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Presenting an Artificial Intelligence Curriculum Model in Primary Education of the Iran

ABSTRACT

This research was conducted with the aim of presenting an artificial intelligence curriculum model in primary education within the Iran. The current study was applied in terms of its objective and utilized a mixed qualitative approach (classical grounded theory and the Delphi method). The study population comprised curriculum specialists in virtual education and Information and Communication Technology (ICT) nationwide during the 2024–2025 academic year. Purposive sampling was employed until theoretical saturation was achieved; consequently, to reach data sufficiency, interviews were conducted with 25 individuals. Interviews were utilized as the primary method for data collection. Data analysis was performed based on open coding, axial coding, and selective coding systems. To ensure the validity and reliability of the extracted concepts, the derived concepts were shared with the interviewees (member checking), and procedures to establish the dependability of the extracted data in alignment with the research objectives were applied. Overall, the results indicated that the components of the artificial intelligence curriculum model in primary education of the Iran consisted of ten dimensions: objectives (6 axial codes), content (4 axial codes), learning activities (4 axial codes), tools (6 axial codes), resources (6 axial codes), time scheduling (5 axial codes), learning environments (4 axial codes), evaluation (5 axial codes), grouping (4 axial codes), and rationale (5 axial codes). Experts' opinions indicated that the proposed artificial intelligence curriculum model is founded on: skill-based and technology-driven objectives, forward-looking content and digital literacy, practical and innovative activities and tools, rich human and knowledge resources, a technology-driven and blended learning environment, and a multipurpose, forward-looking evaluation system. Components with lower Item-Level Content Validity Index (I-CVI) and Content Validity Ratio (CVR) scores (e.g., affective and attitudinal aspects, innovative instructional design, financial resources, and interests and aptitudes) require modification, revision, or reinforcement to ensure the curriculum is comprehensive and aligned with the future-oriented objectives of artificial intelligence.

Keywords: Artificial intelligence curriculum model, primary education.

Introduction

The advent of the Fourth Industrial Revolution has precipitated an unprecedented and rapid integration of emerging computational technologies into the fundamental fabric of daily life, with Artificial Intelligence (AI) standing unambiguously at the vanguard of this transformative era. Within the expansive realm of global education, AI is no longer conceptualized merely as a supplementary technological tool or an isolated subject of niche interest; rather, it represents a profound epistemological paradigm shift that necessitates a comprehensive reevaluation of traditional pedagogical frameworks,

instructional methodologies, and overarching institutional goals. The integration of such disruptive technologies into educational settings has fundamentally altered the structural and functional dynamics of knowledge dissemination, thereby demanding a systemic curriculum revolution, particularly within higher education, to adequately prepare a modern workforce capable of navigating an increasingly automated and digitally complex global economy (1). This technological disruption extends deeply into the core of university curricula, where the strategic deployment of AI is not only reshaping traditional academic disciplines but also fostering entirely new dimensions of interactive and hyper-personalized learning environments (2). However, as educational institutions inherently rush to embed these highly advanced technologies to remain competitive and relevant, leading scholars increasingly emphasize the critical and non-negotiable need for generating new curricula from a distinctly human-centered perspective. This approach ensures that sophisticated technology serves as a mechanism to augment human cognitive capacities, ethical reasoning, and social-emotional development, rather than merely supplanting human agency or automating pedagogical neglect (3). Consequently, the foundational step in this ongoing educational evolution involves utilizing artificial intelligence alongside novel educational technologies strategically within foundational school curricula to construct learning ecosystems that are adaptive, resilient, and highly responsive to individual learner trajectories (4).

The transition from theoretical technological adoption to practical, classroom-level pedagogical implementation fundamentally requires the meticulous design and structured compilation of AI-based curricula that encompass a wide array of diverse educational dimensions (5). Such ambitious academic endeavors must deliberately transcend isolated coding bootcamps or rudimentary robotics classes, moving purposefully toward a comprehensively holistic curriculum for artificial intelligence that seamlessly integrates cognitive science, ethical philosophy, and broad societal considerations (6). A truly holistic educational framework inherently recognizes that AI instruction should never be rigidly confined to a singular, siloed technical discipline. Instead, it must be viewed and taught through a robustly transdisciplinary lens. By acknowledging the vital confluence of strict curricular objectives and broader, evolving community needs, transdisciplinary AI education fosters a significantly more grounded, contextually relevant, and socially responsible instructional approach. This paradigm empowers students not just to understand algorithms, but to actively apply AI solutions to complex, real-world societal challenges, bridging the gap between theoretical computer science and practical civic engagement (7). Furthermore, the pervasive utilization of artificial intelligence robustly extends beyond the mere substantive content being taught to the students; it is increasingly becoming instrumental in the structural, administrative evaluation of the educational programs themselves. Advanced AI algorithms and machine learning models are now being actively leveraged to streamline and optimize outcome-based curriculum evaluation and development. This continuous feedback loop provides educators and curriculum theorists with highly granular, data-driven insights necessary to iteratively refine specific learning objectives, tailor instructional activities, and recalibrate assessment protocols in real-time to maximize educational efficacy (8).

The widespread instructional utility and transformative potential of AI are perhaps most clearly evidenced by its highly varied and deeply customized integration across highly disparate academic disciplines, each presenting unique curricular opportunities and complex pedagogical challenges. In the rigorously structural and applied sciences, such as advanced engineering, the overarching curricular design must continuously and rapidly adapt to relentless industry advancements, necessitating a remarkably careful balancing act to fully harness AI's analytical opportunities while simultaneously mitigating profound challenges related to algorithmic bias, technical obsolescence, and the ethical deployment of autonomous systems (9). Conversely, within the health sciences, there is a rapidly emergent, specialized focus on integrating AI to develop highly targeted professional training programs. These programs are meticulously designed to promote deep digital and algorithmic literacy among future healthcare practitioners, ensuring they can safely interface with AI-driven diagnostic and patient-

management tools (10). The humanities and the creative arts are equally experiencing an unprecedented technological renaissance due to these advancements. For instance, aesthetic education curricula within higher education are increasingly being driven by AI, utilizing sophisticated generative models to intentionally foster entirely new forms of multidimensional creative expression, artistic critique, and theoretical exploration (11). Moreover, language acquisition and linguistic curricula are undergoing radical structural transformations. Forward-thinking educational technologists are actively leveraging AI to comprehensively revolutionize language proficiency frameworks, an evolution clearly visible in modern, highly interactive curriculum designs specifically tailored for French language instruction and mastery (12). Similarly, the bold integration of advanced generative AI tools into second language curricula within Chinese higher education has prompted extensive empirical exploration of faculty experiences, highlighting the urgent need for robust instructional adaptations and continuous professional development (13). The remarkable precision, cultural nuance, and contextual awareness of contemporary AI also strictly dictate a pressing need to continuously align professional translation curricula with these rapid technological advancements. This complex alignment process essentially requires a deep, ongoing synthesis of technical insights from leading artificial intelligence researchers combined with the practical, pedagogical wisdom of experienced language educators (14). Beyond the confines of traditional academic subjects, the versatile application of artificial intelligence has even permeated physical education and extracurricular spheres, where highly sophisticated, data-driven sports applications are utilized systematically to optimize student health tracking, refine physical performance metrics, and promote long-term overall physical well-being (15).

While higher education institutions and specialized disciplinary domains undeniably provide robust, resource-rich environments for initial AI implementation and experimentation, establishing a deeply rooted, foundational technological literacy fundamentally requires a massive, concerted, and sustained focus on the broader K-12 educational spectrum. To ensure that future generations are not relegated to being merely passive, uncritical consumers of proprietary technology, but rather become active, ethically grounded creators and informed digital citizens, it is absolutely imperative to systematically develop a model curriculum that deliberately builds comprehensive competencies in artificial intelligence progressively across all K-12 grade levels (16). Specifically within the context of secondary education, computer science teachers and curriculum administrators have rigorously evaluated and vehemently emphasized the critical, non-negotiable importance of embedding expansive, deeply analytical AI modules directly within the standard high school computer science curriculum to ensure baseline college and career readiness (17). However, achieving successful and meaningful integration at this crucial academic level cannot be dictated entirely from a detached, top-down administrative perspective. It fundamentally necessitates the active, collaborative co-designing of AI education curricula with cross-disciplinary cohorts of high school teachers. This participatory design process inherently ensures that the resulting instructional materials are pedagogically sound, practically executable within standard classroom constraints, and profoundly resonant with highly diverse student populations (18). Furthermore, comprehensive empirical effectiveness studies conducted in diverse academic settings have consistently and unequivocally demonstrated that well-structured, teacher-led AI literacy curricula implemented directly in K-12 classrooms significantly and measurably enhance students' baseline computational thinking, their nuanced algorithmic understanding, and their overall technological self-efficacy (19).

Despite the significant attention dedicated to secondary and post-secondary educational tiers, the intricate cognitive scaffolding strictly required for advanced AI comprehension and ethical reasoning in later years must inevitably, and effectively, begin during the highly formative stages of human cognitive development, specifically within primary and elementary education. The long-term societal prospects for integrating artificial intelligence into the standard elementary school curriculum are extraordinarily vast, yet they fundamentally require highly specialized, painstakingly developed pedagogical approaches meticulously tailored to the specific developmental psychology, cognitive load capacities, and socio-emotional

needs of young, early-stage learners (20). At the primary educational level, an effective AI curriculum must masterfully translate highly complex computational concepts—such as machine learning mechanics, neural network topographies, and the sociological implications of algorithmic bias—into highly intuitive, developmentally appropriate, and engaging learning activities. This process necessitates a distinct pedagogical transition from abstract, syntax-heavy theoretical instruction to highly concrete, experiential, project-based, and play-oriented learning environments. Young primary students must be systematically exposed to foundational digital literacy principles, fundamental ethical considerations regarding autonomous technology, and basic algorithmic problem-solving skills through active, hands-on interactions with tangible educational robotics, adaptive smart tutoring systems, and intuitively designed digital interfaces. The ultimate educational objective at the primary level is emphatically not to prematurely produce highly proficient software engineers or data scientists; rather, it is to deliberately cultivate an early, intuitive fluency in the fundamental language of future digital technologies. This cultivated environment ensures that young learners can begin to critically evaluate digital information, understand the basic, underlying mechanisms of the AI-driven tools that surround them, and intentionally develop a highly resilient, adaptable, and forward-looking intellectual mindset. This crucial developmental stage is absolutely vital for instilling a robust, internalized ethical framework regarding modern digital citizenship, data privacy, and human-computer interaction, which will subsequently guide and inform their interactions with complex intelligent systems throughout the entirety of their academic journeys and eventual professional careers.

To successfully actualize these pressing global educational imperatives within a highly specific, localized national context, it is vitally important to structurally and philosophically align any innovative curriculum models with the established macro-educational policies and socio-cultural frameworks of the respective region. Within the specific context of the Iran, the national educational system is strictly guided by foundational, overarching strategic frameworks explicitly designed to adapt to rapid, contemporary scientific advancements while simultaneously maintaining deep cultural, philosophical, and institutional integrity. Investigating the potential role of artificial intelligence and the absolute necessity for cultivating a highly flexible, responsive curriculum within the strict parameters of the national Fundamental Transformation Document of Education reveals a highly pressing, undeniable demand for profound structural modernization and the aggressive integration of forward-looking, technology-centric competencies (21). The contemporary Iranian educational landscape is currently situated at a highly critical juncture, actively striving to permanently bridge the existing digital divide, elevate the technological infrastructure of its schools, and adequately prepare its massive younger demographic for active, competitive participation in a heavily technology-driven, globalized economy. However, despite the widely recognized, critical importance of broad AI literacy and the explicit, modernization-focused goals distinctly outlined in various national educational transformation documents, there remains a highly noticeable, distinct absence of a thoroughly localized, empirically validated, and structurally comprehensive AI curriculum model specifically engineered and tailored for the unique dynamics of Iranian primary schools. Existing, traditional curricular frameworks within the country frequently lack the deep multidisciplinary integration, the dynamic, formative assessment methodologies, and the requisite localized technological infrastructural planning necessary to actually and effectively implement highly conceptual AI education at the crucial foundational level. Addressing this significant academic and structural gap requires a highly rigorous, deeply systematic scientific exploration of all essential curricular components, including the precise definition of educational objectives, the curation of appropriate instructional content, the selection of modern teaching methodologies, the realistic allocation of required technological resources, and the establishment of scientifically sound evaluation metrics. This meticulous approach guarantees that the proposed educational framework is not only scientifically robust and aligned with global standards but also highly practical, culturally resonant, and seamlessly

applicable within the daily realities of Iranian elementary classrooms. Therefore, the present study aimed to logically conceptualize and present a comprehensive artificial intelligence curriculum model for primary education within the Iran.

Methods and Materials

The current research was applied in terms of its purpose and utilized a mixed qualitative method (classical grounded theory and Delphi). The research setting included curriculum specialists in virtual education and Information and Communication Technology (ICT) nationwide during the 2024–2025 academic year. Purposive sampling was conducted until theoretical saturation was reached; in this manner, to achieve data sufficiency, interviews continued up to 25 individuals. In this sampling method, the researcher continued interviewing as long as new and unique information was obtained from the interviewees. Subsequently, when the repetition of concepts and responses reached a point where there was no longer a need to add a new interviewee, the researcher concluded that sufficient data had been collected for analysis and investigation. The research instrument was an in-depth and unstructured interview, and the questionnaire questions were developed gradually based on the interviewees' responses. An in-depth interview is a type of individual and unstructured interview that attempts to accurately understand the opinions, beliefs, feelings, and needs of the respondent. Data collection was carried out by referring to valid domestic scientific databases (Irandoc, Civilica, Magiran, Noormags, SID, etc.) and valid international databases (Elsevier, Emerald, ProQuest, ScienceDirect, Google Scholar, ISC, Sage Publications, etc.). Data analysis was performed based on open coding, axial coding, and selective coding systems. To ensure the validity and reliability of the extracted concepts, the procedure was such that the obtained concepts were provided to the interviewees (member checking), and procedures to establish the dependability of the extracted data aligned with the research objectives were utilized. To ensure credibility, the transferability method was employed.

Findings and Results

To respond to the validity level of the artificial intelligence curriculum model in primary education, the Delphi method was used, which proceeded as follows: In the first step of executing the Delphi method, the main objective of the research for utilizing this method was specified accurately and transparently. In this study, the purpose of using Delphi was to validate the findings obtained from the qualitative analysis and to ensure the appropriateness, comprehensiveness, and necessity of the components, categories, or items extracted from the data. Accordingly, the results of the qualitative analysis phase, including the initial codes, sub-themes, and main themes, were carefully reviewed and structured to provide a set of evaluable components for the experts. After completing the previous steps and reviewing the items based on the CVR and CVI values, the final version of the primary education artificial intelligence curriculum instrument was formulated. All approved items were categorized in the final format, and the structure of each curriculum dimension, including objectives, content, activities, tools, resources, time scheduling, learning environments, evaluation, grouping, and rationale, was fully specified. This action ensured that the research instrument is completely valid and integrated from both scientific and practical perspectives.

Table 1: Final version of the primary education artificial intelligence curriculum instrument

Curriculum Dimension	Axial Code	CVR	I-CVI	Final Decision
Objectives	Philosophical and value-based	0.87	0.93	Approved
	Cognitive	0.73	0.87	Approved
	Skill-based	0.87	0.93	Approved
	Affective and attitudinal	0.60	0.80	Approved
	Educational and social	0.73	0.87	Approved
	Educational technology	0.87	0.93	Approved
Content	Forward-looking content	0.87	0.93	Approved

	Digital literacy and AI content	0.87	0.93	Approved
	Soft skills and human competencies	0.73	0.87	Approved
Activities	Innovative instructional design	0.60	0.80	Approved
	Developing future skills	0.87	0.93	Approved
	Future transformations	0.73	0.87	Approved
	Future technologies	0.87	0.93	Approved
	Future collaborations	0.73	0.87	Approved
Tools	Future analysis tools	0.87	0.93	Approved
	Educational creativity and innovation tools	0.87	0.93	Approved
	Environmental analysis and smart classroom management tools	0.87	0.93	Approved
	Modern technology tools in education	0.87	0.93	Approved
	Teacher-empowering tools in future-oriented classrooms	0.73	0.87	Approved
Resources	Networking and lifelong learning tools for teachers	0.73	0.87	Approved
	Human resources	0.87	0.93	Approved
	Technological resources	0.73	0.87	Approved
	Communication and networking resources	0.73	0.87	Approved
	Support, financial, and project-based resources	0.60	0.80	Approved
Time Scheduling	Physical resources	0.73	0.87	Approved
	Knowledge resources	0.87	0.93	Approved
	Dynamic and flexible time scheduling	0.73	0.87	Approved
	Gradual and phased time scheduling	0.73	0.87	Approved
	Lifelong time scheduling	0.87	0.93	Approved
Learning Environment	Collaborative and networking time scheduling	0.73	0.87	Approved
	Time scheduling aligned with transformations	0.87	0.93	Approved
	Blended learning environments	0.87	0.93	Approved
	Technology-driven and smart environments	0.87	0.93	Approved
	Social and networking learning environments	0.73	0.87	Approved
Evaluation	Experience-based and project-based learning environments	0.73	0.87	Approved
	Adaptive and dynamic evaluation	0.73	0.87	Approved
	Process-oriented evaluation	0.73	0.87	Approved
	Multipurpose and multi-source evaluation	0.87	0.93	Approved
	Authentic performance evaluation	0.73	0.87	Approved
Grouping	Forward-looking evaluation	0.87	0.93	Approved
	Based on interests and aptitudes	0.60	0.80	Approved
	Interdisciplinary grouping	0.73	0.87	Approved
Rationale	Collaborative grouping	0.73	0.87	Approved
	Based on skill levels and experience	0.73	0.87	Approved
	Philosophical rationale	0.87	0.93	Approved
	Value-based rationale	0.73	0.87	Approved
	Scientific rationale	0.87	0.93	Approved
	Structural rationale	0.73	0.87	Approved
	Applied rationale	0.87	0.93	Approved

Table 1 details the final, validated version of the primary education artificial intelligence curriculum instrument, which is structured around ten fundamental dimensions: Objectives, Content, Activities, Tools, Resources, Time Scheduling, Learning Environment, Evaluation, Grouping, and Rationale. The instrument's sub-components, represented as axial codes within these dimensions, were subjected to rigorous expert validation, yielding Content Validity Ratio (CVR) scores that ranged from 0.60 to 0.87 and Item-Content Validity Index (I-CVI) scores spanning from 0.80 to 0.93. Specifically, highly agreed-upon elements such as philosophical and skill-based objectives, forward-looking content, future analysis tools, human resources, and lifelong time scheduling achieved the maximum validity metrics observed in the study (CVR = 0.87, I-CVI = 0.93), while a few specific items like affective and attitudinal objectives, innovative instructional design, support and financial resources, and interest-based grouping recorded the minimum thresholds (CVR = 0.60, I-CVI = 0.80). Ultimately, because every single axial code across all ten dimensions secured strong expert consensus and met the necessary statistical benchmarks, all proposed components were officially approved for inclusion in the final curriculum framework.

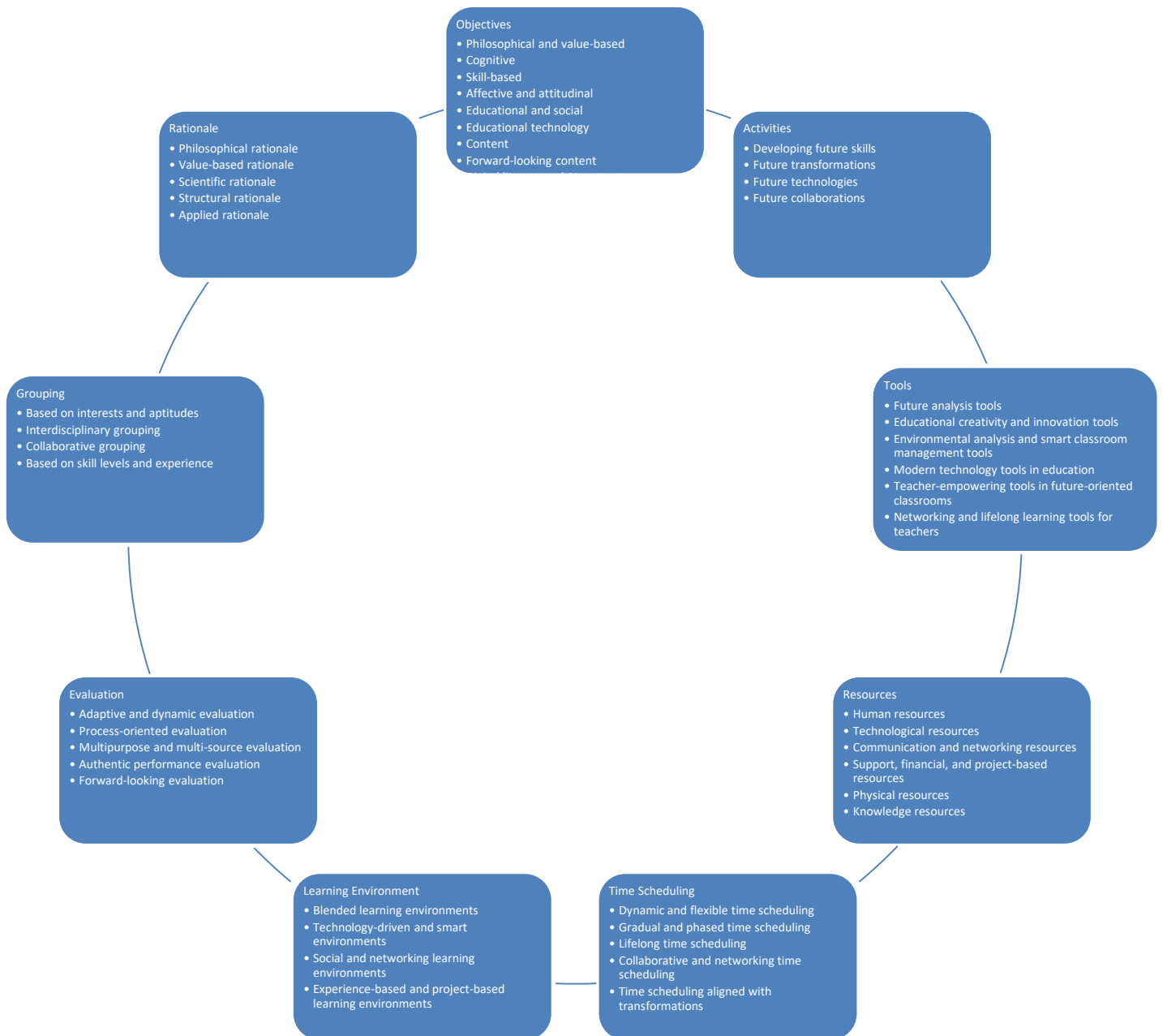


Figure 1: Artificial intelligence curriculum model in primary education

Discussion and Conclusion

The findings of this study culminate in the development and validation of a comprehensive ten-dimensional framework for an artificial intelligence (AI) curriculum model, specifically tailored for the primary education system within the Iran. This model, meticulously constructed through a mixed-methods approach that integrated qualitative grounded theory with the expert consensus-building of the Delphi technique, delineates the critical components essential for a holistic AI education: objectives, content, activities, tools, resources, time scheduling, learning environments, evaluation, grouping, and rationale. The robust validation process, employing both Content Validity Ratio (CVR) and Item-Content Validity Index (I-CVI) metrics, revealed a strong and consistent consensus among the panel of experts, affirming the appropriateness, comprehensiveness, and necessity of each dimension and its sub-components. This section discusses the significance of these findings by interpreting them in the context of existing scholarly literature.

The objectives dimension of the proposed model is intentionally multifaceted, encompassing philosophical and value-based, cognitive, skill-based, affective and attitudinal, educational and social, and educational technology goals. This broad scope moves beyond a purely technical or instrumentalist view of AI education. It underscores a critical shift towards a holistic curriculum that not only imparts technical proficiency but also cultivates critical thinking, ethical awareness, and a deep sense of social responsibility. This finding is in strong alignment with contemporary calls for AI curricula that are humanistic and value-driven, ensuring technology serves to augment, not supplant, human capacities (6). The pronounced emphasis on skill-based and technology-driven objectives directly addresses the imperative to equip young learners with the future-ready competencies required to navigate an increasingly automated world (16). Furthermore, the deliberate inclusion of affective and attitudinal elements—fostering a positive yet critical disposition towards AI and its societal implications—resonates deeply with the need for a human-centered perspective in curriculum generation, which prioritizes ethical reasoning and socio-emotional development alongside technological literacy (3).

The content dimension was found to be composed of four core pillars: forward-looking content, digital literacy and AI content, soft skills and human competencies, and innovative instructional design. This structure reflects a sophisticated understanding of the evolving landscape of knowledge and skills necessary in an AI-pervasive society. The focus on forward-looking content and foundational digital literacy is paramount for preparing students not just for current technologies but for the unpredictable technological advancements of the future (4). Critically, the model's insistence on integrating soft skills and human competencies, such as creativity, collaboration, and emotional intelligence, acknowledges a fundamental truth: as AI automates routine tasks, uniquely human abilities become more valuable. This perspective is strongly supported by advocates for a transdisciplinary approach to AI education, which posits that technical skills must be developed in concert with a rich understanding of human and societal contexts (7). The affirmation of innovative instructional design principles as a key content component further supports the need for dynamic, adaptive, and engaging methods of content delivery that can respond to the individual needs of learners.

Congruent with its forward-looking objectives and content, the model's activities dimension is designed to be experiential and future-oriented, emphasizing the development of future skills, an understanding of future transformations, familiarity with future technologies, and engagement in future collaborations. This aligns perfectly with the broader scholarly understanding that effective AI education must be active, not passive, preparing students to become creators and innovators in dynamic future environments. Such an approach fosters the collaborative problem-solving skills essential for tackling complex, real-world challenges (18). This focus on future transformations and skills is not merely aspirational; it is a direct response to the systemic

curriculum revolution that AI is driving across all levels of education, demanding a fundamental rethinking of what and how we teach (1).

The dimensions of tools and resources highlight the practical and logistical infrastructure required for successful implementation. The tools dimension is comprehensive, covering future analysis tools, tools for creativity and innovation, smart classroom management systems, modern educational technologies, and, crucially, teacher-empowering and networking tools. This conceptualization treats AI not just as a subject of study but as an integral tool to augment and enhance the entire teaching and learning ecosystem. This view supports the broader vision of leveraging technology to revolutionize educational design and delivery (12). The specific inclusion of tools for teacher empowerment is particularly salient, as the success of any curriculum innovation hinges on the confidence and competence of educators; providing teachers with the right tools and training is a critical factor for effective AI integration (19). Similarly, the resources dimension—encompassing human, technological, communication, financial, and knowledge resources—cements the understanding that a holistic support structure is non-negotiable. This finding corroborates the view that effective implementation requires a synergistic combination of technological infrastructure, highly skilled human capital, sustained financial investment, and accessible knowledge bases (16).

The final four dimensions—time scheduling, learning environment, evaluation, and grouping—address the pedagogical and structural delivery of the curriculum. The time scheduling dimension advocates for dynamic, flexible, gradual, lifelong, and collaborative approaches, reflecting the rapid pace of technological change and the corresponding necessity for continuous, lifelong learning paradigms (3). The learning environment dimension calls for a blend of technology-driven smart environments, social and networking spaces, and experience-based, project-based learning. This aligns with extensive research on creating more engaging, interactive, and effective learning experiences through the thoughtful integration of AI and digital tools into pedagogy (2). The evaluation dimension represents a significant departure from traditional assessment, proposing adaptive, process-oriented, multi-source, authentic, and forward-looking methods. This is vital for accurately measuring the complex, higher-order skills fostered by AI education and mirrors the sophisticated use of AI itself in modern, outcome-based curriculum evaluation (8). Finally, the grouping dimension promotes personalized and collaborative structures based on student interests, aptitudes, and skill levels, as well as interdisciplinary and collaborative arrangements. This student-centered approach is well-suited to the inherently interdisciplinary and problem-based nature of artificial intelligence (7).

In conclusion, the ten dimensions are not isolated pillars but form an interconnected, synergistic framework. The foundational rationale, comprising philosophical, value-based, scientific, and applied principles, provides the ideological anchor for the entire model, ensuring that the integration of AI into primary education is purposeful, ethically sound, and aligned with Iran's broader societal and educational goals. The high degree of consensus among experts, as evidenced by the CVR and I-CVI scores, strongly suggests that this model is perceived as a valid, comprehensive, and essential roadmap for preparing young learners for an AI-driven future. The model's rigorous development process provides a robust and credible foundation for its subsequent implementation and refinement within the Iranian educational context and offers a valuable reference for other nations undertaking similar curricular reforms.

This study, while comprehensive in its scope and rigorous in its methodology, is subject to several inherent limitations. Firstly, the research was conducted entirely within the socio-cultural and educational context of the Iran. Consequently, the specific components of the model, particularly those related to philosophical and value-based objectives, may not be directly generalizable or transferable to educational systems in nations with vastly different cultural norms, economic conditions, or technological infrastructures without significant adaptation. Secondly, the Delphi method, while highly effective for achieving expert consensus, is fundamentally reliant on the subjective judgments, experiences, and potential biases of the participating experts. Although care was taken to select a diverse panel, the possibility that a shared perspective or an unacknowledged bias

influenced the final framework cannot be entirely dismissed. Thirdly, the study's explicit focus was on primary education. While the foundational principles of the model are broadly applicable, the specific content, pedagogical strategies, and assessment methods would require substantial modification and development for effective use at the secondary and higher education levels. Finally, this study validated the curriculum model at a conceptual level through expert opinion. The practical feasibility, effectiveness in real-world classroom settings, and long-term impact on student learning and development were not assessed. This represents a crucial next step that lies beyond the scope of the present research.

Building upon the foundation established by this study, several avenues for future research are recommended. The most critical next step is the empirical implementation and rigorous evaluation of the proposed AI curriculum model in diverse primary school settings across Iran. This would involve developing pilot programs to assess the model's real-world effectiveness, identify implementation challenges, and measure student learning outcomes. Comparative studies could be conducted to contrast the effectiveness of this holistic model against more traditional or less integrated approaches to teaching AI and technology. Furthermore, longitudinal studies are essential to track the long-term impact of this early AI education on students' cognitive development, ethical reasoning, career choices, and overall technological fluency as they progress through their educational journeys. Future research could also focus on the development of novel AI-powered assessment tools specifically designed to measure the complex, multifaceted competencies fostered by this curriculum, moving beyond conventional testing methods. Expanding the research to explore the transdisciplinary integration of AI concepts into other primary school subjects, such as arts, humanities, and social studies, would also be a valuable contribution. Finally, a critical area for investigation is the design and evaluation of comprehensive teacher training programs, as the successful implementation of this ambitious curriculum is heavily dependent on equipping educators with the necessary pedagogical skills, technical knowledge, and confidence to deliver it effectively.

For the findings of this research to translate into meaningful educational change, several practical steps should be taken by stakeholders. Educational policymakers and national curriculum developers should consider the formal adoption and systematic adaptation of the proposed ten-dimensional AI curriculum model as a guiding framework for primary education reform. To support this, dedicated teacher training and continuous professional development programs must be established to equip educators with the skills and pedagogical knowledge required to implement the curriculum effectively. This training should be hands-on, ongoing, and collaborative. Concurrently, resource allocation at both the national and local levels must be prioritized to provide schools with the necessary technological infrastructure, software, digital learning materials, and human support. Implementation should proceed in a phased and strategic manner, beginning with well-supported pilot programs in a variety of school settings to gather feedback and refine the approach before a nationwide rollout. A culture of collaboration should be fostered among educational institutions, technology experts, industry partners, and the wider community to ensure that the curriculum remains relevant, dynamic, and responsive to the evolving needs of society and the rapid advancements in the field of artificial intelligence.

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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.

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