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Research Article

When AI enters Moroccan primary schools: what uses, challenges, and prospects for tomorrow's education?

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Abstract: This study explores the integration of artificial intelligence (AI) in primary education in Morocco through teachers' perceptions, identifying current uses, major challenges, and key factors facilitating its adoption. Using a mixed-methods approach, it combines quantitative and qualitative analyses based on a questionnaire administered to 200 primary school teachers, mainly from the public sector. The results indicate that AI is perceived as a tool for enhancing pedagogical practices, particularly for lesson planning and the creation of educational content in language teaching, scientific awakening, and mathematics. However, its integration remains limited due to a lack of training, restricted access to technology and the Internet, and insufficient institutional support. Statistical analysis reveals a slightly significant tendency among experienced teachers to integrate AI more effectively into their teaching practices ($r = 0.270$, $p < 0.01$). Given these challenges, this study highlights the urgency of implementing targeted training programs and a multidimensional educational policy to fully harness AI's potential while clearly distinguishing its uses from other digital tools.

Keywords: artificial intelligence (AI); primary education; teaching practices; teacher training; digital learning

1. Introduction

In the digital age, education is undergoing a major transformation, marked by the increasing integration of innovative technologies into learning environments. Among these advancements, artificial intelligence (AI) stands out for its potential to redefine pedagogical practices by facilitating the teaching-learning process and optimizing the planning and management of educational resources. Globally, several countries are investing in AI to enhance the quality of education and improve the efficiency of educational systems. In 2019, China launched a program to deploy intelligent learning platforms in more than 500 experimental schools. Similarly, in 2020, the European Union published its Digital Education Action Plan, highlighting AI as a key driver for modernizing educational systems.

In the Moroccan context, AI integration remains limited despite efforts to modernize the education system. In 2019, the Al-Khawarizmi program was launched to strengthen teachers' digital skills and gradually introduce AI-based tools in schools. However, several studies indicate that its adoption is hindered by institutional, technological, pedagogical, and socio-economic barriers. While AI undeniably holds the potential to transform teaching practices, its effective integration into Moroccan primary classrooms raises critical questions: To what extent is AI truly incorporated into pedagogical practices, and what are the key factors facilitating or hindering its adoption by teachers?

In response to these challenges, this research aims to examine the integration of AI in Moroccan primary education, focusing on three main aspects: existing pedagogical practices, the challenges impeding AI adoption, and strategies to ensure effective and equitable implementation. Based on an empirical approach, this study relies on the perceptions and experiences of Moroccan primary school teachers. The ultimate goal is to develop recommendations tailored to the realities of the education system to optimize AI integration into teaching practices and support student learning.

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2. Literature Review

2.1. Artificial Intelligence in Education: Definition and Forms

AI is defined as a set of technologies that simulate human cognitive processes such as learning, problem-solving, and decision-making (Russell & Norvig, 2021). This capability distinguishes AI from other digital tools, which merely automate tasks without replicating human cognitive complexity (Zawacki-Richter et al., 2019). In the educational context, AI takes various forms, enabling greater personalization of learning.

Intelligent Tutoring Systems (ITS) are one of the most common applications of AI in education. According to some scholars (Fotsing et al., 2023), these systems provide personalized instruction by guiding learners through exercises tailored to their skill levels interactively. They adjust content in realtime based on student responses, allowing for better identification of learning gaps and enhancing the overall learning experience (Fotsing et al., 2023). ITS are particularly notable for their ability to simulate teacher-student interactions while continuously tracking learners' progress.

Adaptive learning platforms represent another significant application of AI in education. These platforms analyze learner data to adjust instructional content according to individual needs (McAfee & Brynjolfsson, 2017). AI thus enables large-scale personalization by adapting not only to students' skill levels but also to their learning pace and preferences (Pane et al., 2015). This approach transforms education into a more dynamic and responsive process, facilitating concept acquisition.

Predictive analytics tools are also used to improve assessment and monitoring processes (Herodotou et al., 2019). By collecting and analyzing vast amounts of data, these tools can forecast students' future performance and identify those at risk of dropping out. This AI-driven approach holds significant potential for educational institutions, as it enables early and targeted intervention (Herodotou et al., 2019; Siemens, 2013).

Finally, conversational agents and immersive environments, such as chatbots and virtual reality, enhance the learning experience by fostering student interaction and engagement (El Bahlouli, 2024). Conversational agents leverage natural language processing (NLP) to answer students' questions and guide them in their studies, while immersive environments – combining AI with augmented or virtual reality – immerse learners in interactive and engaging educational settings (Benabbou & Lelong, 2023).

2.2. Applications and Benefits of AI in Education

AI is redefining pedagogical approaches and educational management systems by offering a variety of innovative strategies and applications to improve teaching and learning processes. One of AI's greatest strengths is its ability to personalize the learning experience for each student, allowing for differentiated teaching strategies (Sajja et al., 2023). Adaptive learning systems adjust content and exercises in realtime based on student performance, ensuring that each learner progresses at their own pace. Studies show that these systems enhance knowledge retention and improve academic success, particularly by reducing performance gaps among students (Sajja et al., 2023).

Another key application of AI is enhancing student engagement through immersive technologies such as virtual reality and augmented reality. These technologies provide a more interactive learning experience, allowing students to visualize abstract or complex concepts in immersive environments (Chen et al., 2021). For example, in scientific fields, students can explore simulations of natural phenomena or conduct virtual experiments, facilitating deeper understanding and better knowledge retention (Jensen & Konradsen, 2018). This immersion strengthens motivation and enhances learning interactivity, both crucial for maintaining student attention (Radianti et al., 2020).

The automation of assessment is a major contribution of AI in education. Thanks to advancements in NLP, automated assessment systems can analyze students' textual responses to evaluate their conceptual understanding with high precision (Somers et al., 2021). These tools provide instant feedback to learners, promoting a more dynamic and interactive learning experience. Additionally, automated assessment platforms optimize grading management, reducing teachers' workload and allowing them to focus more on pedagogical support (Acuña & Bansal, 2024). Moreover, recent developments in automatic question generation and response evaluation facilitate personalized assessments tailored to student's specific needs, thereby enhancing teaching effectiveness (Pradana & Josiah, 2024).

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2.3.Challenges and Limitations of Integrating AI into the Moroccan Education System

The integration of AI into the Moroccan education system faces several challenges, some inherent to the nature of AI itself and others specific to the country's socio-economic and educational context. One of the major obstacles lies in teacher training. Although AI plays a crucial role in improving teaching practices, many teachers are not yet adequately trained to effectively utilize these technological tools (Jenfi & Zitouni, 2024). The majority of Moroccan teachers do not have access to continuous training programs that would allow them to familiarize themselves with AI tools, which hinders their adoption in classrooms (Bekdemir, 2024).

Another significant challenge concerns digital infrastructure. Although government initiatives have been implemented to modernize the education sector, inequalities persist in access to advanced technologies, particularly in rural areas of Morocco. As highlighted by Boudine, Bentaleb, Soulaymani, Karfa, and Tayebi (2024) in their study on the "Moroccan Digital Classes" project, the inclusion of different social groups in intelligent educational solutions remains limited due to geographical and socio-economic disparities. Students and teachers in peripheral areas often lack access to stable internet connections and modern digital devices, limiting the use of AI-based solutions. According to Pradana and Josiah (2024), the absence of digital infrastructure in rural schools complicates the application of advanced technologies in educational management. Furthermore, Salemink, Strijker, and Bosworth (2017) emphasize that inequalities in access to information and communication technologies in rural areas lead to limited adoption and unequal use of digital tools, exacerbating the digital divide.

Resistance to change is also a major obstacle. This resistance, observed among both teachers and administrators, can be attributed to a widespread fear of task automation and the radical transformation of traditional teaching practices. According to Ojha (2024), this resistance is heightened by negative perceptions regarding the loss of teacher control over the educational process and concerns related to educational sovereignty. In this context, the adoption of AI is not only a technical or pedagogical issue but also a socio-cultural and political one, requiring awareness and support initiatives for education stakeholders.

Research on the impact of AI in the Moroccan education system is still emerging, but the challenges identified in the studies of Jenfi and Zitouni (2024) as well as Fakhar, Lamrabet, Echantoufi, Khattabi, and Ajana (2024) indicate that implementing these technologies will require a structured approach and rigorous planning. For AI to become a true driver of transformation in the Moroccan education system, ambitious public policies must be put in place, particularly in teacher training, digital infrastructure support, and the regulation of student data privacy.

Research questions

These observations raise several fundamental questions:

1. How is AI concretely transforming teaching practices in Moroccan primary schools?
2. What are the main factors facilitating or hindering the adoption of AI by Moroccan primary school teachers?
3. What strategies can be implemented to ensure an equitable and effective integration of AI in education in Morocco?

3. Materials and Methods

3.1. Population and Sampling

This research aims to explore the use of AI in the teaching practices of primary school teachers in Morocco, taking into account their professional experiences and perceptions regarding the integration of these technologies into their teaching. A sample of 200 teachers participated freely and voluntarily in the study. The participants were unevenly distributed by gender, with 71% women and 29% men, reflecting a female predominance among teachers.

Regarding age groups, 65% of respondents were under 25 years old, indicating a high

proportion of young teachers at the beginning of their careers. The other age groups were represented as follows: 19% of participants were aged 25 to 34, 9% were aged 35 to 44, and 7% were 45 years or older. Regarding professional experience, 69% of teachers had less than three years of experience in primary education, while 11% had 3 to 5 years, 11% had 6 to 10 years, and 9% had more than 10 years of experience. Additionally, a large majority of participants (96%) worked in the public sector, while 5.5% worked in the private sector.

It is worth noting that ethical considerations were upheld throughout the study, with voluntary participation and informed consent obtained from all participants. Participants' confidentiality was ensured, and data were used solely for research purposes, adhering to ethical guidelines regarding participants' rights and professional integrity.

3.2. Data Collection Instrument

The questionnaire used for data collection was designed through the Google Forms platform and then validated by a panel of experts in the fields of education and information technology. The questions were carefully developed to meet the objectives of the study and ensure their relevance to the topics being explored. The data collection instrument includes both closed and open-ended questions, allowing for the exploration of various aspects of AI usage in education. The main themes covered include:

- Demographic and professional information: gender, age, years of experience, field of activity, grade levels taught, average class size.
- Specific training in educational technologies, including AI.
- Use of AI tools: types of tools used, subjects involving AI integration, educational objectives targeted.
- Perception of the effects of AI on teaching and learning.
- Barriers to integrating AI into teaching practices.
- Description of a real-life situation related to AI.

3.3. Data Collection and Analysis Procedure

The questionnaire was administered online via Google Forms. Teachers were invited to participate in the survey through professional groups on social media (WhatsApp, Facebook) as well as through direct contact with schools. Data collection took place over three weeks, ensuring voluntary and anonymous participation from the respondents.

Data analysis was conducted using a mixed-methods approach, combining both quantitative and qualitative analyses to provide a comprehensive understanding of primary school teachers' perceptions and practices regarding the integration (or lack thereof) of AI in their teaching:

- Quantitative analysis: Data from closed-ended questions were processed using descriptive statistics to identify general trends and patterns in teachers' responses.
- Additional statistical analysis: A Pearson correlation analysis was conducted using SPSS software (version 25) to examine the relationships between various variables. This analysis identified the relationship between the teachers' professional experience, their training, their level of technological competence, and the extent to which AI tools were integrated into their teaching practices.

Qualitative analysis: Responses to open-ended questions were subjected to thematic analysis to identify key recurring themes and concepts. This analysis provided deeper insights into teachers' perceptions of the impact of AI on their pedagogical practices

4. Results

4.1. Analysis of Quantitative Results

The research revealed diverse and varied results, which can be presented according to two main axes as follows:

4.1.1. Pedagogical Practices and the Use of AI

Figure 1 presents the teachers' responses regarding using AI tools in teaching, revealing varied levels of adoption. Only 15.5% of participants use these tools regularly, indicating recognition of their importance in the educational process. In contrast, 50.5% use them sporadically, reflecting a mixed interest, likely due to a lack of resources or training. Among the teachers who have not yet adopted these tools, 30.5% express a willingness to train in the future, showing openness to innovation. Finally, a minority of 3.5% show complete disinterest in these tools, indicating resistance or a lack of awareness of their benefits.

In this context, it should be noted that, in the upcoming quantitative results, we will

exclude the category of teachers not integrating AI into their pedagogical practices, representing 34% of the participants. This approach will allow us to focus our quantitative analysis on the practices of teachers who have adopted these tools, to varying degrees.

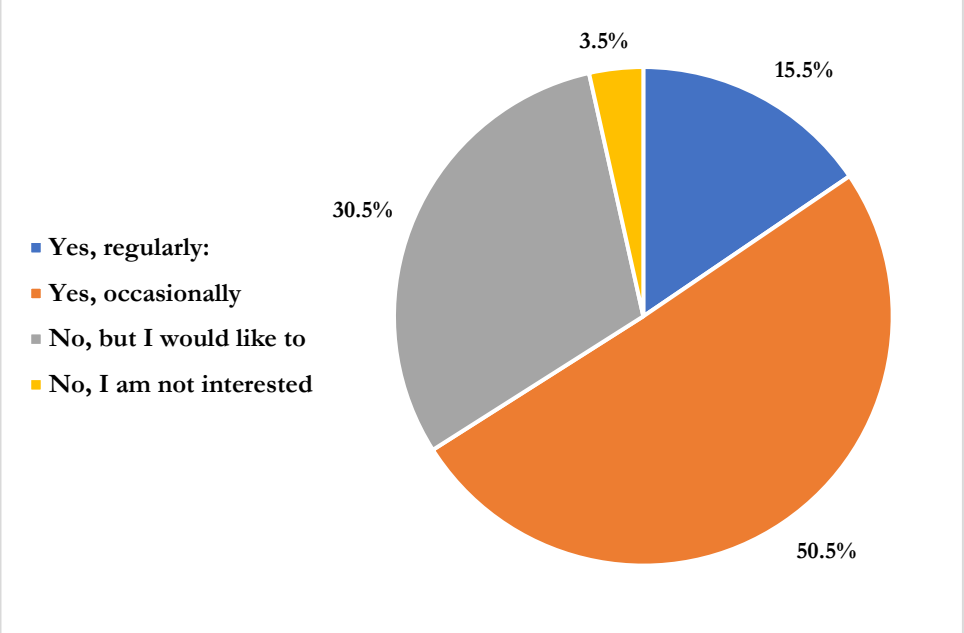

Figure 1. Responses of teachers participating in the study regarding the use of AI tools in teaching (n=200).

The results in Table (1) show that AI tools are primarily used for planning and creating educational content (73%), highlighting their key role in optimizing time and stimulating creativity. Their use is moderate in interactive teaching (27.5%) and the personalization of resources (25%). In contrast, their adoption remains limited in areas such as supporting specific needs (19.5%), performance tracking (18.5%), and learning data analysis (9%). The development of socio-emotional skills ranks last, with only 8% usage, revealing an untapped potential.

Table 1. Use of AI tools in various educational activities (n=132).

Educational activities	Percentage of use
Planning and creating educational content	73%
Differentiated instruction and support for specific needs	19.5%
Interactive teaching and student engagement	27.5%
Student assessment and monitoring	18.5%
Personalized feedback and performance analysis	14%
Personalized educational resources	25%
Developing socio-emotional skills using AI	8%
Analyzing learning data with AI	9%
Planning and creating educational content	73%

When we asked teachers which subjects they use AI in, the results showed particularly high adoption in language teaching (81%), highlighting its significant impact in this area. Subjects such as mathematics (41.5%) and scientific awareness (54.5%) also show notable use. In contrast, AI is less used in disciplines such as history geography (17.5%), and Islamic education (16.5%). These results illustrate both the advancements of AI in certain educational practices and the gaps in other areas.

The results in figure 2 show that the integration of AI has had varied effects on teachers' pedagogical practices. About 11% of participants (22 responses) indicated that the use of AI did not change their teaching strategies. In contrast, 38.5% of participants (101 responses) reported that AI led to minor changes in their pedagogical practices, while 50.5% (77 responses) stated that AI caused significant changes in lesson planning and implementation.

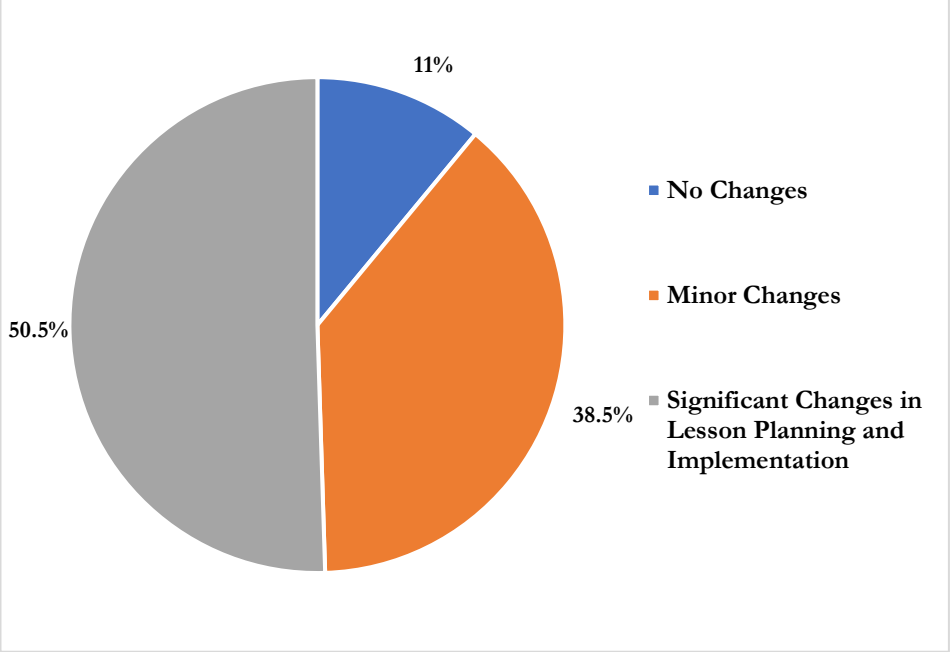

Figure 2. Teachers' perceptions of the positive effect of AI on their educational practices (n=132).

In the same context, the survey results reveal that AI tools have a significant positive impact on learners in the classroom. Among the 110 selected participants (excluding those who reported no positive effects), 61.5% stated that these tools improve students' attention and engagement. Furthermore, 46% observed a better understanding of complex concepts, while 31.5% noted a contribution to the development of self-learning skills. Finally, 36.5% reported a reduction in learning difficulties (see figure 3). These results suggest that AI plays a beneficial role in enhancing the educational process, although its impact may vary depending on contexts and classes.

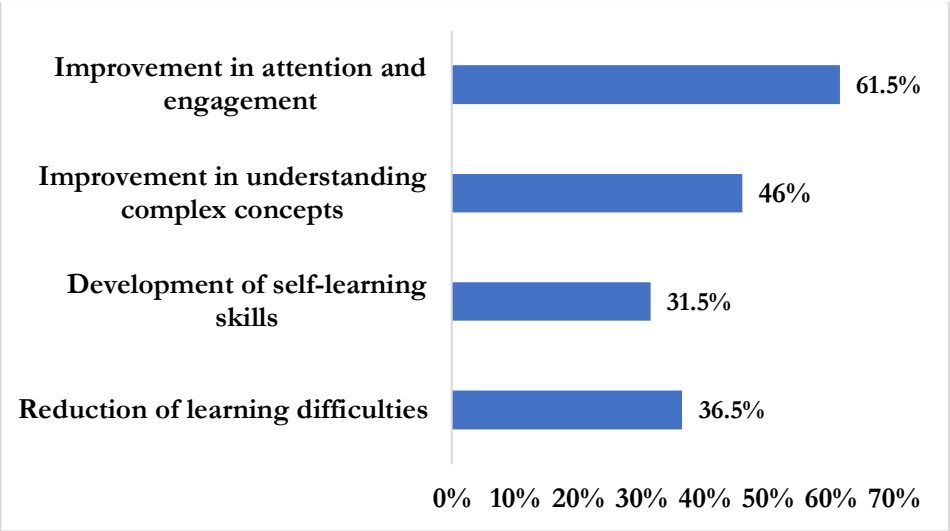

Figure 3. Perceptions of the impact of AI tools on students in the classroom (n=110).

To gain a deeper understanding of the factors influencing the adoption of AI tools by teachers, a Pearson correlation analysis was conducted to examine the relationship between the professional experience of the participating teachers, their training, their level of technological competence, and the degree of integration of AI tools in their teaching practices. The table 2 below shows the Pearson correlation coefficients between these variables:

Table 2. Correlation between teaching experience, training, technological competence, and AI integration (n=200).

	Teaching experience	Training	Technological competence	AI integration
Teaching experience	1	-0,037	+0,091	+0,270 **
Training		1	+0,069	+0,021
Technological competence			1	+0,023
AI Integration				1

** Correlation is statistically significant at the 0.01 level (two-tailed).

The Pearson correlation analysis reveals a significant positive relationship between teaching experience and the integration of AI into the educational process ($r = 0.270$, $p < 0.01$). This suggests that more experienced teachers tend to adopt these tools more easily. In contrast, no significant relationship was observed between AI training and its integration into teaching ($r = -0.021$, $p = 0.772$), indicating that prior training in this field does not necessarily guarantee increased adoption of these technologies. Similarly, no significant correlation was found be-tween perceived technological competence and AI integration ($r = 0.023$, $p = 0.752$). These results highlight the key role of teaching experience in the adoption of modern technologies while emphasizing that training or technological competence alone is not enough to promote AI integration in education.

4.1.2. Obstacles and Needs to Improve Pedagogical Practices

The results reveal that teachers face several obstacles when integrating AI into their pedagogical practices (table 3). The main challenge, cited by 56% of participants, is the lack of specific pedagogical training, highlighting the need for targeted training for the effective use of AI. This is followed by technological deficiencies, mentioned by 45% of teachers, and internet access issues, noted by 49.5%, which severely limit the use of these tools. Additionally, 27% of teachers mentioned an increased workload, while 27.5% pointed to the lack of institutional support, emphasizing the need for a conducive environment for AI integration. Finally, a minority (0.5%) mentioned the lack of necessary tools and materials.

Table 3. Obstacles to the integration of AI in pedagogical practices (n=200).

Obstacles	Percentage
Lack of specific pedagogical training	56%
Insufficient technological resources	45%
Difficulties in accessing the Internet	49.5%
Additional work load	27%
Absence of institutional support	27.5%
Lack of tools	0.5%
Absence of tools and materials	0.5%

In response to these challenges, teachers expressed a growing need for specific training. Thus, 74% of participants seek practical training on the use of AI tools, while 49% want to learn how to integrate AI into lesson planning. Furthermore, 27% are interested in designing interactive pedagogical activities, and 34% wish to be trained in data analysis to track student performance. These requests reflect a desire to fully leverage the potential of AI to improve teaching and learning.

4.2. Analysis of Qualitative Results

To better understand the participants' experiences regarding the use of AI, an open-ended question was asked to the teachers: "Could you describe a specific situation where you used (or avoided using) AI in the classroom, and explain why?" The responses collected show that while some teachers have adopted AI tools they deem relevant for enriching their teaching practices, others, on the contrary, have chosen not to use them for various reasons.

A key observation from the analysis is that many teachers associate AI with the interactive digital tools they regularly use in the classroom. Among the platforms mentioned are Google Forms, Kahoot, and Duolingo, which are used for assessment, learning management, and educational activities. Some teachers report using these tools to automate

assessments and provide immediate feedback to students: "*I used Google Forms and Kahoot to automate some assessments and offer immediate feedback to students. This allowed me to better manage time in class...*" Others mention using them to improve foreign language pronunciation or diversify teaching materials: "(…)*Duolingo helped my students improve their English pronunciation. They found it motivating and fun.*" However, while these tools include advanced features, they do not primarily rely on AI algorithms. This confusion reflects a broader perception of AI, where any technology that facilitates teaching is equated with AI, based on its functionality.

At the same time, some teachers have adopted more specific uses related to the capabilities of AI. Some have used ChatGPT to generate educational content tailored to the level of their students, allowing for personalized exercises and optimizing lesson preparation time: "*I use ChatGPT a lot to generate texts suited to my student's level in French. This allows me to diversify exercises instead of spending a long time searching for texts...*". Others mention using voice recognition tools to help students improve their reading and diction, especially in Arabic: "(…)*voice recognition apps are great for reading and diction in Arabic...*". These applications, by analyzing and adapting to students' mistakes, illustrate a more targeted use of AI in education. Similarly, some experiences highlighted the use of adaptive learning software that allows students to progress at their own pace: "*Century Tech offers differentiated exercises in mathematics, which allowed students to progress at their own pace, although the adaptation took time for some*".

The analysis also highlights several factors that could explain this confusion between AI and digital tools. On the one hand, the lack of training on AI in education limits teachers' ability to distinguish truly intelligent tools from traditional interactive applications: "*I don't use it because teacher training on these tools is insufficient. I don't feel ready to integrate them effectively...*". On the other hand, the omnipresence of digital technologies in teaching practices, with the gradual integration of automated technologies, contributes to blurring the boundary between automation and AI. Finally, some teachers tend to associate any automated process with AI, without necessarily considering the distinction between programmed algorithms and systems capable of autonomous learning and adaptation: "*I avoided AI in teaching history because I think traditional materials (books and discussions) are better suited for critical thinking...*". These results demonstrate a still partial and uneven adoption of AI in education, influenced by varied and sometimes inaccurate perceptions of teachers regarding the nature of these technologies.

5. Discussion

The analysis of the results highlights contrasting dynamics in the adoption of AI in education, revealing both a growing interest in these technologies and persistent obstacles to their integration. Quantitative data indicate that teachers generally perceive AI as an essential tool for improving their teaching practices, particularly in fostering student engagement, facilitating personalized learning, and automating certain tasks. The majority of teachers use AI mainly for lesson planning and content creation, while others employ it for activities such as interactive teaching, differentiated instruction, or student assessment. These varied uses reflect the versatility of AI tools in supporting pedagogical practices. This aligns with the findings of Holmes and Tuomi (2022), who emphasize that AI is primarily used in education to optimize time management and adapt resources to learners' needs. However, a Pearson correlation analysis reveals a significant positive relationship between teaching experience and AI integration in the educational process ($r = 0.270$, $p < 0.01$). This suggests that more experienced teachers tend to adopt these tools more easily, highlighting the importance of experience in adopting modern educational technologies. This observation is consistent with the work of Luckin and Cukurova (2019), which underscores the impact of professional experience on the acceptance of new educational technologies.

Qualitative results reveal a frequent confusion between AI and traditional interactive digital tools. Many teachers associate applications like Kahoot, Google Forms, or Duolingo with AI, even though these tools do not rely on machine learning algorithms or automated data processing. This confusion reflects a lack of understanding of AI's specific features in education, a phenomenon also observed by Zawacki-Richter, Marín, Bond, and Gouverneur (2019), who highlight the importance of clarifying the distinction between AI and conventional digital tools. A limited understanding of AI's actual capabilities could hinder its full adoption in teaching practices, suggesting that it is essential to incorporate more in-depth training to enable a better understanding and utilization of these technologies. Training programs should not only focus on technical aspects but also the pedagogical implications of AI.

Teachers' testimonies reveal that the impact of AI on teaching practices varies

significantly depending on the context of use. Its adoption is mainly observed in language teaching, mathematics, and science education, where it plays a particularly significant role. For example, tools like ChatGPT for generating content adapted to different learning levels or adaptive platforms that allow students to progress at their own pace are cited as successful examples of AI use in language instruction. These practices align with the work of Lawrance, Sambath, Shiny, Vazhangal, and Bala (2024), which highlights the benefits of adaptive learning systems for differentiated instruction, particularly in language education.

However, some teachers report that the introduction of AI has not fundamentally changed their teaching approach, suggesting that the effectiveness of these tools strongly depends on the subject matter and implementation conditions. These findings confirm the conclusions of Azzam and Charles (2024), who stress that AI's effectiveness in education depends on a gradual adoption process and an implementation strategy tailored to each educational context.

The lack of specific training remains one of the most frequently cited obstacles by teachers, aligning with the recommendations of certain researchers on the need to better understand students' and teachers' perceptions of AI to optimize its integration into Moroccan education (Khoual et al., 2025). Additionally, inequalities in access to technological infrastructure, particularly in rural areas, hinder the optimal use of AI-based tools. These findings confirm the work of Adoui (2024), who highlights the importance of international digital networks and intelligent systems in promoting equitable access to educational technologies (Adoui, 2024).

Beyond these material constraints, pedagogical resistance persists. Some teachers express concerns about excessive student reliance on technology, fearing it may affect their cognitive autonomy. This concern is shared by Selwyn (2019), who warns about the risks of excessive automation potentially hindering the development of critical and reflective thinking in students.

The integration of AI into the education system also faces challenges related to equitable access. Bekdemir (2024) emphasizes the need to ensure fair accessibility to AI-powered educational resources for all students, including those from disadvantaged backgrounds. The digital divide remains a major issue, particularly in developing contexts where infrastructure and connectivity inequalities persist. To ensure inclusive and equitable education, coordinated actions are essential to bridge this digital gap, as advocated by Azzam and Charles (2024), who call for strengthened collaboration between policymakers, educators, and technology providers.

6. Conclusions

This study examined the integration of AI in primary education in Morocco, highlighting both its benefits and the challenges it presents. While most teachers perceive AI as an effective tool for enhancing teaching practices, its adoption remains uneven, influenced by factors such as years of experience, individual perceptions, access to infrastructure, and pedagogical concerns. The results reveal that AI is mainly used for lesson planning, content creation, and adaptive learning, with greater adoption in subjects like language teaching, mathematics, and science education. However, qualitative analysis indicates a tendency to confuse AI with general digital tools, underscoring the need for clearer conceptual distinctions and targeted professional training. These measures are essential to ensure a meaningful and effective implementation of AI in educational practices.

Although this research provides relevant findings, several limitations must be considered to refine its scope. First, the use of self-reported data may introduce biases, potentially affecting the reliability of conclusions regarding AI adoption. Second, restricting the study to primary education limits the generalization of results to other levels of education. Despite these constraints, the diversity of collected responses offers a rich perspective on how AI is perceived and integrated into teaching practices.

To further explore these findings, future studies should adopt a multidimensional approach. On the one hand, it is essential to examine the effects of AI on student learning and engagement, considering its ethical, cognitive, and social implications. On the other hand, expanding the study to other educational levels (secondary, higher education) and employing mixed methods – such as classroom observations, qualitative interviews, and quantitative analyses – would be valuable. Such an approach would provide a more comprehensive understanding of AI's overall impact on education and help identify the necessary conditions for its successful integration.

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