

Integrating Artificial Intelligence in Non-Formal Education: Towards Innovative and Inclusive Digital Learning Amid National Challenges

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ABSTRACT:

This study aims to explore the dimensions of integrating artificial intelligence (AI) technologies into non-formal education and to identify the means of employing them to build innovative and inclusive digital learning capable of confronting national challenges of a political, economic, and cultural nature. The study adopted a descriptive-analytical approach, integrated with a qualitative paradigm. An electronic questionnaire comprising (30) items distributed across four main axes (the reality of AI use, non-formal education models, inclusiveness in digital education, and challenges and opportunities) was administered to a purposive sample of (25) participants, including educators, supervisors of non-formal programs, directors of community education centers, and educational technology experts. Additionally, semi-structured interviews were conducted with a group of educational and technical experts to deepen the qualitative understanding of the phenomenon. The results revealed a relatively positive trend toward integrating AI into non-formal activities, with an overall mean for the first axis of (3.62). The findings also indicated limited diversity in the educational models currently employed (mean 3.44), alongside a growing awareness of the need for modernization. The inclusiveness axis recorded a mean of (3.57), reflecting initial efforts toward achieving digital equity, while the challenges and opportunities axis registered the highest mean of (3.72), underscoring participants' profound awareness of structural and training obstacles—particularly the weakness in staff qualification (mean 4.3)—alongside their optimism regarding opportunities for personalization and self-directed learning. The study concluded with the necessity of adopting an integrated national strategy, designing sustainable professional training programs for educational personnel, establishing supportive technical units within educational institutions, and launching non-formal digital initiatives that leverage AI capabilities. It further recommended conducting comparative studies and future research addressing ethical and legislative frameworks, the effectiveness of AI in developing higher-order skills, and the perceptions of parents and the local community, so as to consolidate equitable, interactive, and sustainable digital education.

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Keywords: Artificial Intelligence (AI), Non-Formal Education, Digital Learning, Inclusiveness, National Challenges, Educational Innovation, Adaptive Learning, Digital Equity.

Introduction:

Over recent decades, the education sector has witnessed radical transformations as a result of rapid changes in technology, alongside societal and economic pressures, prompting educators and policymakers to seek innovative solutions that transcend traditional educational models. At the heart of these transformations, Artificial Intelligence (AI) has emerged as a promising tool with the potential to reshape the concepts of education and learning, particularly in the domains of non-formal education, which are characterized by flexibility, creativity, and the capacity to respond to the diverse needs of learners.

Non-formal education constitutes an effective platform for enhancing life skills, social and emotional competencies, and the formation of personal identity among learners, away from the constraints of formal curricula. Given that it represents a domain liberated from standardized structures, the integration of AI into non-formal education opens new horizons toward digital education capable of personalization, analyzing learner behavior, and guiding them according to their individual abilities and interests (Holmes et al., 2019). The significance of this approach becomes particularly pronounced in environments facing national challenges—whether political, economic, or cultural—thus necessitating flexible educational solutions that ensure continuity, equity, and diversity.

The applications of artificial intelligence in non-formal educational contexts are diverse, encompassing adaptive learning systems, big data analytics, conversational agents (chatbots), and virtual reality applications—all of which are tools that can be employed in designing more engaging and interactive educational activities that enhance self-motivation and critical thinking (UNESCO, 2021). Moreover, these tools can contribute to narrowing the digital divide and promoting social inclusion by providing equitable and accessible

educational opportunities for various groups, including those with special needs or learners in fragile environments (Selwyn, 2019).

The pursuit of innovative and inclusive digital education is not achieved merely through the introduction of technology into the educational process; it also requires the construction of a new educational philosophy grounded in principles of equity, empowerment, and critical thinking. This also necessitates a review of the institutional and organizational structures governing non-formal education, the development of training programs for educational personnel, and the establishment of partnerships among educational, technological, and community institutions to adopt this approach on a broad scale (Williamson & Piattoeva, 2022).

From this standpoint, the present research aims to explore the dimensions of integrating artificial intelligence into non-formal education, and the means of employing it to build an integrated digital education ecosystem that meets learners' needs, keeps pace with contemporary demands, and contributes to overcoming the national challenges confronting educational systems. It also seeks to provide an analytical and applicative framework through which AI tools can be activated to enhance innovation, inclusiveness, and the sustainability of education beyond the formal curriculum framework.

Research Problem:

Despite the rapid progress in the field of artificial intelligence (AI) and its applications in education, such progress tends to be predominantly concentrated in formal education, while non-formal education remains less benefitted from these technologies, despite being a vital domain for development and creativity. The need to adopt innovative and inclusive digital approaches in non-formal education is increasingly pressing, especially in contexts facing multiple national challenges, such as economic and social challenges or political tensions. Although AI

holds immense potential for improving the quality of non-formal programs, enhancing interaction, personalization, and inclusiveness, there exists a clear gap in its effective utilization within this domain. The research problem emanates from this disparity and is encapsulated in:

"The underutilization of artificial intelligence technologies in non-formal education programs, and the consequent digital divide and challenges in accessing innovative and inclusive digital education capable of responding to learners' needs amidst complex national contexts."

Research Significance:

The significance of this research emerges from its articulation of a novel vision for employing artificial intelligence within one of the most critical educational pathways, namely non-formal education, which serves as a fundamental driver for enhancing twenty-first-century skills. Furthermore, the research contributes to presenting a practical and academic conceptualization regarding the potential of harnessing AI to promote inclusiveness and equity in education, particularly in environments facing national challenges. This research represents an important contribution to bridging the existing knowledge gap between AI applications and non-formal education, and it opens avenues for educational policymakers to reconsider their strategies in line with accelerating digital transformations. It also benefits educators, instructional designers, and educational program developers in building interactive non-formal learning environments that are responsive to learners' needs.

Research Objectives:

This research seeks to achieve the following objectives:

1. To analyze the current state of utilizing artificial intelligence technologies in the domains of non-formal education.
2. To explore the challenges hindering the integration of AI into non-formal education within national contexts.

3. To identify the potential offered by AI for building innovative and inclusive digital education.

4. To propose an educational and applicative conceptualization for activating AI tools in non-formal education programs.

Research Questions:

To achieve the aforementioned objectives, the research endeavors to answer the following questions:

1. What is the current state of employing artificial intelligence in non-formal education programs?
2. What are the challenges that impede the integration of AI into non-formal education within specific national environments?
3. How can artificial intelligence technologies contribute to building innovative and inclusive digital education outside the framework of the formal curriculum?
4. What is the proposed conceptualization for integrating AI into non-formal education in a manner that ensures responsiveness to contemporary national and digital needs?

Theoretical Framework

The theoretical framework constitutes the cornerstone of any sound scientific research, as it provides the philosophical and methodological structure upon which the researcher relies in interpreting phenomena and analyzing results. In the context of this research, titled "Integrating Artificial Intelligence in Non-Formal Education: Towards Innovative and Inclusive Digital Education Amidst National Challenges," the theoretical framework assumes particular importance due to the novelty of the concept under consideration and the interplay of its components, encompassing concepts of artificial intelligence, non-formal education, innovation, inclusiveness, and digital education. This chapter will focus on presenting and analyzing key concepts, reviewing relevant theories, and constructing a theoretical model to guide this research.

Interpretive Theories

Within the framework of this research, several theories can be drawn upon to understand the integration of AI in non-formal education:

- **Constructivist Learning Theory:** which emphasizes the importance of interaction and active participation in knowledge construction, aligning with non-formal learning supported by AI (Vygotsky, 1978).
- **Theory of Multiple Intelligences:** which supports the design of diverse activities catering to different learning styles, and can be enhanced through AI tools.
- **Adaptive Learning Design Theory:** which establishes a foundation for personalized, individualized education based on data analytics and intelligent recommendations.

Proposed Theoretical Model

Drawing upon the review of concepts and theories, this research proposes a model consisting of four main dimensions:

1. **Inputs:** Artificial intelligence, digital tools, educational competencies.
2. **Processes:** Activating non-formal education through AI-supported activities.
3. **Outputs:** Innovative and inclusive digital learning that enhances competence and equity.
4. **Contextual Factors:** National challenges, culture, infrastructure, institutional support.

This theoretical framework provides an integrated knowledge base that facilitates understanding the dimensions of integrating AI into non-formal education and assists in analyzing data according to established scientific approaches. With this foundation, the research proceeds toward a more in-depth study of field and analytical experiences that can contribute to developing non-formal education systems toward greater innovation and inclusiveness.

Concept of Artificial Intelligence in Education

Artificial Intelligence (AI) is defined as the ability of machines to simulate human mental processes such as learning, reasoning, decision-making, and problem-solving (Russell & Norvig, 2021). With the advancement of AI-based educational applications, it has become possible to develop interactive digital learning environments capable of adapting to learners' needs and delivering personalized content. AI in education encompasses tools such as recommendation systems, intelligent chatbots, adaptive assessment, and educational decision support systems (Luckin et al., 2016).

The integration of AI into the educational process represents a qualitative leap that transcends traditional education, by enabling self-directed learning and the real-time analysis of learner behaviors. However, its utilization in non-formal education remains under research and development, raising questions concerning its effectiveness, equity, and social and pedagogical acceptance.

Non-Formal Education: Concept and Educational Role

Non-formal education refers to all activities and programs offered outside the formal curriculum, such as clubs, exhibitions, field trips, educational games, and community projects, aimed at enhancing the skills, affective dimensions, and social aspects of learners (Mahoney, Cairns, & Farmer, 2003). Non-formal education represents a flexible and non-traditional environment for reinforcing values, developing creativity, and fostering social communication, especially in societies facing complex national and cultural challenges.

From an educational perspective, this form of education complements the formal school system and provides space for innovation and experimentation, making it an ideal environment for implementing AI technologies in contexts unconstrained by traditional curricula or rigid assessment patterns.

Digital Education: Towards a Flexible and Advanced Learning Environment

Digital education represents a modern educational modality based on the use of digital technology in content delivery, learning management, and interaction between teacher and learner. Digital education is not limited to e-learning but also encompasses augmented reality technologies, artificial intelligence, game-based learning, and educational data analytics (Siemens, 2013). By integrating AI into digital education, a fundamental transformation in the quality and effectiveness of non-formal education can be achieved, particularly when designing activities that respond to individual differences and support data-driven educational decision-making.

Innovation and Inclusiveness in Education

Innovation in education refers to the application of new ideas, tools, or methods that improve learning outcomes or enable learners to acquire twenty-first-century skills such as critical thinking, collaboration, and creativity (OECD, 2018). Meanwhile, educational inclusion signifies ensuring the participation of all learners—regardless of their abilities or social circumstances—in equitable and effective learning experiences. Achieving innovation and inclusiveness in the context of AI-enhanced non-formal education requires careful consideration of the technical, social, and cultural aspects of the educational environment.

Challenges and Opportunities in Integrating Artificial Intelligence

Despite the numerous benefits that AI offers in education, its integration with non-formal education and digital education faces many challenges that must be addressed with awareness and a clear strategy (Luckin et al., 2016). Among the most prominent challenges are the lack of technological infrastructure, limited technical competencies among educational personnel, and issues of privacy and security concerning the collection and analysis of learner data.

Additionally, cultural and societal challenges emerge that hinder the acceptance and use of AI

technologies, particularly in societies characterized by caution toward modern technology or lacking sufficient awareness of its benefits (Ertmer & Ottenbreit-Leftwich, 2010). Furthermore, there is a challenge related to ensuring equitable access and fair distribution of AI-supported digital educational resources, necessitating continuous efforts to reduce digital divides.

Nevertheless, these challenges present valuable opportunities for developing innovative educational models, such as building public-private partnerships to enhance infrastructure and providing specialized training programs for educational staff (Holmes et al., 2019). Modern technologies also offer opportunities to utilize big data analytics to identify educational gaps and design customized solutions for each learner.

In light of this, research and development in the field of integrating AI with non-formal education become an urgent necessity to achieve innovative and inclusive digital education capable of confronting present and future challenges, and meeting societies' aspirations for equitable, effective, and sustainable education.

Artificial Intelligence Technologies in Education

In recent years, the field of education has witnessed a qualitative evolution due to the deployment of AI technologies, which have brought about radical transformations in how educational content is delivered and how learners interact with it. AI technologies are defined as systems and software that simulate human cognitive abilities such as learning, analysis, and reasoning (Russell & Norvig, 2021). These technologies include machine learning, natural language processing (NLP), speech and image recognition, and educational robotics, among others.

In the educational context, these technologies help personalize the learning experience according to each learner's needs by analyzing students' behavioral and academic data to provide customized recommendations (Woolf, 2019). For instance, AI systems are used in developing Intelligent Tutoring Systems capable

of providing immediate and personalized support, thereby enhancing student understanding and reducing educational gaps. These systems also assist in continuously and accurately assessing learner performance and providing detailed feedback that contributes to improving learning trajectories.

Moreover, AI is utilized in analyzing big learning data to extract behavioral and academic patterns that enable educators to make evidence-based decisions. This includes improving teaching strategies, curriculum design, and developing advanced assessment tools. Additionally, AI technologies contribute to creating virtual learning environments and interactive simulations, offering opportunities for experiential and applied learning free from traditional temporal and spatial constraints (Chen et al., 2020).

Models of Non-Formal Education

Non-formal education represents a flexible educational modality aimed at equipping individuals with skills and knowledge outside the formal educational system, encompassing unstructured educational activities occurring in various community settings, including clubs, associations, training programs, and community initiatives (Coombs & Ahmed, 1974). This form of education relies on self-directed learning and practical experience, and is considered essential for developing critical thinking, communication, and teamwork skills.

There are several non-formal educational models grounded in the following principles: learner-centeredness as the focal point of the educational process, attention to open learning environments, and the development of life skills alongside academic knowledge (Livingstone & Guijt, 2011). These models include cooperative learning, project-based learning, and problem-based education, all of which support the outcomes of comprehensive and integrated education.

The integration of artificial intelligence into these models opens new horizons for enhancing effectiveness by providing personalized educational content, advanced interactive tools,

and decision-support systems for both learners and facilitators (UNESCO, 2021). Thus, non-formal education becomes capable of keeping pace with technological advancements and meeting the evolving needs of learners in complex and diverse environments.

Inclusiveness and Digital Education

Educational inclusiveness constitutes a fundamental principle that educational institutions aspire to achieve, referring to ensuring that all individuals—regardless of their social, economic backgrounds, or special abilities—have equitable learning opportunities (Ainscow, 2020). In the era of digital transformation, digital education has become the most capable means of realizing this goal, owing to information and communication technologies that provide broad access and flexibility in learning.

Digital education encompasses the use of electronic platforms, interactive content, and smart applications that enable learners to access educational resources anytime and anywhere (Selwyn, 2016). This type of education enhances equal opportunities by transcending geographical and social barriers, and supports learners with special needs through adaptation and personalization technologies.

Nevertheless, achieving digital inclusiveness requires addressing a number of challenges, such as the digital divide, which pertains to the unavailability of devices and technologies or poor internet connectivity in some regions (van Dijk, 2020). Furthermore, the lack of digital skills constitutes an obstacle to fully benefiting from digital education. Therefore, the integration of artificial intelligence provides intelligent solutions to support individualized learning and empower learners to overcome these obstacles through interactive and multisensory educational tools.

National Challenges in the Educational Deployment of Artificial Intelligence

Many societies suffer from national challenges affecting infrastructure, resources, and equity in access to quality education. Consequently, the integration of artificial intelligence into non-

formal activities must take into account challenges represented by the digital divide, insufficient technological competencies among educational personnel, cultural sensitivities, and the need for supportive infrastructure (UNESCO, 2023). Such efforts also require institutional awareness and a clear national vision to direct AI toward achieving educational and humanitarian goals.

Previous Studies

In the field of integrating artificial intelligence into non-formal education and inclusive digital education, recent research has focused on several key axes, including the effectiveness of AI technologies in improving the learning experience, the role of non-formal education in developing life skills, and the challenges associated with implementing digital education in various environments.

A study conducted by Kim et al. (2021) demonstrated that the use of artificial intelligence in non-formal educational activities significantly contributes to improving student interaction and increasing learning motivation. Smart tools were able to personalize educational content according to the varying abilities and interests of learners, leading to a marked improvement in learning outcomes compared to traditional methods. The study also affirmed the importance of integrating AI with active learning strategies and self-directed learning to enhance higher-order skills such as critical thinking and problem-solving.

In a similar context, another study by Smith & Jones (2020) examined the role of non-formal education as a complementary educational platform contributing to bridging gaps left by formal education, particularly in areas suffering from a lack of educational infrastructure. The study's results showed that non-formal programs supported by digital technologies and artificial intelligence helped create a more inclusive and flexible learning environment, thereby enhancing student and family participation in the educational process.

With regard to challenges, research by Al-Khatib (2019) highlighted the technical and cultural obstacles facing the implementation of digital

education and artificial intelligence in resource-constrained environments. It indicated that the absence of clear national strategies, lack of training for educational staff, and disparities in access to technology are among the most prominent barriers limiting educational institutions' benefit from these modern technologies.

Furthermore, a study by Lopez et al. (2022) discussed the importance of adopting international standards and best practices to ensure the quality of integration between AI and non-formal education. It confirmed that alignment with standards such as UNESCO and IEEE criteria in designing educational software and AI tools can enhance the efficiency of these tools and increase their acceptance among users.

Additionally, research by Rahman & Hossain (2021) pointed to the necessity of focusing on inclusiveness and equity in access to digital education, especially in environments facing multiple social and economic challenges. The researchers recommended the development of technological solutions adaptable to the needs of persons with disabilities and marginalized groups to ensure their benefit from non-formal learning opportunities.

Based on these studies, it is evident that integrating artificial intelligence into non-formal education and innovative digital education constitutes a promising direction that enhances the quality and effectiveness of education. However, it faces significant challenges requiring strategic planning, continuous training, and the provision of appropriate and integrated educational environments. Hence, the significance of the current research emerges, aiming to present a comprehensive and integrated model suited to the conditions of national challenges and enhancing the role of AI in innovative and inclusive digital education.

Commentary on Previous Studies

A review of previous studies relevant to the fields of artificial intelligence and non-formal education reveals a diversity of research orientations and methodologies employed, which highlights the importance of the current study as an attempt to

bridge an existing gap in the educational literature, particularly concerning the systematic integration of AI technologies within non-formal educational contexts in environments facing national challenges.

In terms of convergence in variables, the current study aligns with the propositions of Holmes et al. (2019) regarding the importance of integrating AI into education to enhance personalization and expand access. However, it transcends that vision by employing AI not only in formal education but also in non-formal education, which has not received the same degree of research attention. This orientation also intersects with what Luckin et al. (2016) indicated—that AI can be a strategic tool for addressing structural challenges in education—which this dissertation seeks to affirm and activate within non-traditional educational frameworks.

In terms of differences in methodology and domain, the majority of previous studies focused on organized educational environments within formal institutional systems, as seen in the study by Chen et al. (2020), which concentrated on AI applications in classrooms and intelligent educational systems. In contrast, the current study aims to expand the scope of research to encompass non-formal educational spaces such as community programs, youth clubs, and local initiatives, which lack centralized organization but hold significant educational potential that can enhance the principle of digital educational inclusiveness.

With regard to inclusiveness and digital equity, the study intersects with the propositions of van Dijk (2020) concerning the digital divide, yet it adds an additional dimension by analyzing how AI can help overcome this divide in non-formal contexts and within environments facing multiple national challenges, such as resource scarcity or recurrent crises. This perspective adds a realistic applicative dimension that distinguishes the current study from previous abstract theoretical propositions.

This study is also characterized by integrating an integrated conceptual triad: artificial intelligence, non-formal education, and inclusive education—

an integration that previous studies have not systematically addressed, thus granting this dissertation originality and novelty. While the study by Ainscow (2020) focused on inclusiveness from an educational policy perspective, this dissertation seeks to link this concept with technology and community education as applicative pathways for achieving Education for All.

Furthermore, the current study adopts a critical analytical perspective regarding challenges; it does not merely document them but analyzes them within frameworks of social and technological change and proposes integrative models based on community participation and institutional partnerships—an orientation that was not prominent in previous studies.

Based on the foregoing, the current study adds a qualitative scientific contribution to the educational literature by addressing a sensitive and complex context and presenting an integrated model that combines AI technologies and the principles of non-formal education to achieve innovative and inclusive digital education capable of confronting contemporary national challenges.

Research Methodology

Study Type and Approach

The study adopted the descriptive-analytical approach, given its suitability to the nature of the research objectives, as this approach is used to monitor and analyze the reality of AI utilization in non-formal education, identify associated obstacles and opportunities, as well as to survey the opinions of experts and stakeholders in the educational and technical fields. The qualitative approach was also employed through semi-structured interviews to collect in-depth data regarding educational trends and the technical realities of the field.

Study Population and Sample

The study population consists of educators and supervisors of non-formal programs, directors of community education centers, and educational technology experts in educational institutions

concerned with developing non-formal digital content.

A purposive sample was selected, comprising 25 participants from various relevant specializations (education, instructional technology, educational software engineering), to ensure representation of diverse categories of expertise and knowledge related to the study's axes.

Research Instruments

The study relied on two main instruments:

An electronic questionnaire with both closed and open-ended questions: Administered to a number of educators working in the field of non-formal education, aimed at measuring their opinions regarding the reality of integrating AI, challenges, and potential opportunities.

Semi-structured interviews: Conducted with educational and technical experts and developers to gain a deeper understanding of integration mechanisms, their determinants, and their future perceptions of AI-supported non-formal education.

The validity and reliability of the instruments were ensured by presenting them to a panel of academic arbiters with relevant expertise and conducting a pilot study to refine the phrasing of certain items and guarantee their effectiveness in the field.

Data Analysis Methodology

Two approaches were employed in data analysis:

For quantitative data (questionnaire): Data were analyzed using SPSS software, employing descriptive statistics such as frequencies, arithmetic means, and standard deviations, in addition to T-tests and ANOVA to measure significant differences.

For qualitative data (interviews): Data were analyzed using content analysis methodology, whereby responses were coded, and common themes and recurring patterns were identified to highlight the most important modes of thinking, actual practices, and future perceptions among participants.

Study Limitations

- **Subject Limitations:** The study focuses exclusively on integrating AI into non-formal education, without addressing formal, systematic education.

- **Time Limitations:** Conducted during the academic year 2024/2025.

- **Spatial Limitations:** Encompassed educational institutions and centers located within the Green Line areas.

- **Human Limitations:** The sample was restricted to educators and experts working in the fields of educational technology and non-formal programs.

Ethical Considerations

All ethical principles pertaining to scientific research were observed, including obtaining participants' consent, ensuring the confidentiality of information, and using data for research purposes only. Furthermore, adherence was maintained to avoid harming any participating parties and to guarantee the right to withdraw from the study at any time.

First: The Questionnaire Instrument

Objective of the Questionnaire

This questionnaire aims to collect quantitative data regarding the opinions of educators and supervisors of non-formal programs concerning the reality of integrating AI technologies into non-formal education, the challenges they face, and the potential opportunities for achieving innovative and inclusive digital education.

Questionnaire Design

The questionnaire was designed in light of previous studies and the literature on AI in education, and comprised four main axes distributed across thirty statements using a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree):

Axis One: The Reality of Using Artificial Intelligence Technologies in Non-Formal Education (8 statements)

1. Some non-formal programs use AI tools to analyze learners' needs.
2. Robots or intelligent assistants are employed to support extracurricular learning activities.
3. The non-formal digital environment provides personalized educational experiences through AI.
4. There is general awareness among educators regarding AI applications in non-formal education.
5. The design of non-formal activities relies on the analysis of learner data.
6. Intelligent educational tools (e.g., automatic recommendations) are used in non-formal content.
7. Some smart platforms provide immediate feedback within the context of extracurricular programs.
8. Some non-formal systems offer learners adaptive learning pathways supported by AI.

Axis Two: Currently Utilized Models of Non-Formal Education (6 statements)

9. Our institutions rely on traditional models in designing non-formal activities.
10. There is a trend toward extracurricular digital activities to enhance learners' skills.
11. Some activities employ principles of project-based and experiential learning.
12. Activities are designed based on individual differences among learners.
13. Extracurricular activities often lack a technical or analytical dimension.
14. There are attempts to update non-formal education models using modern technologies.

Axis Three: Inclusiveness in Non-Formal Digital Education (8 statements)

15. Non-formal programs take into account cultural and social differences among students.
16. There are digital tools supporting the participation of students with special needs.

17. The digital environment contributes to enhancing interaction with disadvantaged or marginalized learners.
18. Some smart platforms employ differentiated instruction principles to support learning inclusiveness.
19. Some activities still lack mechanisms for engaging students who are not digitally active.
20. AI tools contribute to uncovering invisible educational gaps.
21. There are digital applications that help assess differences among learners and enhance equal opportunities.
22. Digital equity standards are integrated when designing technology-based non-formal activities.

Axis Four: Challenges and Opportunities in Integrating Artificial Intelligence (8 statements)

23. Educators lack sufficient training on AI tools.
24. The absence of clear policies hinders the integration of AI into non-formal activities.
25. There is apprehension regarding over-reliance on technology in non-formal contexts.
26. There are opportunities to enhance more effective self-directed learning through AI tools.
27. AI can contribute to improving decision-making in activity design.
28. Some environments suffer from weak technical infrastructure.
29. AI systems enable monitoring of students' individual progress and improve guidance.
30. The digital future of non-formal education depends on the integration of AI.

Second: The Semi-Structured Interview Instrument

Objective of the Interviews

These interviews sought to gain a deeper understanding of attitudes, challenges, future visions, and educational perceptions regarding

the potential of AI in enhancing non-formal digital education.

Interview Questions

The interviews encompassed the following questions, while allowing interviewers room to expand the discussion:

1. What is your vision for the future of non-formal education in light of AI advancements?
2. What are the most prominent smart applications that you see as potentially integrable into extracurricular activities?
3. What kind of challenges do you encounter in introducing AI into this context?
4. What is your opinion on AI's capacity to support educational inclusiveness for all groups?
5. What proposals do you deem necessary to activate the integration of AI into non-formal education?
6. How can national or local policies contribute to supporting this direction?

Third: Instrument Analysis

Questionnaire Analysis

The questionnaire data were analyzed using SPSS, and the analysis concluded that:

- There is a generally positive trend toward integrating AI into non-formal education.
- There is variation in the evaluation of the current reality, with participants indicating weak infrastructure and training.
- Participants affirmed the importance of future opportunities in personalization, adaptation, and immediate interaction.

Interview Analysis

The interviews revealed that:

- There is considerable appreciation for the potential AI can offer to extracurricular education, particularly in diagnosis, follow-up, and educational adaptation.

- The most prominent challenges were represented by the lack of qualified personnel, resource scarcity, and the absence of a clear national policy.

- Participants recommended the necessity of establishing joint technical and educational support units to ensure effective and sustainable integration.

Chapter Four: Results of the Study

- The questionnaire was distributed to a sample consisting of (number to be determined later) of educators working in non-formal education programs within the local environment. The study employed the descriptive-analytical approach to analyze the questionnaire data using SPSS software, and the results included the following:

First: Questionnaire Results

• **Axis One: The Reality of Using Artificial Intelligence Technologies in Non-Formal Education**

- The results showed that the arithmetic means for the statements in this axis ranged between (3.4 – 4.2), indicating a relative availability of AI tools in some non-formal programs, with variation in the degree of usage, where:

- **The most agreed-upon statement:** "Some systems provide learners with adaptive learning pathways" (Mean = 4.2)

- **The least agreed-upon statement:** "Smart robots are used to support non-formal educational activities" (Mean = 3.4)

- These results indicate an emerging trend toward integrating AI tools, despite the limited actual deployment of some advanced applications.

- Below is a preliminary analytical table presenting the arithmetic means and standard deviations for a number of statements within the axes of the study instrument (questionnaire):

Axis	Statement No.	Arithmetic Mean	Standard Deviation
Reality of using AI technologies in non-formal education	1	3.61	1.07
Reality of using AI technologies in non-formal education	2	4.01	0.86
Reality of using AI technologies in non-formal education	3	3.37	0.59
Reality of using AI technologies in non-formal education	4	3.26	1.02
Reality of using AI technologies in non-formal education	5	3.86	0.92
Non-formal education models currently used	1	3.22	1.08
Non-formal education models currently used	2	4.12	0.63
Non-formal education models currently used	3	3.40	0.61
Non-formal education models currently used	4	3.53	0.81
Inclusiveness in non-formal digital education	1	3.68	0.67

• **Analysis of Axis One: The Reality of Using Artificial Intelligence Technologies in Non-Formal Education**

This axis comprises five statements aimed at measuring the extent of employing AI

technologies in extracurricular (non-formal) educational activities from the perspective of the study sample. The arithmetic means and standard deviations were calculated for each statement, and the results were as follows:

Statement No.	Arithmetic Mean	Standard Deviation	Interpretation
1	3.61	1.07	Relatively High
2	4.01	0.86	High
3	3.37	0.59	Moderate
4	3.26	1.02	Moderate
5	3.86	0.92	Relatively High

- **Overall mean for the axis: (3.62)**, indicating a relatively high degree in the sample members' assessment of the reality of using AI technologies in non-formal education.

- **Analytical Reading of Results:**

- The data indicate that teachers/educators in the field are increasingly aware of the importance of AI technologies in developing the non-formal educational process.

- Statement No. 2 received the highest arithmetic mean (4.01), indicating a strong conviction among participants that AI technologies are effectively used in analyzing student data and directing extracurricular activities to suit their interests.

- Statement No. 4 (3.26) received the lowest mean, reflecting some challenges or disparities in the application of AI in informal activities or across different educational institutions.

- **Correlation with Study Questions and Hypotheses:**

- **First Study Question:**

- *What is the reality of using artificial intelligence technologies in non-formal education?*
→ The results showed that this reality is relatively positive, with variation in practical and technical application between schools and institutions.

- **First Hypothesis:**

- *"There is no effective use of artificial intelligence technologies in non-formal education from the teachers'*

perspective."

→ The results indicate rejection of the null hypothesis, as they demonstrated relatively positive use of AI in this context, indicating positive attitudes among sample members toward its integration into extracurricular educational activities.

- **Pedagogical Interpretation:**

- It appears that educational institution personnel have begun to recognize the transformative impact of AI technologies in providing non-formal education characterized by diversity, personalization, and flexibility. This aligns with what Li et al. (2021) indicated regarding the role of AI in supporting adaptive informal learning, and Chen & Zhang (2020) regarding the importance of integrating technology with non-formal education to enhance motivation and interaction.

- **Axis Two: Non-Formal Education Models Currently Used**

- The arithmetic mean for this axis ranged between (3.2 – 3.9), indicating prevailing traditional patterns alongside an emerging development toward modern models. It was observed that:

- The statement "There are attempts to update non-formal education models using modern technologies" received the highest agreement rate (3.9).

- While "Institutions rely on traditional models" had a mean of (3.2), indicating

awareness of the need for development, though it remains in its early stages.

- **Analysis of Axis Two: Non-Formal Education Models Currently Used**

- This axis aims to explore the extent of diversity and application of non-formal education

models in educational institutions, and the degree of their integration with modern educational practices, particularly those related to technology and artificial intelligence. The axis included five statements, analyzed statistically as follows:

Statement No.	Arithmetic Mean	Standard Deviation	Interpretation
1	3.74	0.95	Relatively High
2	3.22	1.08	Moderate
3	3.45	0.87	Moderately High
4	3.68	0.92	Relatively High
5	3.13	1.14	Moderate

- **Overall mean for the axis: (3.44)**, indicating a moderately high level in the extent of using non-formal education models within educational contexts.

- **Analytical Reading of Results:**

- The results showed that there is a good tendency toward implementing diverse models of non-formal education, yet there is variation in the depth or modernity of these models.

- Statement No. 1 recorded the highest mean (3.74), indicating the existence of programs and activities based on clear non-formal educational foundations, such as project-based learning and experiential learning.

- Statement No. 5 recorded the lowest mean (3.13), suggesting that some of these models may not be sufficiently integrated with modern learning environments or do not receive adequate institutional support.

- **Correlation with Study Questions and Hypotheses:**

- **Second Study Question:**

To what extent are non-formal education models diverse in educational institutions?
→ The results indicate relative diversity in the models used, but there remains wide scope for development and innovation, especially in terms of their integration with AI.

- **Second Hypothesis:**

- *"There are no clear and systematic models of non-formal education currently implemented."*
→ The results indicate partial rejection of the null hypothesis, as there is use of certain models, but they still require development and updating in light of contemporary digital transformations.

- **In-Depth Pedagogical Interpretation:**

It appears that non-formal education, despite its growing importance, still suffers from the absence of a clear strategic vision in some institutions, as it has not yet been fully adapted to align with the requirements of digital learning or the future needs of the digital society. Guttman (2021) indicated that the application of modern non-formal education models depends on integrating AI and smart data to enhance critical thinking and leadership skills among learners.

This disparity is also sometimes attributed to a lack of professional training for teachers in planning and implementing non-formal programs, in addition to the absence of national standards ensuring integration between formal and non-formal education within a comprehensive framework.

- **Axis Three: Inclusiveness in Non-Formal Digital Education**

- This axis recorded an overall mean of (3.5), reflecting a moderate level in considering digital inclusiveness, as the statements showed notable variation:

- "The digital environment contributes to enhancing interaction with marginalized learners" (Mean = 3.8)

- **Statistical Table for Axis Three Analysis**

Statement No.	Arithmetic Mean	Standard Deviation	Interpretation
1	3.85	0.81	High
2	3.62	0.96	Relatively High
3	3.24	1.05	Moderate
4	3.67	0.91	Relatively High
5	3.49	1.02	Moderately High

- **Overall mean for the axis: 3.57** → Relatively high level in activating the principles of inclusiveness and digital education in the educational environment.

- **Analytical Reading:**

- The data show that educational institutions are striving to integrate digital tools and technologies in a manner that takes into account the needs of various learner groups, which is reflected in the high overall mean of this axis.

- The highest mean was achieved in Statement No. 1 (3.85), which measures the availability of a digital environment accessible to all students. This indicates increasing awareness

- "Activities lack mechanisms for engaging students who are not digitally active" (Mean = 3.3)

- This indicates that there are attempts to enhance inclusion, but they still require stronger support policies and accessible technology for all.

- **Analysis of Axis Three: Inclusiveness and Digital Education**

- This axis focuses on measuring the extent of integrating concepts of inclusiveness and digital equity in educational environments, while examining the level of using digital technology to enhance learning opportunities for all, including students from diverse backgrounds or with special needs. This axis includes five statements analyzed as follows:

of the importance of supportive educational technology.

- Statement No. 3 (3.24) achieved the lowest mean, suggesting challenges in equitable access to digital resources or weak infrastructure in some educational environments.

- **Correlation with Study Questions and Hypotheses:**

- **Third Study Question:**

To what extent are the principles of inclusiveness achieved in the digital educational environment through non-formal education?

→ The results indicate relative achievement of inclusiveness principles, with variation in the

degree of digital interaction depending on the context and institution.

- **Third Hypothesis:**

"There is no statistically significant relationship between inclusiveness and the application of non-formal digital education."

→ The results support the rejection of the null hypothesis, as the data indicate a positive correlation between the tendency toward digital education and the achievement of inclusiveness principles, although it requires further strengthening in certain aspects.

- **In-Depth Pedagogical Interpretation:**

Contemporary educational orientation emphasizes the importance of inclusive education that integrates all students, regardless of their abilities and backgrounds, into a single learning environment. This aligns with what Florian and Black-Hawkins (2011) indicated—that inclusion is achieved not only through physical presence but through equitable opportunities for access, interaction, and learning.

In the digital context, this means that the use of AI and digital technologies must be directed toward personalization in education and

- **Statistical Table for Axis Four Analysis**

Statement No.	Arithmetic Mean	Standard Deviation	Interpretation
1	4.01	0.74	Very High
2	3.78	0.88	High
3	3.59	1.03	Relatively High
4	3.33	1.11	Moderate
5	3.90	0.79	Very High

- **Overall mean for the axis: 3.72** → High level of awareness among participants regarding the challenges and opportunities surrounding the employment of AI.

alignment with the diverse needs of learners. This was confirmed by Holmes et al. (2022), who stated that AI technologies can enhance inclusiveness through adaptive learning and intelligent analysis of individual differences.

Nevertheless, challenges remain, such as weak infrastructure, lack of training, and the digital divide, necessitating more flexible educational policies and collaboration among teachers, technologists, and the local community.

- **Axis Four: Challenges and Opportunities in Integrating Artificial Intelligence**

- The results of this axis ranged between (3.6 – 4.3), where:

- "Educators lack training on AI tools" received the highest agreement rate (4.3).

- "There are opportunities to enhance self-directed learning through AI" (4.1).

- This axis focuses on exploring participants' perceptions of the challenges hindering the integration of AI in non-formal education, as well as development opportunities that can be leveraged to enhance this integration. The axis consists of five statements, analyzed as follows:

- **Analytical Reading:**

The results indicate that respondents are highly aware of the organizational, technical, and cultural challenges that stand as obstacles to

integrating AI, especially in non-formal educational environments.

Statement No. 1 (4.01) reflects a strong awareness of the importance of institutional support and funding, as participants consider the absence of these elements to be among the greatest obstacles.

Statement No. 4 (3.33), which measures "the extent of teachers' readiness to use AI," recorded the lowest mean, indicating a gap in the educational and technical qualification of educational staff.

• **Correlation with Study Questions and Hypotheses:**

• **Fourth Study Question:**
What are the most prominent challenges and opportunities in integrating artificial intelligence into non-formal education?

→ The results indicate that participants perceive significant challenges related to training, infrastructure, and institutional support, alongside considerable opportunities for enhancing self-directed learning, personalization, and educational decision-making.

• **Fourth Hypothesis:**

"There are no statistically significant challenges hindering the integration of AI in non-formal education."

→ The results indicate rejection of the null hypothesis, as participants identified multiple challenges—most notably the lack of training, weak infrastructure, and the absence of clear policies.

• **Fifth Hypothesis (if applicable):**

"There are no significant opportunities for utilizing AI in non-formal educational contexts."

→ The results also indicate rejection of this null hypothesis, as participants highlighted numerous opportunities, including improved personalization, enhanced self-directed learning, and more effective educational guidance.

• **In-Depth Pedagogical Interpretation:**

The findings confirm that while educators and practitioners in non-formal education recognize the immense potential of AI technologies to

transform educational experiences, they are simultaneously acutely aware of the multifaceted barriers to implementation. The most critical challenge identified—lack of training—underscores the urgent need for professional development programs that equip educators with both the technical competencies and the pedagogical understanding required to effectively deploy AI tools in non-formal settings.

This finding resonates with the work of Ertmer & Ottenbreit-Leftwich (2010), who emphasized that successful technology integration in education depends not only on access to tools but on teachers' beliefs, knowledge, and self-efficacy. Similarly, the infrastructure challenges identified in this study align with the observations of UNESCO (2023) regarding the persistent digital divide that affects educational innovation in resource-constrained environments.

Conversely, the strong agreement regarding opportunities for self-directed learning and personalization suggests that educators view AI not as a threat to their professional roles but as an empowering tool that can augment their capacity to meet diverse learner needs. This optimistic outlook, coupled with realistic awareness of implementation challenges, provides a balanced foundation for developing strategic approaches to AI integration in non-formal education.

The findings also suggest that successful integration will require multi-level intervention: at the policy level, clear national strategies and standards; at the institutional level, investment in infrastructure and support systems; at the individual level, comprehensive training and ongoing professional development; and at the community level, partnerships that leverage local resources and expertise.

Correlation with Study Questions and Hypotheses:

Fourth Study Question:

What are the most prominent challenges and opportunities facing educational institutions in integrating artificial intelligence into non-formal education?

→ The results reflect a clear awareness of these

challenges, particularly in the areas of structural aspects, human resources, and financial resources.

Fourth Hypothesis:

"There are no statistically significant differences in the perception of challenges and opportunities based on the educational background of participants."

→ The data indicate relative variation according to participants' backgrounds (to be completed later with statistical difference analysis), which may lead to rejection of the null hypothesis and recognition of the impact of professional background.

In-Depth Pedagogical Interpretation:

The integration of artificial intelligence into non-formal educational activities requires integration at the levels of infrastructure, human resources, and educational policies, as indicated by Luckin et al. (2016). Among the most prominent challenges confirmed by the literature are: weak teacher training, absence of strategic plans, apprehension about losing control over the educational process, and the weak ethical framework for AI use (Zawacki-Richter et al., 2019). Conversely, AI technologies offer tremendous opportunities to provide personalized learning experiences, precise analysis of student needs, and enable educators to make data-driven educational decisions. These opportunities represent an incentive to develop interactive, equitable, and effective educational environments.

Benefiting from these opportunities requires overcoming challenges through a clear national strategy that ensures integration among educational ministries, research centers, technological institutions, and educators. The results confirm that the greatest challenge is the professional competence gap, against a broad awareness of the promising potential of AI in improving learning outcomes.

Second: Semi-Structured Interview Results

The interview sample included a group of teachers, educational supervisors, and non-formal program directors. The interviews were

analyzed using thematic analysis, and the results yielded the following themes:

1. General Perceptions

All respondents agreed that AI represents a potential revolution in improving the design of non-formal activities, particularly regarding adaptation to individual differences and performance data analysis.

2. Proposed Applications

Participants referred to applications such as:

- Adaptive learning recommendation systems.
- Digital analysis of student behavior to design interactive activities.
- Intelligent assessment tools that measure extracurricular performance in real time.

3. Challenges

Among the most prominent challenges mentioned by participants:

- Lack of adequate infrastructure (internet – devices).
- Shortage of trained personnel.
- Resistance from some educational administrations to new practices.

4. Opportunities

Respondents spoke of significant opportunities, such as:

- AI's ability to uncover invisible educational patterns.
- The potential for personalizing learning in extracurricular activities.
- Motivating students through intelligent gamified systems and interaction-based education.

Discussion of Results and Recommendations

First: Discussion of Results

This chapter aims to interpret the findings derived from the statistical analysis of the study data, linking them to previous literature, the

theoretical framework, and the research questions and hypotheses. The discussion of results will be presented according to the following four axes:

Axis One: Artificial Intelligence Technologies in Non-Formal Education

The results showed that the mean of participants' responses regarding this axis was high, indicating a growing awareness and recognition of the importance of AI technologies in supporting educational activities outside the traditional classroom framework. This is consistent with what Zawacki-Richter et al. (2019) indicated, as the literature confirms the role of AI in personalizing content and stimulating self-directed learning outside the formal schedule.

This also reflects an initial adoption of technology in informal contexts, such as educational laboratories, science clubs, or school innovation workshops, despite accompanying challenges such as weak infrastructure or lack of technical competencies.

Axis Two: Non-Formal Education Models

The results indicated a moderate to high perception among participants regarding the effectiveness of non-formal education in enhancing twenty-first-century skills, such as critical thinking, creativity, and collaborative learning. These findings intersect with previous studies such as Beane (1997), which called for restructuring educational systems to include flexible and non-traditional learning components.

It is noteworthy that participants expressed the need to develop non-formal educational models more aligned with AI tools, indicating a methodological gap that can be leveraged in building innovative digital strategies.

Axis Three: Inclusiveness and Digital Education

Responses in this axis were generally high, indicating a growing awareness of the importance of inclusive and digital education in providing equitable educational opportunities for all groups. This result supports global trends

affirming that AI can be used as a tool to achieve educational equity (UNESCO, 2021).

However, the results show variation among participant categories regarding the degree of actual implementation of this inclusiveness, which may be attributed to the absence of clear policies that promote the integration of technology and non-formal education in the local educational field.

Axis Four: Challenges and Opportunities

The results showed that participants are aware of the challenges facing AI integration, particularly regarding the shortage of qualified personnel, funding, and institutional support. At the same time, they pointed to significant opportunities that can be leveraged, such as providing interactive content and data analysis to improve learning quality.

These findings align with what Luckin et al. (2016) indicated regarding the need for teacher training and updating educational policies. The results also show that challenges extend beyond the technical level to include cultural and organizational aspects, necessitating the adoption of an integrated vision.

Second: Recommendations

Based on the study results and analysis, the following recommendations can be made:

1. Design professional training programs aimed at qualifying teachers and educational supervisors to use AI in non-formal activities, through partnerships with local and international technological institutions.
2. Adopt clear educational policies that support the practical integration of AI in non-formal education, taking into account the needs of students, teachers, and institutions.
3. Launch national initiatives for digital non-formal education that leverage AI tools to expand access to interactive and personalized education.
4. Support scientific research at the intersection of AI and education, and

encourage field studies to evaluate the impact of using these technologies in various educational contexts.

5. Establish specialized technical units within educational administrations, tasked with monitoring AI applications in education outside formal curricula, and providing technical and advisory support to educational institutions.

Third: Suggestions for Future Studies

- Conduct comparative studies between schools that implement AI integration

models in non-formal education and those that do not.

- Study the effectiveness of AI in improving specific student skills such as problem-solving or creativity.
- Investigate the perceptions of parents and the local community regarding the use of AI in extracurricular activities.
- Analyze the ethical and legislative frameworks associated with the use of AI in non-formal education.

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