perspective was consistent with the study's aim of understanding AI implementation as a context-dependent process rather than solely as a matter of individual technology acceptance.

4. Results

The findings are organised according to the two research questions guiding the study.Analysis revealed two interconnected dimensions: (a) educators' professional and pedagogical use of AI and (b) the organisational, pedagogical, and contextual conditions shaping AI implementation.

4.1 Research Question 1: How do educators use AI tools in their professional and teaching practices?

4.1.1 Levels of Use of Artificial Intelligence Tools by Educators

Before examining the specific ways in which educators used AI, analysis of the interview data revealed three distinct levels of engagement with AI tools: Non-use, Exploratory Use, and Integrated Use (Table 1). These levels emerged inductively from participants' accounts and describe educators' progression from initial awareness to systematic integration of AI into their professional and pedagogical practice.

Although participants entered the study with different levels of prior experience, comparison of the two interview phases indicated a clear shift towards more purposeful and sustained use of AI. Most educators progressed from limited experimentation towards more confident and integrated use, suggesting that exposure, practice, and professional learning facilitated the transition from exploratory engagement to routine implementation. These engagement levels provide the context for understanding the patterns of AI use presented in the following sections.

Table 4.1

Illustrative quotations representing educators' levels of engagement with Artificial Intelligence tools

Level of Engagement	**Illustrative Quotations**
Non-use	*"I haven't used them yet."* (Int1P2) *"I've heard about how you can use them, but I haven't used them yet."* (Int1P3) *"I simply didn't use them."* (Int1P5) *"...I just haven't been motivated to use them yet."* (Int1P9)

Exploratory Use	*"Overall, ChatGPT and I are just getting to know each other."* (Int1P11) *"Yes, I tried using G [ChatGPT]... I asked it to simplify a poem, but instead it turned it into a narrative. It basically gave me a summary. So I ended up simplifying it myself. I simply didn't know how to guide it to produce what I actually wanted."* (Int1P13) *"I haven't really had the chance to experiment with AI tools other than ChatGPT."* (Int1P13) *"So yes, I tried—I made an effort to use it."* (Int1P14) *"Yes, this year I started using AI tools a bit more actively. Through trial and error..."* (Int1P15) *"I tried, but I didn't actually use them. I explored them a little and experimented on my own, but I didn't use them in the classroom."* (Int1P19) *"...I experimented with them and I continue experimenting."* (Int1P21)
Integrated Use	*"We use ChatGPT frequently... as well as MagicSchool, Ideogram, and Muse.ai."* (Int1P4) *"Recently I've started using ChatGPT much more intensively."* (Int1P7) *"Today we already had our first lesson using AI tools with my younger students."* (Int1P10) *"I tried ChatGPT with my students."* (Int1P17) *"I created texts in ChatGPT with specific instructions... and it helped me tremendously."* (Int1P24) *"Definitely. They've become part of my life now."* (Int2P7) *"I don't think there's any going back."* (Int2P9) *"Yes, of course."* (Int2P10) *"Absolutely. I use them for my PhD... and for my everyday teaching practice."* (Int2P21) *"Yes, absolutely. As a person, as a teacher, and as a mother."* (Int2P24)

4.1.2 AI as a pedagogical planning and teaching resource

Analysis of the interviews and concurrent think-aloud protocols indicated that educators initially appropriated AI primarily as a pedagogical planning resource rather than as a classroom delivery technology. AI was first integrated into lesson planning, instructional differentiation, assessment design, and the development of multimodal learning resources, suggesting that teachers initially adopted AI in professional tasks where it reduced preparation time while extending instructional flexibility. Across the two interview phases, educators reported increasing use of AI for lesson planning and the creation of

visual and gamified learning resources, indicating that growing familiarity with AI tools supported a gradual transition from experimentation to more deliberate pedagogical integration.

4.1.3 AI for creativity and student-centred learning

Beyond lesson preparation, educators increasingly integrated AI into student-centred learning activities. Rather than functioning solely as a content-generation technology, AI became a collaborative learning resource through which students generated ideas, co-created multimodal artefacts, and engaged in creative problem-solving activities. Individually, they asked students to use AI for writing, visualising concepts, and exploring ideas. They noted that AI's adaptability supported differentiated instruction, increased student engagement, and benefitted learners with varying abilities and language skills. These findings also revealed that educators did not perceive AI solely as a classroom technology. Increasingly, they described AI as a resource for their own professional learning and instructional development, indicating that AI adoption extended beyond teaching activities into broader professional practice.

4.1.4 AI for professional learning and instructional development

Beyond classroom implementation, educators increasingly perceived AI as a resource for their own professional learning and instructional development. Analysis revealed five interconnected patterns of professional use (Table X). First, educators used AI as an exploratory learning tool, experimenting with different platforms and gradually developing practical skills and confidence. Second, AI functioned as an on-demand professional assistant, providing immediate support for information retrieval, lesson planning, and the creation of teaching resources, particularly when educators faced significant time constraints. Third, participants increasingly personalised AI-generated outputs to meet individual learners' needs, lesson objectives, and language levels, demonstrating growing confidence in adapting rather than simply adopting AI-generated content.

A fourth pattern concerned the use of AI to support interactive and dialogic learning. Educators described engaging with conversational AI systems, designing game-based activities, and developing prompts that encouraged student participation, interaction, and agency. Finally, educators demonstrated increasing critical reflection regarding AI use. Rather than accepting AI outputs uncritically, they questioned issues related to accuracy, ethics, bias, and the longer-term implications of AI for teaching and learning, suggesting the development of a more reflective and pedagogically informed approach to AI integration. Taken together, these findings indicate that educators increasingly positioned AI as a continuous professional learning resource rather than simply as a productivity tool. AI supported not

only instructional preparation but also ongoing experimentation, pedagogical reflection, and professional growth.

4.2 Research Question 2: What barriers and enabling conditions shape the implementation of AI in primary education?

4.2.1 Organisational and systemic conditions influencing AI adoption

Analysis of the second-round interviews revealed that educators perceived the barriers to AI implementation as extending beyond individual knowledge or motivation. Instead, participants described a complex set of interconnected organisational, systemic, and pedagogical conditions that collectively influenced whether AI could be meaningfully integrated into everyday classroom practice. These findings suggest that educators viewed sustainable AI adoption as dependent on coordinated institutional support rather than individual teacher initiative alone.

4.2.1.1 Systemic and organisational support frameworks

Participants consistently identified the absence of coherent policy, institutional guidance, and curriculum support as one of the most significant barriers to AI implementation. Rather than perceiving AI integration as part of a coordinated educational strategy, educators described implementation as largely dependent on the initiative of individual teachers and schools. As one observed: “Right now, the way things are, it all depends on the goodwill of each school and each teacher for these matters to actually work in schools” (Int2P4). They also pointed to insufficient time within the school timetable to experiment with or embed new technologies: “[...] they’ll need to reduce the curriculum load” (Int2P10).

A lack of dedicated curriculum space for students' digital skills development was highlighted as a significant obstacle:“They still don’t have the skills for me to say, ‘OK, save it to your USB” (Int2P14). Participants also raised concerns about missing ethical guidelines, data privacy protocols, and formal mechanisms for monitoring digital practices: “[...] there’s no legal framework in place either” (Int2P9). Outdated teaching materials and lack of account management systems and data infrastructure were further noted as significant barriers to effective AI adoption. These systemic gaps often intersected with practical limitations in infrastructure and access, as described in the following section. Taken together, these findings indicate that educators perceived policy, curriculum, and governance not as separate issues but as interdependent conditions shaping the feasibility of AI implementation in schools.

4.2.1.2 Infrastructure and access to AI technologies

Infrastructure emerged as a second critical dimension influencing AI implementation. Although educators expressed increasing confidence in using AI, inadequate access to digital devices, specialised software, and institutional technological resources frequently constrained classroom application. In the interviews, the majority of participants (12 out of 15) explicitly stated that they still faced a lack of digital infrastructure and limited access to essential tools and technologies. They reported unequal or inadequate access to equipment (Int2P11), lack of access to devices due to institutional policies (Int2P2), and challenges in using specialized AI tools because of licensing or technical limitations (Int2P15). These limitations were further compounded by the broader absence of systemic integration of digital technologies into day-to-day educational practices, as explored in the following section. These findings suggest that infrastructure functioned not merely as a technical resource but as an enabling condition for sustained pedagogical use of AI.

4.2.1.3 Organisational culture and school-level support

Beyond formal policy and infrastructure, participants consistently emphasised the importance of organisational culture in shaping AI implementation. Educators described school leadership, collaborative practices, and access to ongoing technical support as key conditions influencing whether experimentation developed into sustained classroom practice. All fifteen participants highlighted the absence of a supportive institutional culture or framework to promote the adoption of AI in teaching practice. Eight educators described limited support or interest from school leadership, suggesting an overall administrative reluctance toward educational innovation: “The school administration didn’t get involved with me, neither if I did it, nor if I didn’t.” (Int2P9).

Twelve participants reported the absence of technical and infrastructural support at the school level: “…that I actually have to go to the principal’s office to get the tablets, charge them, take them home, set them up myself” (Int2P2). Eleven participants pointed out that digital technologies are still not embedded within the pedagogical culture of schools. In parallel, thirteen educators referred to insufficient time for lesson preparation using new tools: “[...] if I don’t know a tool, it will take up time, which I don’t have, so I have to take that time from somewhere else in order to use it, to learn it.” (Int2P21). Additionally, ten educators reported the absence of formal support roles, such as technology coordinators or mentors, underscoring the lack of sustainable support mechanisms. Overall, these findings indicate that institutional culture influenced not only educators' opportunities to use AI but also their confidence in sustaining innovative teaching practices over time.

4.2.1.4 Professional learning and implementation support

Professional learning emerged as another fundamental condition for meaningful AI implementation. Participants consistently distinguished between informational seminars and sustained, practice-oriented professional development, arguing that meaningful adoption required continuous guidance, mentoring, and opportunities to experiment within authentic classroom contexts. As one explained, “besides the seminars, they should also train us in a more targeted way” (Int2P3). Eleven participants highlighted the lack of trainers with appropriate technical or pedagogical expertise, as well as the absence of guidance mechanisms within or beyond the school environment. One educator remarked:“There should be someone you can turn to at any time”(Int2P19).

Participants further emphasised the importance of practical, experiencebased learning opportunities that are rooted in authentic classroom contexts. As one teacher reflected: “The programs the Ministry offered this year on the topic were more like presentations. This presentation style doesn’t really get you to… [...] I think if I hadn’t come across you, I’d still be watching YouTube videos” (Int2P9). Finally, twelve participants drew attention to the absence of clear pedagogical direction for the meaningful use of AI in teaching. As one educator noted: “And in terms of how to use it in the classroom. We definitely need both guidance and some practical strategies” (Int2P5). These findings suggest that educators perceived professional learning not simply as acquiring technical knowledge but as developing the pedagogical confidence necessary to integrate AI meaningfully into teaching practice.

Taken together, these findings reveal that educators experienced the barriers to AI implementation as an interconnected institutional ecosystem rather than as isolated obstacles. Policy guidance, curriculum, infrastructure, organisational culture, leadership, and professional learning were perceived as mutually reinforcing conditions that collectively shaped opportunities for AI integration. Rather than attributing limited implementation to teachers' willingness to adopt AI, participants consistently emphasised the importance of coordinated systemic support in enabling sustainable classroom use.

4.3.2 Thematic Area 2: Ethical and Pedagogical Concerns of Educators

Beyond organisational and infrastructural barriers, participants also identified a range of ethical and pedagogical concerns that shaped their willingness to integrate AI into classroom practice. Analysis indicated that these concerns extended beyond the technical use of AI, reflecting educators' broader responsibility to ensure safe, equitable, and pedagogically meaningful learning environments. Five interconnected areas of concern emerged from the data. One of the most frequently discussed concerns related to student safety, data protection, and privacy. Participants expressed uncertainty regarding the legal and ethical implications of using AI tools with students and questioned whether existing regulations adequately protected personal data. As one educator reflected: “Yes, or if we're going to use

photos and things that will be in the classroom again. I think, I'm not sure, are we covered in all aspects?" (Int2P3). A second concern related to the changing role of the teacher. Ten educators expressed concern that increasing reliance on AI might gradually diminish teachers' professional role and encourage an overdependence on automated support (Int2P4; Int2P9). Rather than rejecting AI itself, participants questioned how it could be integrated without reducing teachers' pedagogical judgement or students' active involvement in learning.

Participants also highlighted the potential impact of AI on students' critical thinking and authentic learning. Almost all educators argued that excessive dependence on AI-generated responses could discourage independent reasoning, creativity, and problem-solving. As one participant cautioned: "You need to be careful to check that what it tells you is actually correct." (Int2P7). Beyond classroom practice, participants recognised that successful AI implementation also depended on broader stakeholder acceptance. Several educators anticipated resistance from parents, particularly within more conservative or religious communities, and argued that greater communication and public awareness would be necessary to support responsible implementation. As one educator explained: "Also, the Ministry needs to have convinced the parents that they should accept these tools, so that we don't have to deal with parental backlash" (Int2P11).

Finally, educators raised concerns about equity of access, arguing that meaningful AI integration required more equitable provision of digital infrastructure and technological resources across schools. One participant emphasised: "It needs to ensure the strengthening of these networks, labs, tablets; there needs to be, in any case, some equality among schools when it comes to this technological matter" (Int2P2). Taken together, these findings suggest that educators perceived ethical and pedagogical considerations not as barriers to AI adoption, but as essential conditions for its responsible implementation. Rather than questioning whether AI should be used, participants focused on how it could be integrated in ways that safeguarded student wellbeing, preserved pedagogical quality, promoted equity, and maintained public trust.

5. Discussion

The findings demonstrate that educators' engagement with AI evolved from exploratory experimentation towards more deliberate and integrated pedagogical practice. Rather than representing a simple increase in technology use, this progression reflected the gradual development of professional confidence, pedagogical adaptation, and contextual understanding. These findings suggest that meaningful AI implementation in primary education is an evolving professional learning process rather than a one-time technology adoption event.

5.1 Levels of Educators' Engagement with Artificial Intelligence Tools

The progression observed across participants closely reflects the developmental nature of the Concerns-Based Adoption Model (CBAM) (Hall & Hord, 1987). However, rather than simply confirming CBAM's Levels of Use, the findings extend this perspective by illustrating how educators' progression was accompanied by increasing pedagogical sophistication and expanding professional applications of AI. Most participants initially operated at the Orientation or Preparation stages, characterized by limited exposure and initial experimentation (Int1P2; Int1P3; Int1P13). One admitted: "I tried, but I didn't use them in class. I played around a bit" (Int1P19). Similar early engagement patterns have been reported in Malaysia (Paramasveran & Nasri, 2018) and Jordan (Gasaymeh, 2017), where limited awareness and institutional support slowed adoption.

By the second interview phase, most educators had progressed from exploratory engagement towards more purposeful and sustained AI use. This progression was evident not only in the frequency of AI use but also in the increasing complexity of pedagogical applications, including differentiated instruction, assessment design, and the creation of multimodal learning experiences. These findings suggest that familiarity with AI encouraged educators to move beyond experimentation towards intentional instructional integration. One teacher explained: "I definitely use them... especially in my preparation, it helps a lot" (Int2P3), and another added: "Now that I've learned about them, of course I'll continue using them" (Int2P14). Teachers also began to use AI for targeted instructional purposes: "I created texts in ChatGPT with specific instructions and literary style, it helped my students tremendously" (Int1P24). This upward shift aligns with Kimmons et al. (2020), who argue that structured support and experimentation enable meaningful technology integration, and reflects PICRAT's shift from passive substitution to more transformative, student-centred use. Evidence of this shift was seen in examples where educators involved their students in AI-related activities: "We had our first class activity with AI tools. The students were excited!" (Int1P10).

The findings also resonate with the AI-TPACK framework (Ning et al., 2024), suggesting that educators' development extended beyond acquiring technological knowledge towards integrating AI within pedagogical decision-making and subject-specific teaching practices. AI therefore became not merely a technological tool but an increasingly embedded component of educators' instructional repertoire. Some extended AI use beyond teaching: "I use them for my academic work, not just the classroom" (Int2P21), while others balanced between reliance with critical thinking: "It's in my life now, I rely on it, though I try not to forget how to think critically myself" (Int2P7). These findings further support Rogers' Diffusion of Innovations Theory (Rogers et al., 2008), highlighting the importance of experimentation, peer learning, and perceived usefulness in facilitating adoption.

However, the present study also indicates that innovation alone was insufficient to sustain AI integration without broader organisational and institutional support. Taken together, these findings suggest that educators' progression in AI use reflects a dynamic professional learning trajectory rather than a linear process of technology adoption. Although participants demonstrated increasing confidence and pedagogical sophistication, sustained implementation remained dependent on broader organisational and policy conditions. This finding contributes to the emerging literature by showing that educators' engagement with AI evolves through the interaction between professional learning and contextual support, particularly within education systems at an early stage of AI adoption.

5.2 Uses of AI Tools by Educators in Their Professional and Teaching Practice

The findings indicate that educators integrated AI into their professional and teaching practice in progressively more sophisticated ways, extending beyond isolated technological experimentation towards purposeful pedagogical applications. Rather than functioning simply as productivity tools, AI increasingly became pedagogical resources that supported instructional planning, differentiated teaching, assessment, creative learning, and teachers' ongoing professional learning. This progression suggests that educators appropriated AI primarily to enhance and extend existing pedagogical practices rather than replace professional judgement.

A dominant finding concerned the use of AI as a pedagogical planning partner. Participants consistently described employing AI tools such as ChatGPT, Gemini, and MagicSchool to support lesson planning, instructional differentiation, assessment design, and curriculum adaptation. One educator explained: “I can tell the artificial intelligence to create a text that would fit, let's say, fifth grade or first or second grade, and that includes a lot of adjectives” (Int1P4). Similarly, another participant described using AI to simplify activities and adapt learning materials for individual students (Int2P13).

These findings reinforce previous research demonstrating AI's capacity to reduce routine planning tasks and facilitate differentiated instruction (Guilbault et al., 2025). However, the present study extends this literature by showing that educators rarely adopted AI-generated materials without modification. Instead, they actively refined and adapted AI outputs to meet curriculum requirements, students' learning needs, and specific classroom contexts, suggesting that AI functioned less as an autonomous instructional tool and more as a professional resource supporting pedagogical decision-making.

Educators also increasingly integrated AI into student-centred and creative learning experiences. Beyond content generation, AI supported collaborative writing, digital storytelling, image creation, music composition, and gamified learning activities. As one participant described: “Today we had our first lesson using AI tools together with the younger students…” (Int1P10). Another educator explained that students increasingly contributed their own prompts and ideas during AI-supported activities (Int2P10). These findings suggest that participants positioned AI as a collaborative learning resource that promoted creativity, participation, and learner agency, consistent with student-centred pedagogical approaches (Zha et al., 2024). They also reflect principles of multimedia learning (Mayer, 2009), although participants simultaneously recognised the importance of ensuring that AI supported rather than replaced students' critical thinking and creativity.

The findings further demonstrate that educators increasingly appropriated AI as a resource for their own professional learning. Rather than relying exclusively on formal professional development, participants described continuous experimentation with AI tools to explore new instructional approaches, generate resources, and refine lesson ideas. One educator captured this transition clearly: “Now that I've learned about them, of course I'll continue using them” (Int2P14). Another participant highlighted that AI had become integrated into multiple aspects of professional life: “I use them for my academic work, not just the classroom” (Int2P21).

These findings suggest that educators perceived AI not simply as a teaching aid but as a continuous professional learning resource, supporting previous research on self-directed and experiential teacher learning (Çelik & Baturay, 2024). Participants also emphasised the importance of collaborative learning communities, mentoring, and personalised support, reinforcing evidence that sustainable technology integration depends on both individual experimentation and social learning (Nguyen et al., 2025). Importantly, educators approached AI critically rather than uncritically. Alongside the reported benefits, they consistently reflected on issues related to professional deskilling, student overreliance, and the preservation of creativity and human judgement. As one participant observed: “It's in my life now... I rely on it, though I try not to forget how to think critically myself” (Int2P7).

Rather than rejecting AI, participants emphasised the importance of using it responsibly and reflectively. These findings align with Pangrazio and Selwyn's (2021) argument that meaningful AI integration requires critical engagement with the ethical and educational implications of digital technologies. Taken together, these findings indicate that educators increasingly viewed AI not as a replacement for teaching but as a pedagogical partner supporting instructional planning, creativity, differentiation, and professional learning. At the same time, they recognised that these opportunities

could only be realised through critical pedagogical judgement and sustained professional reflection. The present study therefore contributes to the emerging literature by demonstrating that meaningful AI integration in primary education is characterised not simply by increased technology use but by the gradual transformation of teachers' pedagogical practices and professional learning.

5.3 Barriers to the Implementation of AI Tools in the Classroom

The findings indicate that educators perceived the barriers to AI implementation as extending well beyond individual technological competence. Rather than describing isolated obstacles, participants consistently portrayed AI integration as a complex process shaped by the interaction of systemic, organisational, pedagogical, infrastructural, and cultural conditions. These findings reinforce international evidence that successful AI implementation depends not only on teachers' willingness to adopt new technologies but also on the institutional environments within which adoption occurs (Ghimire & Edwards, 2024). At the same time, the findings extend this literature by illustrating how these conditions interact within an education system at an early stage of AI adoption, where implementation remains largely dependent on individual teacher initiative.

5.3.1 Systemic policy and governance

The absence of coherent national policy emerged as one of the strongest barriers to AI implementation. Participants consistently described working without official guidance, ethical protocols, curriculum direction, or ministry-supported implementation strategies. As one educator explained: “Right now, everything depends on the goodwill of each school, of each teacher…” (Int2P4). Similarly, another participant commented: “We're on our own. No training, no materials” (Int2P5). Rather than simply requesting additional resources, participants emphasised the need for a coherent policy framework capable of legitimising AI use and providing consistent pedagogical direction. Questions regarding legal responsibility, ethical guidance, and ministry approval further reflected educators' uncertainty about institutional expectations: “We don't even know if the Ministry has ethical concerns... does it allow us? To what extent?” (Int2P11).

These findings are consistent with Holmes et al. (2022), who argue that AI implementation remains fragmented when institutional governance is absent. They also resonate with the Cyprus Digital Decade 2025 Report, which identifies digital competence gaps despite improvements in national connectivity, and with the Cyprus Education Profile, highlighting uneven implementation of national

digital strategies. Together, these findings suggest that policy functions not simply as regulation but as an enabling condition for sustainable AI implementation.

5.3.2 Infrastructure, access and technological equity

Infrastructure constituted a second interconnected barrier. Although educators demonstrated increasing confidence in using AI, unequal access to equipment, unreliable internet connectivity, outdated hardware, and limited availability of specialised AI applications frequently constrained classroom implementation. Several educators described transporting equipment themselves or adapting lessons because technological resources were unavailable. One participant reflected: “I have to carry the laptops upstairs myself, and sometimes there's no internet or battery” (Int2P10). Another highlighted inequalities between schools: “There should be equality with funds and support” (Int2P2).

Participants also identified licensing and subscription costs as an additional layer of inequity. Many relied on restricted free versions or personally financed subscriptions to continue developing instructional materials: “I started creating something, but I couldn't finish it because the free trial ran out” (Int2P13). These findings support UNESCO's (2023, 2025) position that equitable access to digital infrastructure and AI technologies represents a prerequisite for meaningful educational innovation. Importantly, participants perceived technological access as encompassing not only hardware but also sustainable access to AI services.

5.3.3 Pedagogical readiness and professional capacity

Participants also identified several pedagogical barriers limiting meaningful AI implementation. Many challenged the widespread assumption that younger learners naturally possess advanced digital competence, describing instead considerable variation in students' ability to use digital technologies effectively. As one educator explained: “They still don't have the skills for me to say, 'OK, save it to your USB” (Int2P14). Consequently, teachers often invested additional instructional time developing foundational digital skills before AI-supported learning activities could be introduced.

Similarly, participants highlighted the absence of sustained, classroom-oriented professional learning. Rather than requesting additional seminars, educators emphasised practical mentoring, continuous support, and opportunities to experiment within authentic teaching contexts. One participant observed: *“*Besides the seminars, they should also train us in a more targeted way” (Int2P3). Another reflected: “If I hadn't come across you, I'd still be watching YouTube videos” (Int2P9). These findings

reinforce growing evidence that professional learning supporting AI implementation must extend beyond technical training towards sustained pedagogical development and situated classroom practice.

5.3.4 Organisational culture, leadership and collaborative support

Beyond policy and professional learning, participants consistently described school culture as shaping AI implementation. Leadership support, opportunities for collaboration, and access to technical assistance influenced whether educators' initial experimentation developed into sustained classroom practice. Experiences varied considerably. Some educators described highly supportive leadership: “Our principal gives us complete freedom to experiment” (Int2P17). Others experienced organisational indifference: “They didn't get involved, whether I did it or not didn't matter” (Int2P9).

Participants also highlighted limited peer collaboration and the absence of in-school mentors capable of providing timely pedagogical or technical assistance. One educator stated: “There should be a consultant at the school, someone we can call when we want to use the computers” (Int2P3). Another commented: “If I had a colleague like you... I would dare. But I'm alone” (Int2P15). These findings support previous research demonstrating that sustainable technology integration depends not only on individual teacher agency but also on collaborative organisational cultures and supportive leadership (Ertmer & Ottenbreit-Leftwich, 2010; Harris & Jones, 2019).

5.3.5 Community expectations and ethical responsibility

Finally, participants recognised that successful AI implementation extended beyond schools themselves. Parental concerns, cultural sensitivities, ethical uncertainty, and invisible administrative work all influenced educators' willingness to integrate AI into teaching. Participants argued that greater ministry communication with families was necessary to build trust and legitimacy around AI use. They also described substantial invisible labour associated with account management, technical troubleshooting, and data protection, often undertaken outside working hours without institutional recognition. Rather than viewing these issues as isolated barriers, educators considered them integral components of responsible AI implementation requiring coordinated institutional responses. Overall, these findings demonstrate that educators experienced AI implementation as a multi-layered organisational ecosystem rather than a collection of independent barriers. Policy, infrastructure, leadership, professional learning, school culture, community acceptance, and ethical governance operated as interconnected conditions that collectively shaped opportunities for AI adoption. This extends previous research by showing that, within early-adoption education systems, sustainable AI

implementation depends less on teachers' willingness to innovate than on the alignment of multiple institutional conditions that enable innovation to move beyond isolated individual practice.

5.3.6 Educators' Ethical and Pedagogical Concerns Regarding AI Use

The findings demonstrate that educators approached AI neither as an inherently beneficial nor as an inherently threatening technology. Instead, participants consistently evaluated AI through an ethical and pedagogical lens, balancing its potential to enhance teaching and learning against concerns regarding responsible implementation. Rather than rejecting AI, educators questioned the conditions under which it could be integrated while preserving professional responsibility, student wellbeing, and the educational value of classroom learning. Four interconnected concerns emerged from the analysis: privacy and data protection, professional identity, authenticity of learning, and sociocultural acceptance.

Privacy and data protection emerged as educators' most immediate concern. Participants expressed uncertainty about the collection and storage of personal data, particularly when AI platforms required students' email addresses, photographs, or personal information. One participant explained: “I felt unsafe... it asked for my phone number, and I didn't want to give it” (Int2P9). Rather than reflecting resistance to AI itself, these concerns revealed uncertainty regarding teachers' legal responsibilities in the absence of clear institutional guidance. As another educator argued: “We need a legal framework to stay at this level and not let things get out of hand” (Int2P4). These findings reinforce previous calls for comprehensive ethical governance frameworks that support educators in using AI responsibly while protecting students' rights and privacy (Holmes et al., 2022).

Participants also reflected critically on **the changing role of the teacher** within AI-enhanced classrooms. Although educators recognised AI's capacity to support planning and instruction, they questioned whether increasing reliance on AI might gradually diminish teachers' professional expertise or reduce students' willingness to engage in independent thinking. As one participant observed: “It's a bit scary to think our role might be obsolete in a few years” (Int2P10). Similarly, another educator questioned: “Will students even need to try anymore?” (Int2P4). These concerns reflect wider debates regarding the evolving nature of teacher expertise in AI-supported education (Ng et al., 2022). However, the findings also suggest that participants viewed teachers' pedagogical judgement, rather than content generation, as the defining element of professional practice. AI was therefore perceived as a tool requiring human mediation rather than a replacement for educators' expertise.

A third concern related to **the authenticity of learning**. Participants consistently emphasised that AI should support rather than replace students' critical thinking, creativity, and independent

problem-solving. Importantly, educators did not view AI as inherently detrimental to learning. Instead, they argued that its educational value depended on purposeful pedagogical design. As one participant explained: “If we teach them to use it properly, it can develop their imagination and metacognition” (Int2P2). This finding extends previous research by demonstrating that educators adopted a nuanced position towards AI, recognising both its opportunities and its risks. Rather than advocating unrestricted or restrictive use, participants emphasised the importance of developing students' AI literacy alongside critical thinking and reflective learning practices, consistent with Ifenthaler et al. (2024).

Finally, educators highlighted **the importance of sociocultural acceptance** for sustainable AI implementation. Participants anticipated parental hesitation, particularly within communities characterised by more conservative attitudes towards emerging technologies, and argued that schools should not be expected to manage these concerns independently. As one educator explained: “Some parents don't want their kids exposed to this at all” (Int2P19). Another participant added: “We need to convince parents first” (Int2P11). These findings suggest that successful AI implementation extends beyond classroom practice to include broader community engagement and institutional communication. This supports previous research demonstrating that public trust and stakeholder acceptance play a central role in the adoption of educational technologies (Selwyn et al., 2021).

Taken together, these findings indicate that educators' concerns were not expressions of resistance to AI but reflections of their commitment to responsible educational practice. Participants consistently argued that meaningful AI integration requires robust ethical governance, protection of student privacy, preservation of teachers' professional judgement, support for authentic learning, and active engagement with parents and the wider school community. These findings therefore suggest that responsible AI implementation depends not only on technological capability but also on the development of ethical, pedagogical, and societal conditions that enable educators to use AI confidently and responsibly.

6. A Framework for Sustainable Pedagogical Integration of AI in Primary Education

The findings of this study informed the development of a five-pillar framework for the sustainable pedagogical integration of AI in primary education. Rather than proposing a prescriptive implementation model, the framework represents a conceptual synthesis of the organisational, pedagogical, and contextual conditions that participants identified as essential for meaningful AI implementation. It is intended as a heuristic framework to support decision-making across policy, school, and classroom levels while recognising that implementation will necessarily vary according to local educational contexts. The framework proposes that sustainable AI implementation depends on the

interaction of five interrelated pillars rather than on isolated technological initiatives. Each pillar addresses a different dimension of educational change, but meaningful implementation requires their coordinated development.

Pillar 1: Policy, governance and ethical leadership

The first pillar recognises that sustainable AI implementation requires coherent policy direction and ethical governance. The findings demonstrated that educators sought clear institutional guidance regarding the pedagogical, legal, and ethical use of AI, particularly in relation to data protection, accountability, and responsible classroom implementation. Rather than relying on individual interpretation, participants emphasised the importance of nationally coordinated frameworks that provide shared expectations for schools while supporting professional autonomy. Such frameworks should include ethical guidance, approved AI tools, age-appropriate implementation principles, and transparent procedures for evaluating AI applications.

Pillar 2: Equitable access and digital infrastructure

The second pillar addresses the importance of equitable technological access. Participants consistently described infrastructure not simply as a technical requirement but as a prerequisite for educational equity. Sustainable AI implementation therefore requires reliable connectivity, adequate hardware, accessible AI platforms, and equitable distribution of technological resources across schools. The findings further suggest that centrally managed digital ecosystems reduce the administrative burden placed on individual teachers while promoting more consistent implementation.

Pillar 3: Continuous professional learning and implementation support

The third pillar reflects educators' consistent emphasis on ongoing professional learning. Rather than viewing professional development as a series of isolated seminars, participants advocated continuous, practice-oriented learning opportunities embedded within authentic classroom contexts. Sustainable implementation therefore requires mentoring, collaborative professional learning communities, school-based digital support, and protected time for experimentation, reflection, and pedagogical innovation. The findings suggest that professional confidence develops progressively through supported classroom practice rather than through technical instruction alone.

Pillar 4: Pedagogically purposeful classroom integration

The fourth pillar emphasises that AI should be integrated as a pedagogical resource rather than as an independent technological innovation. Throughout the study, educators consistently described AI as most valuable when supporting existing curricular goals, differentiated instruction, creativity, communication, and critical thinking. Consequently, sustainable implementation requires adaptable pedagogical models, classroom examples, and curriculum-aligned resources that enable educators to integrate AI meaningfully within everyday teaching rather than as an additional curricular component.

Pillar 5: Community engagement and shared trust

The fifth pillar recognises that successful AI implementation extends beyond schools themselves. Participants repeatedly emphasised the importance of parental understanding, community acceptance, and transparent communication regarding the educational purpose of AI. Building public trust therefore becomes an essential component of sustainable implementation. This includes ongoing dialogue with families, transparent communication regarding ethical safeguards, and opportunities for wider educational stakeholders to participate in discussions surrounding AI use in schools.

Collectively, these five pillars illustrate that sustainable AI implementation is not achieved through technological adoption alone. Rather, the findings suggest that meaningful implementation emerges through the interaction of coherent governance, equitable access, continuous professional learning, pedagogically purposeful practice, and community trust. The framework therefore extends existing models of educational technology integration by conceptualising AI implementation as a systemic educational process that simultaneously encompasses organisational, pedagogical, ethical, and societal dimensions. Although developed within the context of Cypriot primary education, the framework offers a transferable conceptual model for other education systems seeking to support responsible AI integration during the early stages of adoption.

7. Limitations of the Study

This study has several limitations that should be considered when interpreting its findings. First, the study involved a relatively small sample of fifteen primary school educators from Cyprus. As is typical of qualitative case study research, the findings are intended to provide an in-depth understanding of a specific educational context rather than statistical generalisation. Although participants represented diverse schools, levels of digital experience, and geographical locations, all were experienced educators with more than ten years of teaching experience. Consequently, the findings may not fully reflect the experiences, attitudes, or practices of early-career teachers or educators working in different educational

contexts. Second, data were collected over a six-month period (November 2024-April 2025), capturing educators' early experiences with AI implementation rather than longer-term patterns of classroom integration. Teachers' perceptions, confidence, and pedagogical practices are likely to continue evolving as AI technologies, national policies, and professional learning opportunities develop. Longitudinal research would therefore be valuable in examining how educators' AI practices mature over time.

Third, the study focused primarily on educators' perspectives and did not include the views of students, school leaders, parents, or policy makers. Although methodological triangulation was achieved through interviews, concurrent think-aloud protocols, and lesson plans, the absence of classroom observations limited opportunities to examine how reported practices were enacted during authentic teaching and learning activities. Future research incorporating multiple stakeholder perspectives and classroom observations would provide a more comprehensive understanding of AI implementation in schools. Finally, the study did not seek to evaluate or compare the effectiveness of specific AI tools. Instead, it explored educators' experiences of integrating a range of AI applications into their professional and pedagogical practice. Consequently, the findings should be interpreted as reflecting broader implementation processes rather than the effectiveness of particular technologies.

Despite these limitations, the study provides timely empirical evidence from an education system at an early stage of AI adoption. Data were collected during a critical transitional period immediately preceding the implementation of Cyprus' national AI policy for education, offering a unique insight into educators' experiences before formal policy structures became established. As such, the findings contribute to the limited body of research examining AI implementation in primary education within emerging AI policy contexts and may offer transferable insights for other education systems undergoing similar transitions.

8. Recommendations for Future Research

The findings of this study highlight several directions for future research. First, longitudinal studies are needed to examine how educators' use of AI evolves as national policies, professional learning opportunities, and school support structures become more established. Because this study captured educators during an early stage of AI adoption, future research could investigate how teachers' pedagogical practices, confidence, and patterns of AI integration develop over time. Second, future research should adopt a broader multi-stakeholder perspective. While the present study focused on educators' experiences, incorporating the perspectives of students, school leaders, parents, and policymakers would provide a more comprehensive understanding of the organisational, pedagogical,

and societal conditions influencing AI implementation. Classroom observations and analyses of student learning outcomes would further strengthen the evidence base by examining how reported practices translate into authentic teaching and learning.

Comparative research across different educational systems would also be valuable. Cross-national and regional studies could examine how variations in educational policy, digital infrastructure, school culture, and governance influence AI implementation, helping to distinguish context-specific challenges from those that are common across education systems. Such research would contribute to a more nuanced understanding of AI adoption in diverse educational settings. Future studies should also employ a wider range of methodological approaches. Mixed-methods and longitudinal designs could provide a more comprehensive understanding of both implementation processes and educational outcomes, while intervention and design-based research could evaluate the effectiveness of specific implementation models, professional development programmes, and school-based support strategies. Such approaches would complement qualitative findings by providing evidence regarding the sustainability and educational impact of AI integration.

Finally, further research is needed to examine the pedagogical affordances and limitations of specific AI applications across different subjects, age groups, and educational contexts. Comparative studies of tools such as ChatGPT, Gemini, MagicSchool, adaptive tutoring systems, and emerging generative AI applications would help identify which technologies are most appropriate for particular educational purposes. At the same time, additional research should explore how teacher education and continuous professional development can strengthen AI literacy, ethical reasoning, instructional design, and reflective practice, enabling educators to integrate AI in ways that are both pedagogically meaningful and ethically responsible.

Ethical Considerations

All procedures complied with the ethical requirements of the participating institution. Ethical approval was obtained prior to data collection, and all participants provided informed consent before participating in the study. Participation was voluntary, confidentiality and anonymity were maintained throughout the research process, and participants retained the right to withdraw from the study in accordance with the approved ethical protocol.

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