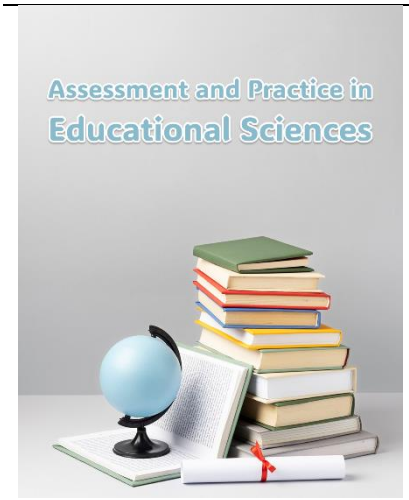
Assessment and Practice in Educational Sciences



Rethinking the Concept of Learning in the Age of Artificial Intelligence: The Possibilities and Limitations of Human Education

1. Shakiba. Ghasemi*: PhD Student, Department of Foundations of Education, Shiraz University, Shiraz, Iran (Email: Shakiba_g@ymail.com)
2. Amin. Izadpanah: Assistant Professor, Department of Foundations of Education, Shiraz University, Shiraz, Iran

Article type:
Original Research

Article history:
Received 23 September 2025
Revised 05 December 2025
Accepted 08 December 2025
Initial Publish 06 January 2026
Published online 01 March 2026

How to cite this article:
Ghasemi, Sh., & Izadpanah, A. (2026). Rethinking the Concept of Learning in the Age of Artificial Intelligence: The Possibilities and Limitations of Human Education. *Assessment and Practice in Educational Sciences*, *4*(2), 1-13. https://doi.org/10.61838/japes.177

ABSTRACT

Artificial intelligence, as one of the most transformative technologies of the present era, has had a profound impact on learning and education processes and is redefining the role of humans, teachers, and educational systems. The aim of this research is to rethink the concept of human learning in the era of artificial intelligence and to explain the opportunities, challenges, and ethical-educational requirements arising from it. The research is fundamental and was conducted with an interpretive qualitative approach combining library research and semi-structured interviews. In the library section, data were extracted from a targeted review of scientific sources between 2019 and 2025, and in the qualitative section, semi-structured interviews were conducted with 16 experts in the fields of education, technology, and AI ethics. Data analysis for the qualitative part was conducted based on Braun and Clarke's (2006) six-step method, and main themes were extracted. The research findings showed that artificial intelligence increases the capacity to improve learning by providing contexts such as personalized learning, intelligent assessment, and real-time feedback. At the same time, it also has limitations and challenges. These limitations and challenges include data bias, privacy violations, weakening of the teacher's role, and cultural incompatibility. As a result, it can be said that learning in the age of artificial intelligence, along with the opportunities and possibilities it creates, also has challenges and limitations. By strengthening opportunities and properly managing challenges, the capacities of artificial intelligence can be used for growth, justice, and excellence in human education.

Keywords: Artificial intelligence, human learning, moral education, localization of educational technology, smart education

Introduction

The rapid expansion of artificial intelligence (AI) across global educational systems has catalyzed a profound transformation in how learning is conceptualized, delivered, and experienced. As educational institutions migrate toward increasingly digital and data-intensive infrastructures, AI is no longer viewed merely as a supplementary instructional tool but as a structural force redefining the epistemological foundations of learning itself. Scholars argue that the integration of AI into teaching–learning ecosystems introduces new layers of cognitive augmentation, instructional automation, and predictive analytics that reshape the roles of teachers, learners, and institutions in unprecedented ways (1-3). This technological evolution has compelled researchers to interrogate not only the capacities of AI-enhanced systems but also the theoretical, ethical, and humanistic implications of delegating aspects of learning, assessment, and pedagogical judgment to computational agents.

The conceptual roots of these debates can be traced to earlier psychological and educational theories, particularly those emphasizing the interplay between cognition, behavior, and social interaction in learning. Bandura's seminal social learning theory, which highlights the reciprocal relationship between observation, modeling, and human agency, remains a central framework for understanding how learners engage with AI-driven systems and automated feedback loops (4-6). As learning is increasingly mediated by algorithms capable of modeling patterns of behavior and predicting future performance, contemporary scholars revisit foundational theories to assess the continuing relevance of human agency, self-regulation, and motivation in environments where intelligent systems shape instructional pathways. Such considerations underscore the need to situate AI within—not outside of—established theoretical traditions.

At the same time, AI's capacity for automation, personalization, and large-scale data interpretation has opened new pathways for enhancing learning effectiveness, reducing instructional inequities, and supporting data-informed educational leadership. For instance, researchers highlight that adaptive learning environments powered by machine learning can adjust content difficulty, pacing, and modality in real time, thereby supporting diverse learners and increasing engagement (7-9). Personalized learning—long considered an aspirational goal in educational reform—is now increasingly achievable due to AI's ability to analyze cognitive, behavioral, and affective data with precision (10, 11). These innovations promise not only to increase efficiency but also to reconfigure the teacher's role from a transmitter of knowledge to a learning architect, decision supporter, and data-informed facilitator.

Yet these opportunities coexist with a parallel discourse centered on risk, limitation, and caution. Critical scholars contend that the accelerating integration of AI into educational decision-making threatens to reduce complex human learning processes into statistical abstractions, thereby oversimplifying the richness of cognition, emotion, and meaning-making (12-14). This critique builds on earlier concerns that algorithmic systems lack intentionality, consciousness, and moral reasoning—qualities essential for pedagogical judgment and holistic human development (13, 15). Algorithmic opacity, data bias, privacy risks, and the potential reproduction of social inequalities also feature prominently in contemporary research, particularly within discussions of ethical governance, responsible design, and the cultural localization of AI (16-18). These concerns reflect the broader tension between technological promise and humanistic values in education.

A useful point of departure for synthesizing these diverse perspectives lies in examining how AI is reshaping the conceptual foundations of learning. Traditional models of learning, influenced by behaviorism and cognitivism, conceptualize learning as a sequential process structured by reinforcement, cognitive load, and information processing (19, 20). In contrast, AI-enhanced learning environments rely on high-frequency data, predictive insights, and adaptive algorithms that operate in continuous loops of measurement and response. Learning thus becomes a dynamic socio-technical system, where the learner interacts not only with content and peers but also with intelligent systems that shape the trajectory of learning in real time (21, 22). This shift necessitates revisiting theoretical assumptions about the nature of knowledge, agency, and the relationship between human and machine cognition.

One of the most significant conceptual innovations emerging from recent literature is the notion of "hybrid intelligence," which proposes a symbiotic interaction between human cognition and machine computation (11). Hybrid intelligence frameworks argue that AI should not be treated merely as a tool for efficiency, but as a cognitive partner that extends human capacities through externalization (offloading cognitive tasks), internalization (absorbing patterns from machine models), and co-construction (interacting with AI to generate new forms of understanding). This reframing contrasts sharply with deterministic narratives predicting that AI will replace teachers, pedagogical judgment, or human reasoning. Instead, hybrid intelligence positions AI as an augmentation of human learning—not a substitute. This perspective aligns with early theoretical

propositions that emphasized the adaptive, social, and situated nature of learning, suggesting that technology becomes meaningful only when contextualized within human processes of interpretation, reflection, and ethical action (4, 5).

The emergence of affective computing and emotion AI has further complicated debates around AI in education. While recent studies show the potential of AI to infer emotional states and support socio-emotional learning, critics argue that reducing emotions to quantifiable data elements risks misrepresenting the deeply subjective and culturally embedded nature of affect (23, 24). Emotion AI may inadvertently classify behaviors based on limited or biased datasets, reinforcing stereotypes or misinterpreting learner experiences. These concerns reflect broader critiques about the limits of AI's epistemological reach—namely, that intelligent systems excel at detecting patterns but struggle to interpret meaning, intention, or moral context (12, 13). As a result, the deployment of emotion AI and other predictive systems must be approached within a robust ethical framework that centers human dignity, privacy, and autonomy.

Parallel to these theoretical concerns, scholars also highlight the institutional and governance challenges associated with integrating AI in educational settings. Policymakers and school leaders are increasingly reliant on AI-driven analytics for decision-making, yet research demonstrates that these systems can amplify existing inequities or mislead decision-makers when deployed without adequate oversight or contextual understanding (16, 25). The overreliance on automation—sometimes described as the "automation trap"—can lead to diminished human oversight, deprofessionalization of teachers, and reduced capacity for critical judgment (26). Importantly, studies show that cultural and contextual factors significantly influence the success or failure of AI integration: systems developed in one linguistic or cultural environment may not seamlessly transfer to another without adaptation (18, 27). This underscores the need for localization, ethical governance, and culturally responsive implementation.

Another essential theme emerging from contemporary literature concerns the shifting role of the teacher in AI-mediated environments. As AI handles routine instructional tasks such as grading, feedback, and content delivery, teachers' responsibilities increasingly shift toward mentorship, emotional support, and the cultivation of critical, ethical, and metacognitive skills (7, 8). But this transformation also raises concerns: if teachers are insufficiently trained in AI literacy or ethical AI use, the pedagogical quality and equity of instruction may suffer. Research shows that teacher preparedness remains one of the most significant predictors of successful AI adoption, particularly in settings where digital literacy varies widely across educators and institutions (10, 20). Thus, AI integration must be accompanied by comprehensive professional development initiatives that strengthen teachers' capacity to interpret data, question algorithmic outputs, and integrate human judgment with computational suggestions.

A related area of debate centers on the cognitive load implications of AI-driven instruction. While AI can reduce extraneous cognitive load by simplifying complex tasks and organizing information more efficiently, it may inadvertently increase intrinsic or germane load by exposing learners to constant streams of data, feedback, and adaptive challenges (19). If poorly designed, AI systems may overwhelm learners, limit opportunities for deep reflection, or encourage passive dependence on automated suggestions. This dynamic accentuates the broader pedagogical question: should AI primarily guide learning or scaffold learners' capacity to guide themselves?

Across these discussions, researchers identify a recurring tension between efficiency and meaning. AI excels at optimizing learning sequences, predicting performance, and structuring tasks; however, human learning also involves ambiguity, creativity, emotion, and moral judgment—domains in which algorithmic systems have limited competence (12, 13). This tension calls for an interdisciplinary approach that integrates insights from educational psychology, cognitive science, data ethics, and philosophy of technology, ensuring that AI serves human flourishing rather than instrumentalizing education for narrow metrics of performance.

Given the increasing pervasiveness of AI technologies, the need for robust ethical, legal, and governance frameworks has become urgent. Scholars emphasize principles such as transparency, accountability, explainability, and respect for learner autonomy as essential components of responsible AI deployment in education (17, 18). Without such frameworks, educational systems risk adopting technologies that reproduce existing biases, undermine trust, or erode fundamental rights such as privacy and informed consent. International discussions of AI in education consistently call for policies that foreground human dignity and ensure that learners' data are protected from misuse, extraction, or manipulation (23, 27).

Despite the complexity of these debates, the literature converges on one central theme: AI has the potential to significantly enrich education, but only when integrated within pedagogically sound, ethically guided, and culturally relevant frameworks. The challenge is not merely technological but philosophical and educational. As scholars continue to rethink the meaning of learning in an era of intelligent machines, the question becomes how to design AI systems that honor the human dimensions of learning—agency, emotion, creativity, and social connection—while leveraging computational power to expand learning possibilities.

Against this backdrop, the present study aims to critically examine and redefine the concept of learning in the age of artificial intelligence by analyzing its theoretical foundations, educational opportunities, ethical risks, and human limitations.

Methods and Materials

This research is fundamental and aims to explain and conceptually rethink human learning in the context of developments caused by artificial intelligence. In terms of research philosophy, the research approach is interpretivist, as it attempts to analyze the phenomenon of learning and the role of technology from the perspective of human meaning, experience, and perception. The research method is a qualitative approach combining library research and semi-structured interviews to obtain a comprehensive picture of the opportunities and limitations of artificial intelligence in education by utilizing documented data and expert perspectives. In the library section, data were extracted from reliable scientific sources including articles, books, and specialized reports and analyzed to develop theoretical foundations and identify research gaps.

In the qualitative section, data were collected through semi-structured interviews and text content analysis. The qualitative community included 16 participants selected through purposive sampling to ensure diversity of expertise across education, technology, and AI ethics. The participants consisted of university professors, school teachers, educational policymakers, IT specialists from the Ministry of Education, researchers in AI ethics and educational philosophy, and entrepreneurs in smart learning startups. Data collection continued until theoretical saturation was reached. The resulting data were analyzed using thematic analysis (Braun & Clarke, 2006) to identify key themes in the areas of opportunities, challenges, and ethical imperatives, while the library data were examined through conceptual and content analysis to identify theoretical gaps. Finally, the integration of theoretical and qualitative data allowed the researcher to interpret and infer a conceptual model for the optimal use of AI for human growth and development. Data analysis was conducted using a six-step approach by Braun and Clarke (2006), which included familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and finally writing an analytical report.

Findings and Results

This section presents the findings of the literature analysis and is based on a systematic analysis of scientific literature. In this stage, data were collected through a targeted review of reliable sources between 2019 and 2025. The sources examined included scientific articles indexed in international databases (Google Scholar, Scopus, and Web of Science), research reports

from educational organizations including UNESCO, and theoretical and analytical studies related to the application of artificial intelligence in teaching and learning.

The analysis process was carried out using thematic analysis based on the six-step approach proposed by Braun and Clarke (2006). In this approach, first, the selected texts were read several times to achieve familiarization with the content; then, initial codes related to key concepts such as human learning, artificial intelligence in education, opportunities, limitations, and ethical requirements were extracted. In the next stage, the codes were grouped based on conceptual similarity and the main themes of the research were formed.

This process led to the identification of three central themes that form the structure of the findings section:

1. Redefining the concept of learning in the age of artificial intelligence,

2. The evolution of the role of teacher and learner in intelligent educational systems,

3. The ethical and philosophical challenges and requirements in data-driven learning.

In what follows, each of these themes is analyzed and explained in detail based on theoretical evidence and findings extracted from previous research.

Table 1. Literature Insights on the Redefinition of Learning in the AI Era

Analytical Section	Author(s) / Year	Key Focus or Theme	Main Findings and Conclusions
A) Conceptual Transformation of Learning in the AI Era	Holmes (2020)	The role of AI in reshaping learning structures	Learning has shifted from a linear process to a dynamic, data-driven model. Intelligent technologies integrate data analytics and real-time feedback into education.
	Hwang et al. (2020)	Classification of intelligent learning systems	Four key dimensions of AIEd: adaptive learning, intelligent tutoring systems, learning analytics, and teacher decision-support agents.
	Zawacki-Richter et al. (2019)	Systematic review of AI applications in education	Learning is now networked, self-regulated, and multidirectional, with learners actively constructing knowledge.
	Cukurova (2025)	Concept of Human–AI Hybrid Intelligence	Cognitive interaction between humans and machines extends human capabilities and transforms learning into a reciprocal process.
	Korteling et al. (2021)	Cognitive representation in intelligent systems	AI simulates cognitive processes such as reasoning and decision-making, complementing human cognition.
B) Opportunities and Potentials of AI-Enhanced Learning	Demartini et al. (2024)	Adaptive learning and intelligent feedback	AI enhances learner self-regulation, provides real-time feedback, and improves teachers' instructional decisions.
	Gligorea et al. (2023)	Machine learning in educational performance	Human–machine interaction increases cognitive engagement and improves learning outcomes.
	Baker (2022)	Personalized learning design with AI	Intelligent algorithms enable the customization of educational content according to individual learner profiles and progress.
	Yuskovych-Zhukovska et al. (2022)	AI for sustainable educational development	AI supports personalized learning and transparency in educational decision-making through data analytics.
	Chen et al. (2020)	Intelligent learning environments	Learning in AI contexts becomes a multi-agent ecosystem involving behavioral analysis, content adaptation, and cognitive support.
C) Conceptual and Ethical Challenges in Redefining Learning	Selwyn (2024)	Critique of techno-centric approaches to learning	AI risks oversimplifying human learning, reproducing inequalities, and diminishing human elements in education.
	Mazurek (2025)	Human mind vs. computational cognition	AI lacks intentionality, meaning, and self-awareness; it cannot replicate human consciousness and must align with educational philosophy.
	Mindigulova et al. (2023)	Ethical considerations in AI-based education	Emphasizes principles of human dignity, transparency, and equity in designing AI-driven educational systems.
	Wang (2021)	Data bias and decision-making in learning systems	Biased datasets may produce unfair educational outcomes and algorithmic discrimination.
	Umoke et al. (2025)	Ethics and data governance in intelligent learning	Calls for robust ethical frameworks to protect data privacy and ensure fairness in AI-enhanced education.

As can be seen in Table 1, a review of scientific literature shows that the concept of learning in the era of artificial intelligence has undergone a multidimensional transformation. The findings indicate that learning is no longer a linear and teacher-centered process, but has become a dynamic, data-driven, and interactive ecosystem in which humans and machines jointly play a role in the construction of knowledge. Researchers such as Holmes (2020), Cukurova (2025), and Korteling et al. (2021) emphasize that artificial intelligence technologies have not only expanded human cognitive capacities, but have also transformed the structure of learning; such that learning is now based on real-time feedback, adaptive pathways, and intelligent decision-making. In this framework, the learner is no longer a mere recipient of information, but acts as an active part of a hybrid human-machine intelligence system.

At the same time, the results of the reviewed studies show that artificial intelligence has provided significant opportunities for improving the quality and accessibility of education. Personalized learning, adaptive systems, and intelligent learning analytics allow the design of educational experiences tailored to individual needs and performance (Baker, 2022; Demartini et al., 2024; Yuskovych-Zhukovska et al., 2022). These approaches not only lead to improved self-regulation of learners and increased educational efficiency, but also help teachers to more accurately analyze student behavior and progress.

However, the findings show that these developments are also accompanied by theoretical and ethical challenges and tensions. Researchers such as Selwyn (2024) and Mazurek (2025) warn that the dominance of technological logic over human principles may lead to the "depersonalization of learning" and the weakening of human interaction. On the other hand, issues such as data bias, privacy violations, and overreliance on algorithmic decision-making are among the main concerns in this field (Mindigulova et al., 2023; Wang, 2021). The set of these findings emphasizes the need to develop a balanced framework between technology and human education that serves human development rather than replaces it.

In order to adapt and analyze these international findings to the conditions of the Iranian education system, the subsequent stage of the research involved conducting semi-structured interviews with 16 experts in the fields of educational technology, educational sciences, and AI ethics. The selection of participants was purposeful and ensured a diversity of expertise, and the data collection process continued until theoretical saturation was reached.

In this section, data from semi-structured interviews with experts are analyzed. Data analysis was conducted based on the six-step approach of Braun and Clarke (2006), which includes familiarization with the data, generation of initial codes, theme search, review, definition and naming of themes, and finally writing an analytical narrative. After the interviews were fully conducted, the data were coded and organized, and from a total of more than 230 initial codes, four main themes and sixteen subthemes were finally extracted. These themes reflect the diverse perspectives of experts on the opportunities, limitations, ethical challenges, and solutions for localizing AI in the Iranian education system.

Based on the data analysis, the first theme titled "Opportunities and Capabilities of AI in Learning" was identified. Participants believed that AI can improve the quality of learning by enabling personalized learning, intelligent assessment, and real-time feedback. In their opinion, AI tools such as adaptive systems, educational chatbots, and learning analytics platforms have the ability to identify the learning style, weaknesses, and cognitive needs of each student. Several experts also emphasized that "in Iran, the use of AI in virtual education and distance learning can reduce geographical gaps and access to resources." Also, in their view, AI can play an important role in supporting teachers through data analysis and educational recommendations and increase educational equity.

The second main theme is "Limitations and Challenges of Applying AI." In this section, experts pointed to obstacles such as the lack of technical infrastructure, weak digital literacy of teachers, lack of local data, and dependence on foreign technologies. Some interviewees noted that "most educational AI systems are designed based on Western language and culture and are not fully compatible with the conditions of Iranian learners." In addition, others emphasized that the lack of a detailed

evaluation system and coordinated policies at the Ministry of Education level is an obstacle to the development of smart education.

The third theme was "ethical and educational challenges of AI," which was repeatedly raised in all interviews. Experts acknowledged that using AI in education without clear ethical frameworks could lead to violations of student privacy, bias in algorithms, and weakening of learner autonomy. Some of them warned that "if algorithms are trained solely on past data, they may reproduce unfair patterns." The importance of maintaining the role of the teacher as a guide and human model was also emphasized, since human learning is not simply a cognitive process, but also an emotional and value-based experience.

The fourth theme includes "Strategies and Requirements for Localizing Artificial Intelligence in Iranian Education." Participants suggested that the development of AI in education should be designed within the framework of national education policies, indigenous culture, and Iranian educational values. Suggested solutions included: training teachers in AI, creating indigenous data banks, developing a national code of ethics for the use of AI in education, and supporting interdisciplinary research between educational sciences and computer sciences. One academic expert stated: "We should not be mere consumers of technology; rather, we should think about producing indigenous knowledge in the field of AI for learning."

Table 2. Main Themes and Sub-Themes Extracted from Expert Interviews

Main Themes	Sub-Themes	Description / Interpretation of Sub-Theme
Opportunities and Capabilities of Artificial Intelligence in Learning	Personalized and Adaptive Learning	AI analyzes individual and cognitive data to tailor learning paths according to each learner's needs and abilities.
	Intelligent Assessment and Real-Time Feedback	Intelligent systems can instantly analyze learner performance and provide precise, targeted feedback.
	Decision-Support for Teachers	AI analyzes educational data and assists teachers in designing more effective teaching strategies.
	Self-Regulated and Autonomous Learning	Intelligent tools help learners monitor and adjust their own learning process based on performance data.
	Promoting Educational Equity and Equal Access	AI removes geographical and temporal barriers, enabling access to quality education for diverse populations.
	Enhancing Collaborative Learning and Human–Machine Interaction	Smart technologies foster group interaction and collaborative learning in virtual environments.
Limitations and Challenges of Implementing AI in Education	Lack of Technical Infrastructure and Localized Data	The absence of reliable networks, domestic servers, and local databases hinders the effective development of AI.
	Low Digital Literacy among Teachers and Educational Managers	Teachers' limited familiarity with AI tools restricts effective utilization of educational potentials.
	Policy Incoherence and Lack of National Strategic Framework	The absence of coherent national policies leads to fragmented initiatives in AI integration within education.
	Dependence on Foreign Technologies and Cultural Incompatibility	Most existing AI systems are designed based on Western contexts and are not fully aligned with local educational needs.
Ethical and Pedagogical Challenges of Artificial Intelligence	Privacy Violations and Data Security	Collecting and processing personal data without ethical supervision may threaten learners' privacy.
	Algorithmic Bias and Educational Inequality	Biased datasets can reproduce inequities and discriminatory patterns in educational decision-making.
	Reduced Human Interaction and Teacher Displacement	Overreliance on intelligent systems may weaken human relationships and diminish teachers' pedagogical roles.
	Transformation of Learner Identity and Learning Essence	Algorithmic education may alter learners' understanding of meaning, value, and motivation in learning.
Strategies and Localization Requirements for AI in Iranian Education	Developing a National Ethical and Legal Framework	Establishing national standards and ethical codes to ensure transparency, accountability, and data protection in AI use.
	Empowering Teachers and Educational Managers	Designing training programs to enhance technological literacy and effective use of intelligent tools.
	Developing Local Data and Software Ecosystems	Creating local educational databases and supporting the development of indigenous AI platforms.
	Strengthening Interdisciplinary Collaboration	Promoting collaboration between experts in education, psychology, data science, and computer engineering to design context-aware AI systems.

Overall, the qualitative findings show that the use of AI in education, along with extensive opportunities, is accompanied by infrastructural, cultural, and ethical challenges, and its success requires a local, integrated, and human-centered perspective. These themes and their corresponding sub-themes are summarized in Table 2.

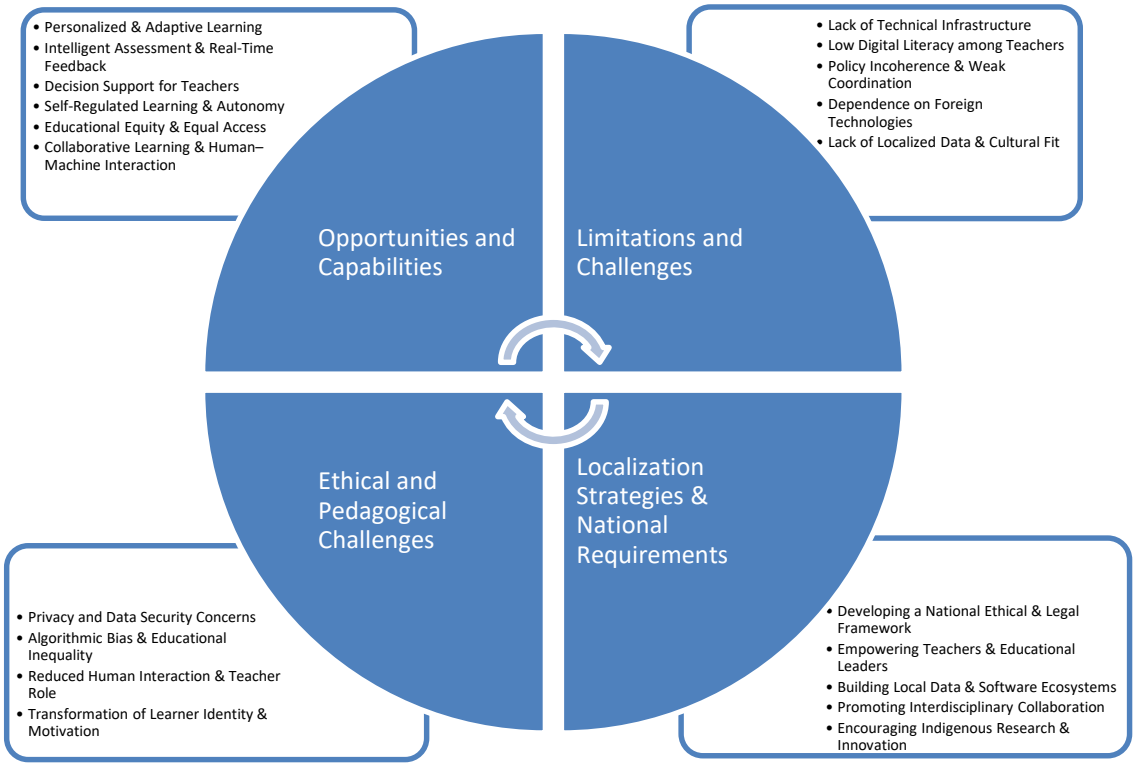


Figure 1. Thematic Model of Opportunities, Challenges, and Localization of AI in Learning

Thematic analysis of expert interviews revealed four major themes encompassing the opportunities and challenges of applying artificial intelligence in education. The findings indicate that while AI offers significant potential for personalized, equitable, and data-driven learning, its successful implementation in Iran requires addressing infrastructural, ethical, and cultural constraints through localized strategies and interdisciplinary collaboration.

Discussion and Conclusion

The findings of this study offer a comprehensive understanding of how artificial intelligence reshapes the conceptualization, processes, and ethics of learning in contemporary education. The results demonstrated that learning in the age of AI is shifting away from a linear, teacher-centered model toward a dynamic human–machine ecosystem characterized by personalized pathways, real-time feedback, multilayered analytics, and algorithmic decision-support. At the same time, the findings highlighted the infrastructural, cognitive, pedagogical, and ethical challenges that complicate the meaningful adoption of AI tools in education. Interpreting these findings in relation to the theoretical foundations and previous empirical studies reveals a multidimensional transformation: one that expands opportunities for learning while simultaneously intensifying concerns regarding human agency, equity, identity, cultural integration, and governance. These results align closely with the global literature and confirm that any attempt to integrate AI into education must balance technological capability with humanistic values, ethical safeguards, and contextual localization.

The results reinforce the premise that AI significantly expands opportunities for personalized learning, adaptive instruction, and data-driven pedagogical decision-making. Participants repeatedly emphasized the potential of AI to tailor learning

experiences based on learner preferences, performance data, and behavioral indicators. This aligns with the findings of Demartini, who showed that adaptive AI environments enhance learner self-regulation and provide high-frequency, targeted feedback that strengthens instructional effectiveness (7). Similar conclusions appear in the works of Baker, who illustrated how AI-driven personalization optimizes learning pathways, increases engagement, and reduces cognitive overload by structuring tasks according to learner needs (9). Moreover, consistent with Gligorea's literature review, the experts in this study noted that human–machine interaction increases cognitive involvement and deepens problem-solving by exposing learners to continuous data-driven feedback loops (8). Together, these converging findings confirm that AI meaningfully enhances the capacity for differentiated learning—a goal long emphasized in educational theory but difficult to achieve at scale through traditional instruction.

Beyond personalization, the findings revealed that AI strengthens the analytical and decision-making capacities of teachers by providing predictive insights into learner needs. This echoes the conclusions of Hwang and colleagues, who identified teacher decision-support systems as a core dimension of AI in education, allowing educators to interpret complex patterns and anticipate learning difficulties earlier and with greater accuracy (2). Chen's multidimensional study of AI ecosystems also supports this interpretation, emphasizing that intelligent systems help integrate behavioral, cognitive, and performance data into actionable pedagogical strategies (1). These aligning studies demonstrate that AI does not diminish the instructional role of teachers but instead amplifies it—provided teachers are equipped with the knowledge, skills, and ethical grounding required to interpret AI-generated insights.

The findings also revealed a profound transformation in the conceptual meaning of learning, echoing theoretical debates in the literature. Participants described AI-mediated learning as a dynamic, interactive process in which learners alternate between internalizing computational models and externalizing their own cognition into the system. This aligns directly with Cukurova's theory of hybrid intelligence, which conceptualizes learning as a distributed process combining human reasoning, machine computation, and reciprocal adaptation between the two (11). From this perspective, AI does not replace human cognitive function but extends it by externalizing memory and pattern recognition while internalizing human inputs to continuously refine its models. The results of this study thus support the argument that AI must be understood not as a competitor to human cognition but as a complementary agent capable of enhancing higher-order thinking when used appropriately.

At the theoretical level, the findings confirmed that AI enhances several dimensions emphasized by classical learning theories. Bandura's emphasis on observational learning and vicarious reinforcement remains relevant, as intelligent platforms allow learners to view modeled behaviors, compare progress, and receive symbolic feedback (4, 5). Similarly, from a cognitive load perspective, AI's ability to structure learning tasks adaptively can reduce extraneous load and allow learners to focus more deeply on essential cognitive processes (19). These alignments suggest that AI does not invalidate earlier theories but instead reshapes their operationalization within technology-rich environments. Gibson's analysis of the integration of learning theories with AI further supports this interpretation by demonstrating how digital systems can operationalize behaviors, cognitions, and constructions of meaning in novel ways (22). The present study's results thus deepen the theoretical understanding of how AI-mediated learning retains foundational psychological principles while simultaneously transcending the limits of traditional one-directional teaching models.

Despite these opportunities, the findings strongly support the widespread concern that AI poses complex ethical, pedagogical, and social risks if adopted without adequate governance. Experts in this study highlighted data privacy risks, algorithmic bias, learner identity distortion, and dependence on foreign technologies. These themes parallel global critiques. For instance, Wang demonstrated how biased datasets can lead to discriminatory educational decisions and reinforce structural inequalities, warning that educational leaders who rely uncritically on AI risk making flawed judgments (16). Similarly,

Mindigulova and colleagues emphasized that AI systems often encode hidden biases, raise questions about authorship and authenticity, and pose ethical threats when transparency is lacking (18). These risks are reflected in this study's findings, particularly regarding the cultural incompatibility of foreign systems and the danger of algorithmic decision-making overriding teacher judgment.

Validation of these concerns also appears in Selwyn's critique that an overreliance on statistical modeling oversimplifies human learning and may reduce educational quality by privileging efficiency over meaning-making (12). Mazurek extends this argument philosophically, showing that AI, despite advances in deep learning, lacks intentionality, consciousness, and value grounding, and therefore cannot replace the human mind's capacity for moral reasoning or contextual interpretation (13). These works echo the concerns expressed by experts in this study who emphasized that AI cannot replicate the affective, motivational, and identity-building components of learning that emerge through human relationships rather than through computational logic.

Another striking alignment emerges between the current findings and those of Vistorte regarding the integration of emotion AI. While some participants acknowledged that AI may support emotional awareness, they also warned that the quantification of emotions risks misrepresenting learners' experiences—a concern documented in Vistorte's systematic review, which argues that emotion AI requires cautious implementation to avoid misclassification and ethical dilemmas (23). DiBerardino similarly warned of the conceptual pitfalls of emotion recognition technologies, particularly when they interpret behaviors stripped from cultural and contextual nuance (24). These studies collectively reinforce the conclusion that emotional dimensions—central to human learning—cannot be reduced to algorithmic outputs.

Participants also emphasized that AI risks diminishing teacher autonomy and reducing human interaction, a finding consistent with Davis' caution that over-automation may shift educational systems toward technocratic governance at the expense of lived human experience (25). Karamuk's concept of the "automation trap" further illustrates this tension, showing how systems designed to support learning can inadvertently deskill educators, increase dependency, and obscure structural problems that cannot be solved algorithmically (26). The results of this study strongly align with these critiques, demonstrating that without strong institutional, pedagogical, and ethical safeguards, AI may undermine the very foundations of meaningful and humane education.

The findings on infrastructure, teacher readiness, and contextual challenges particularly resonate with global discussions. Numerous participants stressed that AI integration in Iran requires substantial investment in local datasets, cultural adaptation, and teacher training. This mirrors the concerns raised by Al-Zahrani regarding the risks of importing educational AI systems without critically examining their epistemological assumptions, cultural fit, or ethical implications (27). Likewise, Zawacki-Richter's systematic review found that educators are often underrepresented in AI development processes, resulting in misaligned tools that do not reflect classroom realities (28). The current study confirms that without pedagogical, institutional, and policy coherence, AI integration remains superficial, fragmented, and potentially harmful.

Taken together, the findings emphasize that learning in the age of AI must be understood as a synthesis of technological capability and humanistic purpose. AI offers unprecedented opportunities to enhance personalization, efficiency, and insight, yet risks eroding human autonomy, meaning, and cultural integrity if allowed to dominate educational decision-making. Aligning with global literature, the results suggest that the key to successful AI integration lies in conceptual clarity, ethical governance, teacher empowerment, and contextual localization. The results of this study thus contribute to the broader discourse by situating global debates within the specific needs, vulnerabilities, and possibilities of the local educational context.

This study, while comprehensive in scope, is limited by the interpretive nature of qualitative analysis and the reliance on expert perspectives, which may not fully represent the experiences of students, teachers, or policymakers across all educational levels. The sample size, although sufficient for thematic saturation, restricts generalizability. Additionally, because the study

synthesizes global literature within a specific national context, certain international findings may not translate directly into local practice without further empirical examination. The rapid evolution of AI technologies also presents a limitation, as new developments may quickly outpace the conceptual frameworks described here.

Future studies should incorporate empirical classroom-based investigations to observe how AI tools influence real-time learning processes, teacher practices, and student outcomes. Longitudinal research is needed to assess how AI impacts learner identity, motivation, and socio-emotional development over time. Comparative international research could also illuminate how cultural, infrastructural, and policy differences shape AI adoption. Finally, the development and validation of indigenous AI learning models should be explored to ensure that future technologies align with local linguistic, cultural, and ethical needs.

Educational institutions should prioritize the development of national ethical guidelines, teacher training programs, and local datasets to ensure responsible AI integration. Policymakers should adopt a balanced approach that safeguards human judgment while leveraging technological capabilities. Schools and universities must foster interdisciplinary collaboration between educators, technologists, and ethicists to design AI systems that enhance, rather than replace, human learning. Finally, practitioners should adopt AI tools selectively and critically, ensuring that they strengthen educational equity, learner autonomy, and meaningful human interaction.

Acknowledgments

We would like to express our appreciation and gratitude to all those who helped us carrying out this study.

Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

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