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Teachers' perceptions and uses of generative artificial intelligence in Moroccan schools: Evidence from the Fez–Meknès region

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Abstract

This study explores how primary and secondary teachers in Morocco's Fez–Meknès region understand and use generative AI in their classrooms. Most educators recognize generative AI as a powerful content-creation tool and believe it can enrich lesson planning, personalize learning for diverse student needs, and support remote instruction. However, fewer have moved from interest to regular use, citing gaps in training and limited technical resources as the main obstacles. Teachers also express pragmatic concerns about data privacy and the importance of maintaining their instructional role alongside AI tools. Nearly all respondents welcome further hands-on professional development, particularly workshops and in-class coaching, to build confidence and practical skills. As schools prepare for a more AI-integrated future, these findings point to the need for targeted training programs, reliable infrastructure, and clear ethical guidelines that empower teachers to harness generative AI effectively and responsibly.

Keywords: Generative AI, artificial intelligence, Teacher Perceptions, Professional Development, Classroom Integration, Ethical Guidelines, Educational Technology.

1. Introduction

Generative artificial intelligence (AI) encompasses a class of machine-learning models, most notably large language models (LLMs) such as GPT-3 and its successors, that can autonomously produce new content, including text, images, video, and code, by learning patterns in massive datasets. In education, these systems promise to automate the generation of lesson materials, craft personalized explanations, and simulate interactive tutors, potentially transforming teaching practices and learning experiences.

Despite AI's roots in educational technology dating back to the 1970s, the advent of generative AI has markedly expanded its scope and capabilities. Holmes, Bialik, and Fadel (2023) document how generative AI can support novel pedagogies, ranging from adaptive content personalization to automated formative assessment, while cautioning that effective deployment depends on robust teacher training and thoughtful integration into curricula [1]. A recent systematic review of AI in K–12 education highlights recurring barriers to adoption, including insufficient professional development, uneven infrastructure, and unresolved ethical concerns [2]. In response, UNESCO's "Guidance for Generative AI in Education and Research" advocates a human-centered

approach, urging policymakers to establish frameworks that safeguard data privacy, promote equity, and build AI literacy among educators and learners alike [3].

Moreover, emerging evidence underscores both the promise and the complexity of integrating generative AI into instructional design. Li et al. (2024) report that coupling generative AI with adaptive learning platforms can boost student performance by as much as 62%, demonstrating AI's capacity to tailor content dynamically to individual learning trajectories [4]. Holmes, Bialik, and Fadel further emphasize AI's ability to generate creative assignments and deliver real-time feedback, thereby fostering deeper learner engagement and autonomy [1]. At the same time, rapid uptake has prompted documented concerns about academic integrity—Eaton and Knight (2023) note “the need for updated honor-code policies and proactive education on responsible AI use,” highlighting how institutions are revising guidelines to address AI-generated work [5]. Together, these developments underscore the dual promise and challenge of generative AI: its ability to produce customized, engaging content offers unprecedented pedagogical opportunities, yet effective integration requires robust ethical frameworks, clear data-privacy safeguards (UNESCO, 2024), and comprehensive teacher training to prevent bias, overreliance, and misuse [2, 3, 5].

Within Morocco, generative AI remains an emergent topic in teacher training and classroom practice. To date, little empirical work has examined in-service teachers' awareness, attitudes, or hands-on use of these tools. This study addresses that gap by surveying 420 primary and secondary school teachers across eleven subject areas in the Fez–Meknès region. We investigate their level of familiarity with generative AI, how they define and perceive its usefulness, the frequency and contexts of its classroom application, perceived benefits and challenges, and preferred modes of professional development. Our findings aim to inform targeted interventions, such as bespoke training workshops, infrastructure investments, and policy measures, that will enable Moroccan educators to harness generative AI effectively and ethically.

2. Literature Review

2.1 Emergence and Pedagogical Potential of Generative AI

Generative AI, particularly large language models (LLMs) such as GPT-3 and DALL·E, has rapidly evolved from research prototypes to classroom tools, enabling the automatic production of textual explanations, illustrative images, and even video content. A recent systematic review by Li et al.

(2024) synthesizes empirical studies on generative AI's impact in higher education, finding that it can support adaptive learning pathways and creative assignments, but also raises concerns about academic integrity and assessment validity [4]. Complementing this, a scoping review on generative AI's role in assessment highlights both opportunities for automating formative evaluations and the need for robust teacher oversight to ensure accuracy and fairness [6]. More broadly, a systematic literature review of AI in education concludes that AI-enabled adaptive learning systems typically improve student performance by up to 62 %, underscoring the transformative potential of AI in personalized instruction [7].

2.2 Teacher Perceptions and Preparedness

Understanding teachers' beliefs and readiness to use generative AI is critical for successful integration. In a rapid survey of 55 teacher educators in Ghana, the majority perceived generative AI as beneficial for resource creation but expressed low preparedness due to limited training opportunities [8]. Similarly, a mixed-methods study of 1,223 teachers across Italy's Veneto region revealed that while educators value AI's potential for personalized feedback, they worry about losing human agency and lack confidence in their own AI competencies [9]. Experimental comparisons also show that AI-generated concept explanations can match or exceed human-crafted ones in clarity, yet teachers remain skeptical about their pedagogical appropriateness without customization [10].

2.3 Barriers to Adoption in K–12 Settings

Despite interest, numerous obstacles hinder generative AI's uptake in schools. A recent report identifies “stumbling blocks” such as inadequate broadband, outdated hardware, and absence of AI-specific policies in K–12 environments [11]. Research in low-resource contexts further notes that high initial investment costs and ongoing maintenance of AI platforms exacerbate educational inequities [12]. Teachers also cite ethical concerns—particularly around data privacy, algorithmic bias, and the risk of overreliance, that can dampen school leaders' willingness to deploy AI solutions without clear governance frameworks.

2.4 Professional Development and Capacity Building

Effective professional development (PD) is consistently highlighted as a linchpin for AI integration. Google's “Generative AI for Educators” course offers self-paced modules and practical exercises, demonstrating improved teacher confidence after completion [13]. Edutopia advocates blended PD models, combining workshops, peer coaching,

and online tutorials, to deepen pedagogical understanding of AI tools and foster communities of practice [11]. Most recently, OpenAI and Common Sense Media launched a free prompt-engineering training for K–12 teachers, emphasizing ethical use and lesson-planning applications [14].

2.5. Policy, Ethics, and Equity Frameworks

Global policy bodies stress that AI must be guided by human-centered principles. UNESCO’s “Guidance for Generative AI in Education and Research” recommends that countries adopt immediate actions, such as updating curricula to include AI literacy, and long-term strategies to safeguard data privacy, promote inclusivity, and respect cultural diversity [3]. Parallel U.S. Department of Education reports call for systems thinking that integrates AI ethics into teacher education and school governance to mitigate bias and maintain human mentoring roles [15].

3. Methodology

3.1. Research Design

This study employed a **descriptive quantitative survey** to capture in-service teachers’ awareness, definitions, uses, perceptions, and training needs regarding generative AI. A **cross-sectional design** was chosen to obtain a snapshot of current practices and attitudes across multiple subject areas. Descriptive survey designs systematically collect and quantify data at a single point in time to describe characteristics of a defined population without exploring causal relationships [16]. Cross-sectional surveys are well suited for educational research because they allow rapid, cost-effective data collection from a large and diverse sample, though they do not support longitudinal inference [17].

3.2. Participants and Sampling

- **Target population:** primary, and secondary, schoolteachers under the jurisdiction of the Fez–Meknes Regional Academy of Education and Training.
- **Actual sample:** 420 teachers (combined primary and secondary levels) who completed the questionnaire.
- **Disciplines represented:** eleven subject areas, Mathematics; Biology and Earth Sciences; Physics and Chemistry; French; Arabic; English; Bilingual and Amazigh Primary Education; Philosophy; Social Sciences; and Islamic Education.

- **Sampling procedure:** the survey link was disseminated via dedicated WhatsApp groups for each discipline. This cascade-sharing strategy (group administrators forwarding the link to their subject cohorts) secured broad coverage across specialties’ and teaching levels, yielding a diverse and balanced sample.

3.3. Instrument

A structured online questionnaire was developed, guided by extant literature on AI in education (e.g., Holmes et al., 2023; UNESCO, 2023) [3]. The instrument comprised six sections:

1. **General Understanding**
2. **Actual Use**
3. **Perceived Contributions**
4. **Most Useful Applications**
5. **Challenges & Concerns**
6. **Training & Vision**

3.4. Validation & Pilot Testing.

- **Content validity** was established via expert review by three teacher-educators at CRMEF.
- A **pilot test** (n = 30) evaluated clarity and timing; minor wording adjustments were made.
- **Reliability** Multi-item sections achieved Cronbach’s $\alpha \geq 0.78$.

3.5. Data Collection

- **Mode:** The survey was hosted on Google Forms.
- **Duration:** Data were collected over three weeks in March 2025.
- **Consent & Ethics:** Participation was voluntary and anonymous: all respondents reviewed an introductory page outlining the study’s purpose, data-handling procedures, and confidentiality guarantees before providing informed consent.

3.6. Data Preparation and Analysis

- ❖ **Export & Cleaning:** Responses were exported as an Excel file (data.xlsx). Open-ended comments were stored separately for qualitative synthesis.
- ❖ **Software:** Quantitative analysis was performed in Python (pandas for data manipulation; matplotlib for visualization).
- ❖ **Procedures:**
 - **Single-choice** items: computed `value_counts()` for absolute frequencies and normalized percentages.
 - **Multi-choice** items: split comma-separated responses, used `explode()` to treat each selection as an individual record, then computed frequencies.
 - **Missing Data:** Blank or “prefer not to answer” responses were dropped (`dropna()`).
- ❖ **Visualization:** Bar and pie charts were generated to illustrate distribution patterns for each question, with consistent color schemes and data-label annotations to enhance interpretability.
- ❖ **Interpretation:** Descriptive statistics (means not applicable) and frequency distributions formed the basis for result interpretation and subsequent discussion.

4. Results and Analysis

Following best practices for reporting educational survey data [18, 19], this section presents a detailed breakdown of the quantitative findings. Each distribution is accompanied by interpretive commentary that links observed patterns to pedagogical implications, drawing on established frameworks for data-driven decision making in education [20, 21].

4.1 Awareness of Generative AI

As Figure 1 shows, a clear majority of teachers (68.9%) report having heard of generative AI, while 31.1% remain unfamiliar. This suggests that most educators have been reached by initial awareness efforts, through professional networks, media, or preliminary workshops, but nearly one-third still lack basic exposure. To close this gap, foundational orientation sessions explaining what generative AI is and how it can support teaching should be offered before advancing to more in-depth, hands-on training.

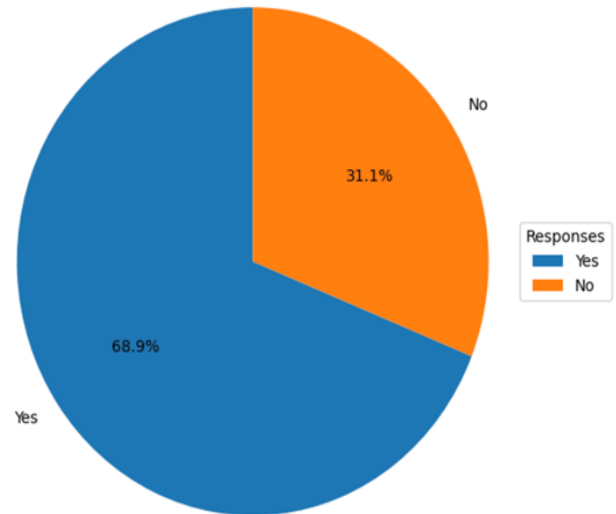


Figure 1: Awareness of Generative AI Among Teachers

4.2 Definition Accuracy

As Figure 2 shows, nearly two-thirds of teachers (64.4%) accurately define generative AI as a content-generation technology, indicating that the majority possess a solid conceptual grasp. However, roughly one-fifth (19.5%) admit they “don’t know,” and smaller proportions misclassify it as an analytics tool (14.8%) or a classroom management system (1.3%). These findings reveal important conceptual gaps: before moving to hands-on applications, professional development should reinforce the core definition of generative AI to ensure that all educators share the same foundational understanding.

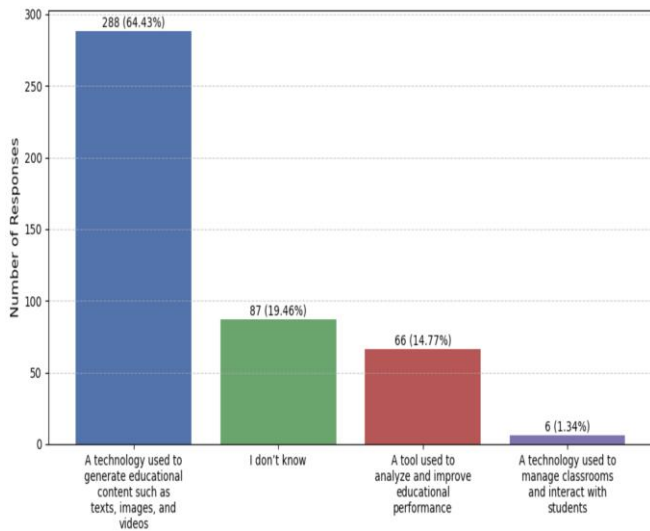


Figure 2: Teachers' Accuracy in Defining Generative AI

4.3 Perceived Usefulness

As Figure 3 shows, a strong majority of teachers (72.5%) consider generative AI a useful tool for improving the educational process. Only 1.3% see no value, while 26.2% remain undecided. This robust endorsement highlights AI's perceived pedagogical potential; the sizable "not sure" group likely needs concrete classroom examples or pilot programs to transform their cautious interest into confident adoption.

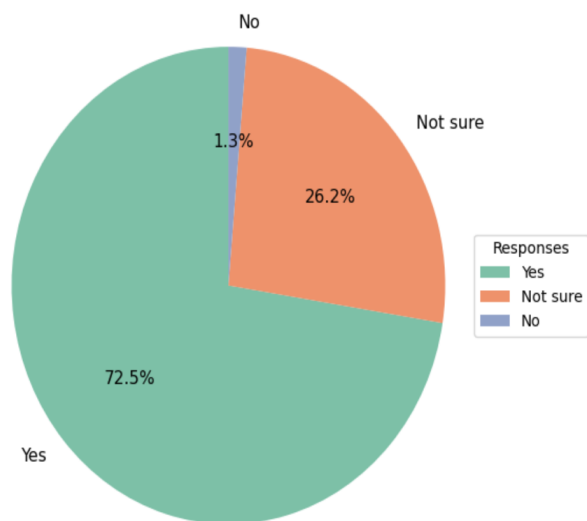


Figure 3: Perceived Usefulness of Generative AI in Education

4.4 Frequency of Actual Use

The data indicate that while most teachers acknowledge AI's value, only 21.5% use generative AI tools frequently in their teaching. A further 18.8% use them occasionally, whereas the largest group (37.6%) have not yet tried these tools despite their interest, making them prime candidates for hands-on introductory workshops. Meanwhile, 22.1% have never heard of generative AI tools, indicating a need for both basic awareness-raising and improved access before deeper integration can occur.

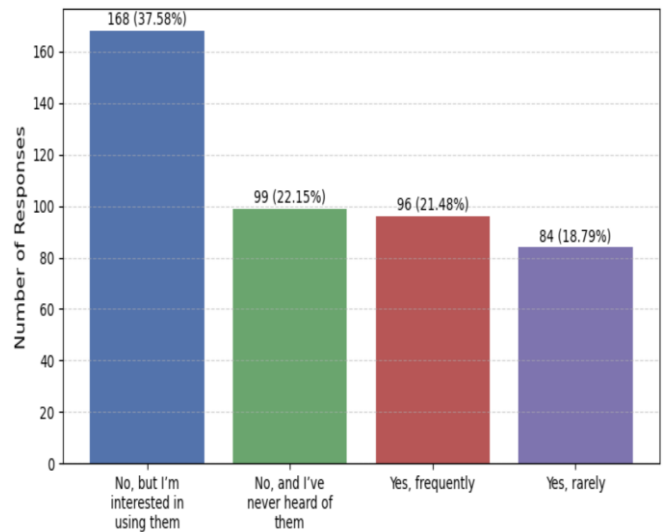


Figure 4: Frequency of Generative AI Tool Use in Teaching

4.5 Perceived Contributions to Education

In Figure 5, **customizing educational content** ranks as the top perceived contribution (23.4%), indicating that teachers most value AI's ability to tailor lessons to individual student needs. Close behind is **offering innovative and dynamic content** (22.5%) and **enhancing student engagement** (21.4%), underscoring the importance of creativity and motivation in AI-supported instruction. **Providing interactive motivation tools** (21.1%) further highlights the role of interactivity, while **accelerating assessment and academic analysis** (11.7%), though the lowest, still represents a meaningful opportunity to streamline feedback loops. Together, these results suggest that professional development should focus first on leveraging AI for personalized, engaging content before moving toward more advanced assessment automation.

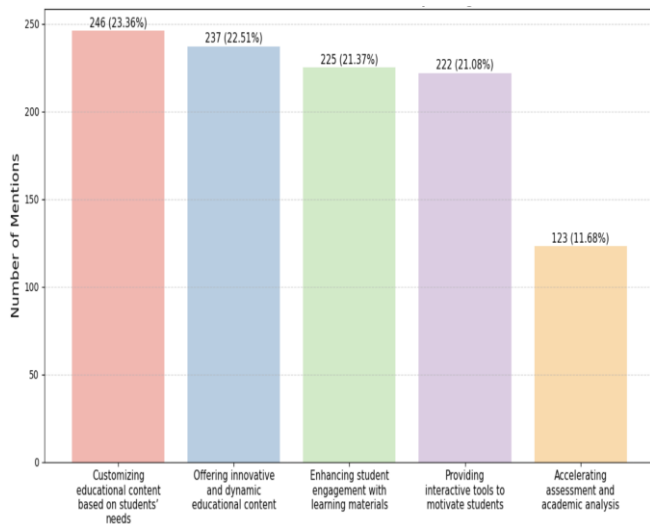


Figure 5: Perceived Contributions of Generative AI to Education

4.6 Most Useful Applications

In Figure 6, **creating educational materials** (texts, images, videos) emerges as the most valued application (36.4%), underscoring teachers' desire for rapid generation of core instructional resources. **Customizing teaching methods** (20.5%) and **creating personalized assessments** (17.9%) follow, reflecting the ongoing emphasis on differentiation and targeted feedback. **Enhancing teacher-student interaction** (14.1%) and **instant performance analysis** (11.1%) are rated lower, likely because many classrooms already employ learning-management systems or manual techniques for these tasks, suggesting that AI integration efforts should prioritize content generation and personalization before expanding into interaction and analytics.

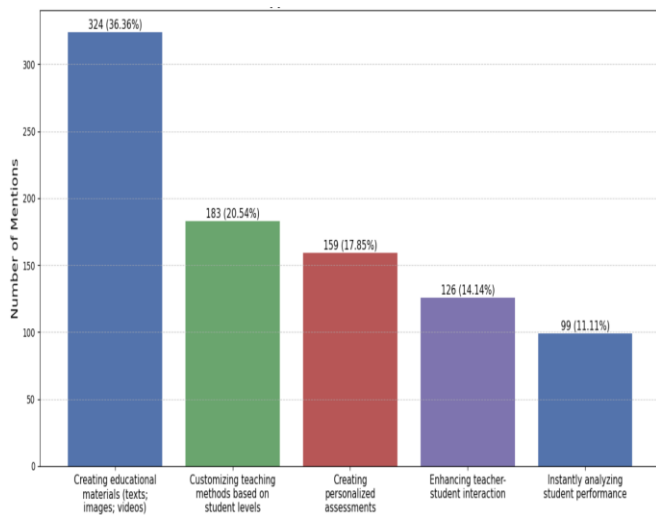


Figure 6: Most Useful Applications of Generative AI in Education

4.7 Challenges Faced

The leading challenges, in Figure 7, are **lack of training and knowledge** (27.3%) and **lack of technical resources and infrastructure** (25.7%), together comprising over half of all mentions. **Concerns about privacy and data security** account for 15.2%, indicating a substantial ethical dimension, while **resistance from students or teachers** is relatively minor (4.4%). These findings suggest that the most impactful interventions will be targeted professional development and improved ICT infrastructure, alongside the development of clear privacy and data-governance policies to mitigate ethical concerns.

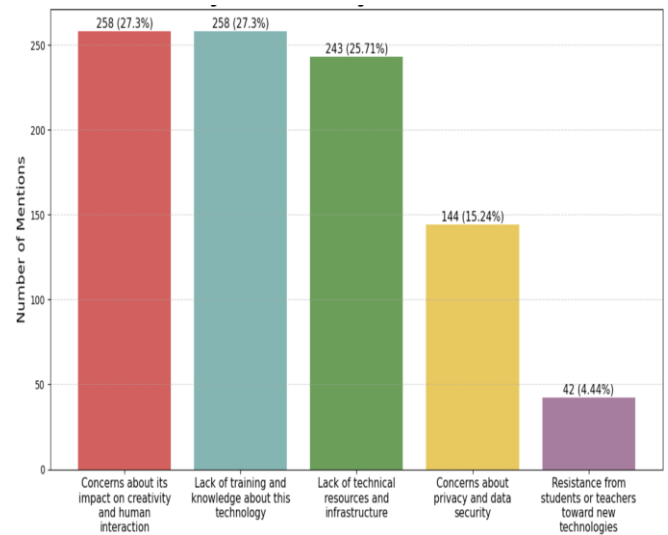


Figure 7: Challenges Faced When Using Generative AI in Education

4.8 Fear of Role Reduction

Nearly half of teachers (45.6%) **do not** fear that generative AI will reduce their role, while 24.8% **do** express concern and 29.5% remain uncertain. In Figure 8, this distribution reveals that most educators view AI as a **complementary** tool rather than a replacement. The substantial “not sure” cohort highlights lingering ambivalence, targeted case studies and exemplars of successful AI-teacher collaboration could help clarify boundaries and reinforce human oversight in AI-enhanced classrooms.

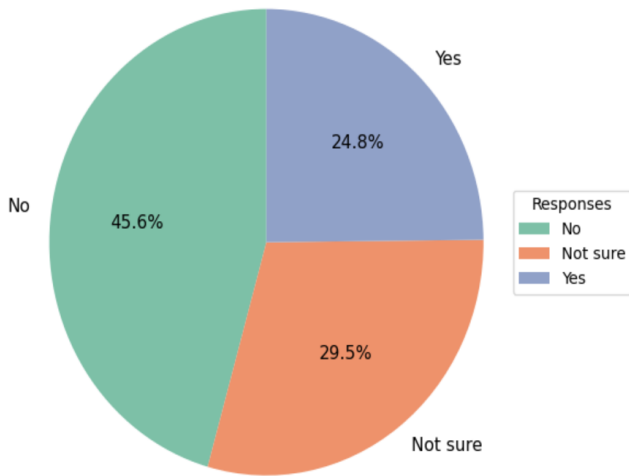


Figure 8: Teachers’ Concern About Generative AI Reducing Their Role

4.9 Equity Promotion

In Figure 9, a slim majority of teachers (52.0%) believe generative AI can foster educational equity by offering personalized learning pathways, while 40.5% remain uncertain and 7.4% disagree. This high “not sure” rate indicates that many educators recognize AI’s potential but seek concrete evidence of its effectiveness in their own teaching environments. To build confidence and move uncertain teachers toward advocacy, pilot programs and case studies should explicitly measure and showcase equity outcomes, such as improved access or performance for underserved learners, when generative AI is thoughtfully integrated.

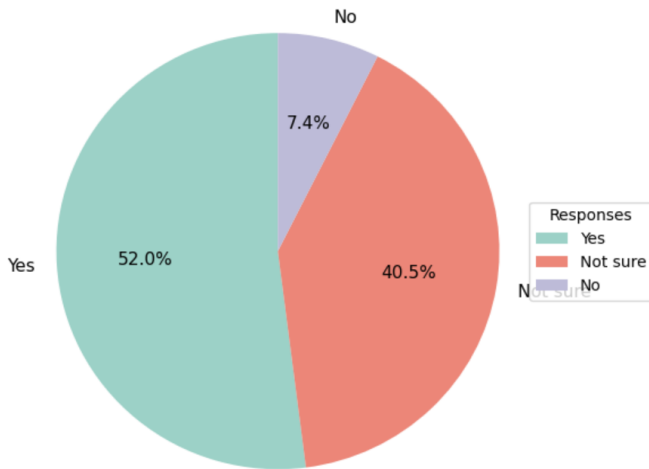


Figure 9: Perception of Generative AI’s Potential to Promote Educational Equity

4.10 Training Interest & Preferred Methods

In Figure 10, a clear majority of teachers (82.6%) express **strong interest** in receiving additional training on generative AI, while 12.1% are undecided and only 5.4% decline. This overwhelming demand indicates that professional development programs should be prioritized to equip educators with the skills and confidence to integrate AI tools.

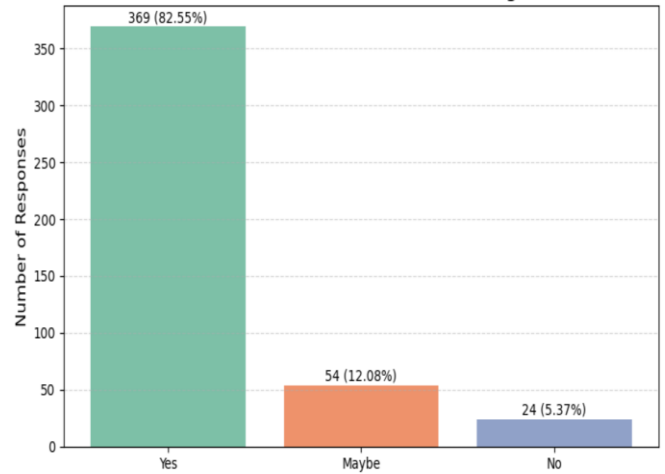


Figure 10: Interest in Additional Generative AI Training

Figure 11 shows that teachers overwhelmingly favor **interactive, experiential PD formats**: **34.2%** choose workshops and training sessions, and **29.2%** select hands-on/live classroom applications. **Online training** (22.5%) is also valued, whereas **books and asynchronous resources** (10.4%) and “no training needed” (3.7%) are less popular. These preferences suggest that PD designers should emphasize face-to-face workshops and practical in-class implementations, supplemented by online modules, rather than relying primarily on self-study materials.

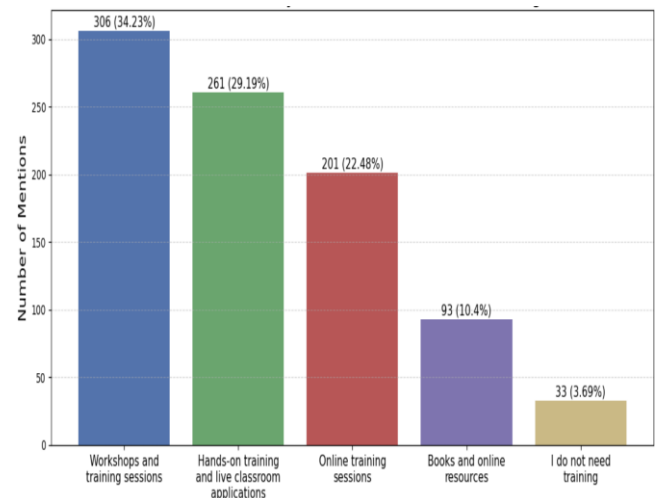


Figure 11: Preferred Methods for Learning Generative AI

4.11 Future Outlook

In Figure 12, an overwhelming majority of teachers (81.1%) view generative AI as an “**essential part of the educational process**”, while 14.2% believe it will remain “**limited to certain areas**”, and only 4.7% expect “**little or no impact**”. This strong consensus reflects educators’ confidence in AI’s long-term relevance for teaching and learning. The small fraction of skeptics underscores that outright dismissal of AI’s potential is rare; instead, most teachers anticipate integrating these tools, provided that outstanding training, infrastructure, and ethical concerns are adequately addressed.

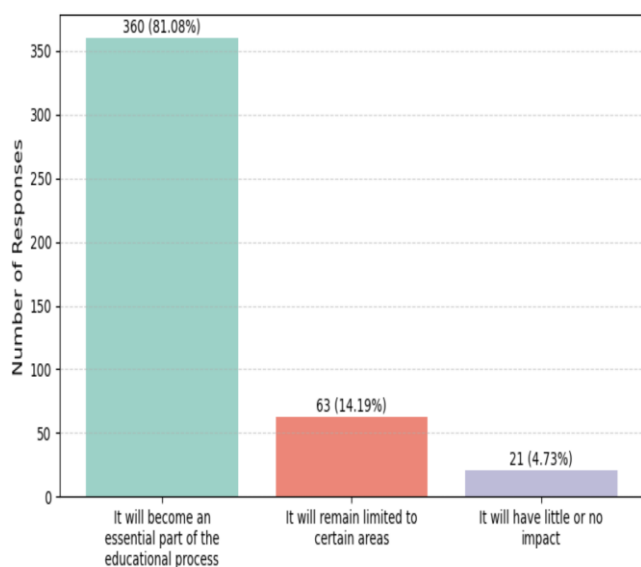


Figure 12: Future Outlook for Generative AI in Education

In Figure 13, **teacher support & lesson design** leads with 26.3% of mentions, indicating that educators most value AI for aiding in the creation and structuring of learning activities. **Personalization for special needs** and **distance/online learning** both account for 20.8%, highlighting strong interest in differentiated instruction and flexible delivery modes. **Innovative primary-education solutions** follow at 18.6%, reflecting teachers’ desire for engaging, age-appropriate content, while **assessment improvements** receive 13.4%, suggesting that, although important, automated evaluation is currently a lower priority compared to content and instructional support.

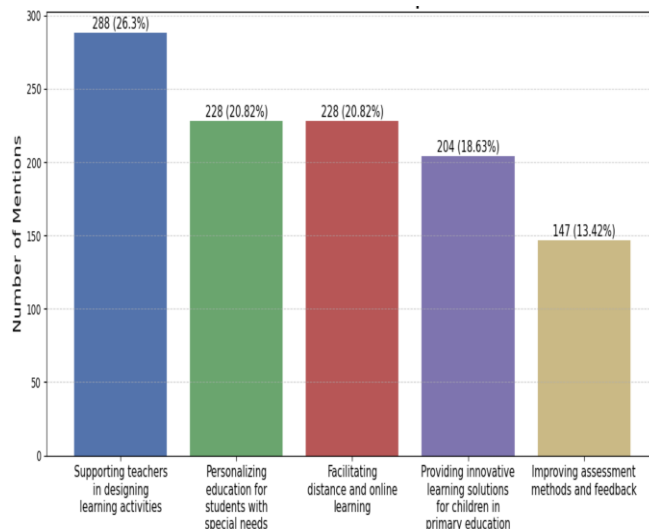


Figure 13: Areas Where Generative AI Can Improve Education

5. Discussion

The survey results reveal a **high level of awareness** (68.9%) and generally accurate conceptualizations (64.4%) of generative AI among Fez–Meknès teachers, mirroring findings from international studies that report widespread teacher familiarity with AI terminology but varying depth of understanding. This baseline awareness provides a solid foundation for deeper professional development: before exploring advanced features or pedagogical applications, training should reinforce generative AI’s core functions to ensure conceptual alignment across all educators.

Despite positive perceptions, 72.5% deem AI useful for improving education, **actual use remains modest**, with only 21.5% of teachers integrating generative tools frequently. This gap between perceived potential and classroom practice reflects well-documented barriers in K–12 settings: insufficient training, lack of infrastructure, and ethical concerns. Our finding that over half of all mentions (53.0%) pertain to “lack of training” and “infrastructure deficits” underscores the urgent need for resource investment. Policy makers should prioritize stable internet connectivity and device access, alongside curated training modules that move beyond theoretical introductions to hands-on tool use.

Teachers’ **top-ranked contributions**, customizing content (23.4%), generating innovative materials (22.5%), and boosting engagement (21.4%), align with the adaptive learning promise highlighted by Li et al. (2024) [22], who report that AI-driven personalization can increase student performance by up to 62%. These results suggest that Moroccan educators are ready to leverage AI for differentiated

instruction, provided they receive targeted support. Small-scale pilots could demonstrate real-world gains and catalyze wider adoption, especially when outcomes are measured and shared within teaching communities.

Importantly, a majority of teachers do **not** fear deskilling or role displacement: 45.6% are unconcerned, and only 24.8% express worry. This positive stance echoes UNESCO's human-centered framework, which positions AI as a complement to, rather than a replacement for, human educators. Coupled with the finding that 52.0% believe AI can enhance educational equity, there is an opportunity to frame generative AI as a tool for inclusive pedagogy, especially for special-needs learners, rather than an existential threat. Communications and case studies should emphasize AI's role in amplifying, not supplanting, teacher expertise.

Finally, the **overwhelming demand for additional training** (82.6%) and preference for **workshops and hands-on classroom applications** (63.4% combined) reinforce best-practice guidelines for professional development. PD programs must be interactive, context-specific, and sustained, incorporating peer coaching and reflective practice to build both technical skills and pedagogical confidence. In parallel, institutions should develop clear policies on data privacy, assessment integrity, and ethical use, areas flagged by 15.2% of teachers as concerns, to foster trust and safe experimentation.

Implications for Practice and Policy:

1. **Invest in Infrastructure & Access:** Ensure reliable internet and devices in all schools.
2. **Design Interactive PD:** Develop workshops, live demonstrations, and classroom-based coaching.
3. **Launch Targeted Pilots:** Showcase AI-enabled content personalization and track learning outcomes.
4. **Establish Ethical Frameworks:** Create clear guidelines on data privacy, academic integrity, and AI literacy.

6. Conclusion

This survey of 420 primary and secondary teachers in the Fez–Meknès region demonstrates both widespread enthusiasm for generative AI and clear roadblocks to its routine use. While nearly seven in ten educators have heard of generative AI and over 70% recognize its potential to enrich teaching and learning, only one in five currently employ these tools regularly.

The most valued AI functions, content creation, personalization, and engagement, align with global evidence of AI's ability to support differentiated instruction and boost student motivation. Equally encouraging is teachers' affirmation that AI should augment rather than supplant their professional role: nearly half express no fear of displacement, and over half see AI as a lever for educational equity.

However, dominant concerns around **training deficits** and **infrastructure shortfalls** underline why many remain "interested but not yet active" users. To bridge this gap, stakeholders must invest in reliable connectivity and hardware, and offer **interactive, hands-on professional development** tailored to teachers' disciplinary needs. Complementary **ethical and policy frameworks** should safeguard data privacy and maintain the integrity of assessment.

Looking ahead, pilot projects that co-design AI-enhanced lessons with teachers, and systematically measure their impact on student outcomes, will be vital to demonstrating real-world benefits. Longitudinal studies could then track how sustained AI integration reshapes pedagogical practice, learning gains, and equity across diverse classrooms.

By strategically addressing resource, training, and governance challenges in tandem, educational leaders in Fez–Meknès (and beyond) can translate teacher enthusiasm into transformative, responsible adoption of generative AI, ensuring that this technology truly serves both educators and learners.

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