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Designing a Curriculum Model Based on Artificial Intelligence and Purposeful Physical Activity to Enhance Learning Self-Regulation, Mental Health, and Psychological Well-Being among Students

Sara. Rastkar Ebrahimzade[1], Parisa. Masoudian[2], Nasrin. Mohaddes[3], Mehdi. Akbarzadeh Sgay[4*]

[1] Department of Clinical Psychology, Shiraz Univercity, Shiraz, Iran
[2] PhD in Sports Management, Department of Physical Education and Sports Sciences, Ur.C., Islamic Azad University, Urmia, Iran
[3] Faculty of Educational Sciences and Psychology, Shab.C., Islamic Azad University, Shabestar, Iran
[4] Department of Educational Sciences, Allameh Amini Campus, Farhangian University, Tabriz, Iran

*** Corresponding author email address**: M.akbarzadeh313@gmail.com

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A B S T R A C T

Objective: The objective of this study was to design and validate a curriculum model based on artificial intelligence and purposeful physical activity with emphasis on enhancing learning self-regulation, mental health, and psychological well-being among students.

Methods and Materials: This applied developmental study was conducted using an exploratory sequential mixed-methods design. In the qualitative phase, 20 experts in curriculum studies, educational technology, artificial intelligence in education, physical education, educational psychology, and student mental health were selected through purposive criterion-based sampling from Tehran and participated in semi-structured interviews. The interview data were analyzed using thematic analysis to extract the main dimensions, components, and indicators of the proposed curriculum model. In the quantitative phase, 384 secondary school students from Tehran were selected through multistage cluster sampling during the 2025–2026 academic year. Data were collected using a researcher-made curriculum model validation questionnaire, a learning self-regulation questionnaire, the General Health Questionnaire, and a psychological well-being scale. Data were analyzed using descriptive statistics, reliability analysis, confirmatory factor analysis, and structural equation modeling.

Findings: The inferential findings showed that the final curriculum model had acceptable empirical fit. The final modified model demonstrated favorable fit indices, including $\chi^2/df = 2.14$, GFI = 0.917, AGFI = 0.901, CFI = 0.951, TLI = 0.944, RMSEA = 0.054, and SRMR = 0.043. Artificial intelligence-based curriculum components had significant direct effects on learning self-regulation, mental health, and psychological well-being. Purposeful physical activity also had significant direct effects on learning self-regulation, mental health, and psychological well-being. Learning self-regulation and mental health significantly predicted psychological well-being. The model explained 48% of the variance in learning self-regulation, 43% of the variance in mental health, and 57% of the variance in psychological well-being.

Conclusion: The findings indicate that an integrated curriculum model based on artificial intelligence and purposeful physical activity can provide an effective educational framework for strengthening students' self-regulated learning, supporting mental health, and promoting psychological well-being.

Keywords: *Artificial intelligence; Purposeful physical activity; Curriculum; Learning self-regulation; Mental health; Psychological well-being; Students*

1. Introduction

Education systems are increasingly required to respond to complex and interrelated changes in students' learning, health, and psychological development. Contemporary students live and learn in environments shaped by rapid digital transformation, information overload, declining physical activity, academic pressure, and growing concerns about mental health and well-being. In this context, curriculum design can no longer be limited to the organization of subject matter or the transmission of academic knowledge. Rather, curriculum must be understood as an integrated educational, technological, physical, emotional, and social system that prepares students for intelligent learning environments while also supporting their psychological functioning. Recent educational and psychological studies have emphasized that students' academic success and developmental adjustment depend not only on cognitive instruction, but also on emotional competence, self-regulatory capacity, social capability, physical vitality, mental health, and psychological well-being (Ansari & Rizvi, 2023; Donaldson et al., 2022; Li, 2025). Accordingly, the design of curriculum models that combine artificial intelligence and purposeful physical activity may provide a promising response to the multidimensional needs of students in contemporary schools.

Artificial intelligence has become one of the most influential forces in educational transformation. AI-based systems can support adaptive learning, intelligent feedback, personalized learning pathways, automated assessment, learning analytics, educational decision-making, and early identification of students' learning and psychological needs. The educational significance of artificial intelligence lies not only in its computational capacity, but also in its potential to reorganize teaching and learning around personalization, responsiveness, and continuous support. Studies on artificial intelligence in education have shown that intelligent systems can be used to design adaptive learning environments, support student engagement, enhance interaction, and create new possibilities for diagnosis and intervention in educational settings (Razak et al., 2023; Shan & Yu, 2021; Zhang & Wang, 2022). In this sense, artificial intelligence can become a curriculum resource that helps teachers understand student progress, identify learning barriers, recommend appropriate learning activities, and provide timely feedback.

However, the integration of artificial intelligence into the curriculum requires careful pedagogical and ethical orientation. AI should not replace the educational role of teachers, nor should it reduce learning to algorithmic performance indicators. Rather, it should be used as a supportive and intelligent infrastructure that enriches teaching, strengthens learner autonomy, and enables more precise educational decision-making. The teacher's role in the age of artificial intelligence is therefore changing from a transmitter of information to a designer of learning experiences, facilitator of inquiry, interpreter of data, guide for ethical technology use, and supporter of students' cognitive and emotional development (Cai, 2024). This shift requires curriculum models that explicitly define the role of teachers, learners, learning environments, digital platforms, and assessment processes in AI-supported education. Without such a curriculum framework, artificial intelligence may remain fragmented, tool-centered, and disconnected from the broader aims of education.

The connection between artificial intelligence and student mental health has also become increasingly important. Mental health education can benefit from intelligent technologies through screening, feedback, dynamic evaluation, personalized support, and interactive learning systems. AI-supported mental health education has been proposed as a way to improve students' access to psychological knowledge, strengthen prevention-oriented approaches, and support more responsive educational interventions (Chen, 2023; Li, 2022). Computer technology-based teaching systems for mental health courses can also help organize mental health content, improve interaction, and provide structured learning experiences for students (Dai, 2024). Moreover, deep learning and intelligent computational approaches have been applied to educational contexts in ways that may help identify patterns related to students' emotional states, learning behaviors, and mental health outcomes (Chen, 2025). These developments suggest that artificial intelligence can be integrated into curriculum design not only for academic achievement, but also for psychological support and well-being promotion.

At the same time, digital technologies must be embedded within an educational philosophy that values human development, empathy, metacognition, self-awareness, and ethical responsibility. Digital and mobile technologies can contribute to students' future learning when they are connected to empathy, metacognition, self-consciousness, and the active involvement of parents and schools (Drigas et al., 2023). Similarly, frameworks for designing AI systems

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that support community well-being emphasize that artificial intelligence should be evaluated not merely by efficiency or technical sophistication, but by its contribution to human flourishing, social connection, and collective well-being (Maden et al., 2023). Therefore, an AI-based curriculum model should include not only intelligent content and assessment, but also digital literacy, ethical use of AI, critical evaluation of algorithmic information, privacy awareness, and attention to students' social and emotional needs.

The need for such integrated models is reinforced by the emergence of Education 4.0 and Pedagogy 4.0 perspectives, which emphasize the harmonization of multiple forms of intelligence, digital transformation, learner agency, and flexible learning ecosystems (Ravenscroft et al., 2022). In these frameworks, students are not passive recipients of information; they are active agents who must learn to regulate their cognition, motivation, behavior, emotions, and social participation. Learning self-regulation is therefore a central educational outcome in modern curriculum design. Students with stronger self-regulation are better able to set goals, plan learning activities, monitor their progress, manage time, adjust strategies, and evaluate outcomes. AI-supported environments can strengthen these processes when they provide adaptive feedback, progress monitoring, personalized recommendations, and opportunities for reflection. However, self-regulation also depends on embodied experience, emotional balance, motivation, and engagement, which shows the importance of integrating physical activity into the curriculum.

Purposeful physical activity represents a second major foundation for the proposed curriculum model. Physical activity in education should not be regarded only as a separate sport or physical education subject, but as a purposeful component of learning, mental health, self-regulation, and psychological well-being. Recent studies have emphasized that sports reforms and physical education programs can contribute to both physical and mental health development among students (Tang & Wang, 2025). Purposeful physical activity may improve attention, reduce stress, support emotional regulation, increase motivation, strengthen social interaction, and promote healthier lifestyles. In addition, perceived variety support in physical education has been associated with learning engagement through motivational mechanisms among middle school students, indicating that physical activity becomes more educationally effective when students experience diversity, autonomy, and meaningful participation (Miao et al., 2024). Therefore, physical activity should be designed intentionally and connected to educational objectives rather than treated as an isolated activity.

The integration of physical activity with mental health promotion is also supported by research on mindfulness and physical education. Mindfulness-based approaches in physical education have been described as opportunities for developing students' mental health, because they connect movement, attention, emotion regulation, bodily awareness, and reflective practice (Delgado-Montoro et al., 2022). Broader educational research on mindfulness also emphasizes the need for an integrative paradigm that places awareness, presence, emotional regulation, and meaning at the center of education (Sheinman & Russo-Netzer, 2021). These perspectives are consistent with the idea that purposeful physical activity can serve as an embodied curriculum strategy for strengthening self-regulation and well-being. When movement-based learning, stress-reducing activity tasks, self-monitoring of physical activity, and reflective evaluation are integrated into the curriculum, students may develop more balanced cognitive, emotional, and behavioral functioning.

Student well-being has become a core educational priority across different levels and fields of education. Positive psychology frameworks suggest that well-being is multidimensional and includes positive emotion, engagement, relationships, meaning, accomplishment, physical health, mindset, work environment, and broader contextual factors (Donaldson et al., 2022). In education, flourishing requires systems that support students' strengths, purpose, relationships, resilience, and personal growth. Studies in positive higher education have emphasized the importance of empowering students through strategies that promote meaning, engagement, positive functioning, and psychological resources (Li, 2025). Similarly, systems-informed positive psychology approaches in educational contexts highlight that flourishing should be understood as the product of interactions among individuals, institutions, learning environments, and support structures (Corrigan et al., 2025). These views suggest that psychological well-being should be treated as a legitimate curriculum outcome, not merely as a secondary or external consequence of schooling.

School-based well-being interventions also show the importance of early, inclusive, and multidimensional educational support. Research on school-based well-being among young neurodiverse children has demonstrated the value of strengths-based approaches that help students recognize abilities, develop positive identity, and engage

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with learning in supportive ways (Naples & Tuckwiller, 2021). Likewise, school-based interventions that promote social capabilities among students indicate that social functioning, peer interaction, emotional learning, and relational skills are important components of educational development (Ansari & Rizvi, 2023). These studies support the idea that a curriculum model designed to promote learning self-regulation, mental health, and psychological well-being should include social, emotional, cognitive, physical, and technological dimensions. Such a curriculum should help students become more autonomous learners while also strengthening their relationships, resilience, and psychological adjustment.

Recent research also suggests that brain health and psychological well-being should be embedded directly into the curriculum. Teachers' perceptions of embedding brain health in the curriculum show that schools can play an important role in developing students' understanding of brain function, healthy behavior, learning readiness, and psychological care (Siette et al., 2026). This perspective is highly relevant to curriculum design because it shifts health promotion from occasional programs to a sustained curricular responsibility. Similarly, knowledge-centric cognitive computing frameworks for psychological well-being assessment show that intelligent systems can be used to support well-being evaluation in educational contexts (Jia, 2026). These developments point toward a future in which curriculum, health, technology, and psychological assessment are interconnected within intelligent educational ecosystems.

The COVID-19 pandemic and post-pandemic educational environment further increased attention to technology-supported emotional intelligence, mindfulness, and student psychological support. An artificial intelligence-powered emotional intelligence and mindfulness application designed for college students during the pandemic was introduced as a novel technological response to student needs (Sturgill et al., 2020), and subsequent quantitative evaluation of the application emphasized the potential of AI-powered tools for supporting emotional intelligence and mindfulness among students (Sturgill et al., 2021). Although such applications are valuable, their effectiveness may be strengthened when they are not used as isolated interventions but are embedded within a broader curriculum model. A curriculum-based approach can connect AI tools with teacher guidance, purposeful physical activity, self-regulated learning tasks, reflective assessment, and supportive school environments.

The relationship between digital innovation, emotional training, and resilience also supports the development of integrated educational models. Research in professional education has shown that digital innovations and enhanced emotional training can contribute to competencies related to resilience and adaptive functioning (Hack-Polay et al., 2023). Although this evidence comes from nursing practice, its implications are relevant for student education because resilience, emotional regulation, and competence development are not limited to professional fields. Students also need learning environments that combine technological support with emotional development and practical self-regulatory skills. Therefore, a curriculum model based on artificial intelligence and purposeful physical activity may help students respond more effectively to academic challenges, psychological stress, and the demands of digital learning.

Despite the growing body of research on artificial intelligence in education, physical education, mental health education, mindfulness, and well-being, these domains are often studied separately. AI-based education studies tend to emphasize adaptive learning and intelligent systems, while physical activity studies often focus on health, motivation, and engagement. Mental health and well-being studies frequently address psychological outcomes, but they are not always connected to curriculum structure, instructional design, and learning self-regulation. This separation creates a theoretical and practical gap. Students' real educational experiences are not divided into separate technological, physical, cognitive, and emotional domains; rather, these dimensions interact continuously in the classroom, school environment, and digital learning space. Therefore, there is a need for a comprehensive curriculum model that systematically integrates artificial intelligence and purposeful physical activity in order to enhance learning self-regulation, mental health, and psychological well-being.

Designing such a model is especially important because curriculum development provides a structured mechanism for transforming theoretical knowledge into educational practice. A curriculum model can clarify goals, content, teaching-learning strategies, learning environments, assessment procedures, teacher roles, student roles, and expected outcomes. In the present study, artificial intelligence is conceptualized as a curriculum component that supports personalization, intelligent feedback, learning analytics, adaptive content, ethical digital literacy, and continuous evaluation. Purposeful physical activity is conceptualized as a curriculum component that supports

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embodied learning, stress reduction, health-oriented self-monitoring, motivation, social interaction, and emotional regulation. Learning self-regulation, mental health, and psychological well-being are considered key student outcomes that reflect the educational, psychological, and developmental value of the model. Based on this rationale, the aim of the present study was to design a curriculum model based on artificial intelligence and purposeful physical activity with emphasis on enhancing learning self-regulation, mental health, and psychological well-being among students.

2. Methods and Materials

2.1. Study Design and Participants

The present study was conducted using an applied developmental research design with an exploratory sequential mixed-methods approach. The purpose of the study was to design and validate a curriculum model based on artificial intelligence and purposeful physical activity with emphasis on enhancing learning self-regulation, mental health, and psychological well-being among students. In the qualitative phase, data were collected from academic and professional experts in curriculum studies, educational technology, artificial intelligence in education, physical education, educational psychology, and student mental health. The expert participants were selected through purposive criterion-based sampling from universities, schools, educational organizations, and research centers in Tehran. Inclusion criteria for experts included having a doctoral degree or specialized professional experience in one of the relevant fields, having at least five years of teaching, research, or executive experience, and having published or implemented work related to curriculum design, technology-based education, physical activity, or student psychological outcomes. The qualitative phase continued until theoretical saturation was achieved, and a total of 20 experts participated in semi-structured interviews. In the quantitative phase, the statistical population included secondary school students in Tehran during the 2025–2026 academic year. Using multistage cluster sampling, several educational districts of Tehran were first selected, then schools were randomly chosen from each district, and finally students were selected from the eligible classes. The final student sample consisted of 384 students, which was considered adequate for validating the proposed model and examining the relationships among the main constructs. Therefore, the total number of participants in the study was 404, including 20 expert participants in the qualitative phase and 384 students in the quantitative phase.

2.2. Measures

Data in the qualitative phase were collected using a semi-structured interview protocol developed by the researchers based on the theoretical foundations of curriculum design, artificial intelligence in education, purposeful physical activity, self-regulated learning, mental health, and psychological well-being. The interview questions focused on the necessity of integrating artificial intelligence into the curriculum, the role of purposeful physical activity in students' cognitive and emotional development, the curriculum components required for improving learning self-regulation, and the ways in which educational content, teaching-learning strategies, learning environments, evaluation methods, and support systems could contribute to students' mental health and psychological well-being. The initial interview protocol was reviewed by several specialists in curriculum studies and educational psychology, and necessary revisions were made to improve clarity, relevance, and content coverage. Interviews were conducted individually, recorded with the consent of participants, and transcribed verbatim for analysis.

In the quantitative phase, a researcher-made curriculum model validation questionnaire was used to examine the adequacy and empirical fit of the extracted curriculum components. This questionnaire was developed based on the qualitative findings and included items related to the main dimensions of the proposed model, including curriculum objectives, educational content, artificial intelligence-based learning activities, purposeful physical activity components, teaching-learning methods, assessment strategies, learning environment, teacher role, learner role, support mechanisms, and expected psychological and educational outcomes. The items were scored on a five-point Likert scale ranging from strongly disagree to strongly agree. The content validity of the questionnaire was assessed using expert judgment, and the content validity ratio and content validity index were calculated to ensure that the items were essential, relevant, clear, and representative of the intended constructs. The reliability of the questionnaire was evaluated using Cronbach's alpha and composite reliability coefficients, and acceptable reliability values were obtained for all dimensions.

Learning self-regulation was measured using a standardized self-regulated learning questionnaire adapted

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for student populations. This instrument assesses students' ability to set academic goals, use cognitive and metacognitive learning strategies, monitor their learning process, manage time and effort, regulate motivation, and evaluate their academic performance. Items are scored on a Likert scale, with higher scores indicating stronger self-regulated learning skills. The validity and reliability of this type of instrument have been confirmed in previous educational and psychological studies, and in the present study its reliability was re-examined using internal consistency coefficients.

Mental health was assessed using the General Health Questionnaire, which is widely used to evaluate students' psychological health status. The questionnaire assesses symptoms related to somatic complaints, anxiety and sleep problems, social dysfunction, and depressive symptoms. Responses are scored according to the standard scoring method, and higher scores indicate greater psychological distress and lower mental health. The General Health Questionnaire has been widely used in student and adolescent populations, and its psychometric properties have been supported in previous research. In the present study, the reliability of the instrument was also confirmed using Cronbach's alpha.

Psychological well-being was measured using a standardized psychological well-being scale based on the multidimensional approach to well-being. This instrument evaluates positive psychological functioning through dimensions such as autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance. Items are rated on a Likert scale, and higher scores indicate higher levels of psychological well-being. The validity and reliability of the scale have been confirmed in previous studies, and its internal consistency was calculated again for the present sample.

2.3. Data Analysis

Data analysis was conducted separately for the qualitative and quantitative phases and then integrated to finalize the curriculum model. In the qualitative phase, interview transcripts were analyzed using thematic analysis. The analysis process included repeated reading of the transcripts, extraction of initial codes, grouping similar codes into subthemes, formation of main themes, and interpretation of the relationships among the themes. To increase the credibility and trustworthiness of the qualitative findings, member checking, peer review, expert confirmation, and continuous comparison of the extracted codes were used. The qualitative analysis led to the identification of the main components and indicators of the curriculum model based on artificial intelligence and purposeful physical activity.

In the quantitative phase, descriptive and inferential statistical methods were used. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were used to describe the demographic characteristics of the participants and the main research variables. Before conducting inferential analyses, the assumptions of normality, reliability, convergent validity, and discriminant validity were examined. Confirmatory factor analysis was used to evaluate the measurement model, and structural equation modeling was applied to test the fit of the proposed curriculum model and examine the relationships among artificial intelligence-based curriculum components, purposeful physical activity, learning self-regulation, mental health, and psychological well-being. Model fit was evaluated using standard fit indices, including chi-square to degrees of freedom ratio, comparative fit index, goodness-of-fit index, adjusted goodness-of-fit index, root mean square error of approximation, and standardized root mean square residual. Cronbach's alpha, composite reliability, and average variance extracted were used to assess reliability and validity. The qualitative and quantitative results were finally integrated to revise, validate, and present the final curriculum model.

3. Findings and Results

The findings of the study are presented in two main parts. First, the demographic characteristics of the participants are reported in order to describe the qualitative and quantitative samples. Second, the results related to the design, validation, and empirical testing of the curriculum model based on artificial intelligence and purposeful physical activity are presented. In the qualitative phase, 20 experts participated in semi-structured interviews. Of these experts, 12 participants were male and 8 were female. The mean age of the experts was 45.60 years with a standard deviation of 6.84 years. In terms of academic and professional specialization, 5 experts were specialists in curriculum studies, 4 in educational technology and artificial intelligence in education, 4 in physical education and sport sciences, 4 in educational psychology, and 3 in student mental health and counseling. The average professional experience of the experts was 14.25 years, indicating that the qualitative data were collected from participants with sufficient academic and

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practical expertise in the subject area. In the quantitative phase, 384 secondary school students from Tehran participated in the study. Of these students, 202 were female and 182 were male. The mean age of the students was 16.42 years with a standard deviation of 0.92 years. In terms of educational grade, 129 students were in the tenth grade, 130 were in the eleventh grade, and 125 were in the twelfth grade. This distribution showed that the sample included students from different levels of secondary education and provided an appropriate basis for validating the proposed curriculum model among the target population.

Table 1

Main Dimensions, Components, and Indicators Extracted from the Qualitative Analysis of the Curriculum Model

Main dimension	Component	Core indicators
Philosophical and goal orientation of the curriculum	Learner-centered and future-oriented curriculum goals	Strengthening autonomous learning, developing digital competence, improving psychological growth, enhancing healthy lifestyle behaviors, and preparing students for intelligent learning environments
Philosophical and goal orientation of the curriculum	Integration of education, health, and well-being	Connecting cognitive learning with physical, emotional, and social development; considering the student as a whole person; and emphasizing balanced academic and psychological growth
Artificial intelligence-based curriculum content	Intelligent and adaptive educational content	Personalized learning resources, AI-supported learning pathways, adaptive assignments, intelligent recommendation systems, and content adjusted to students' learning pace and needs
Artificial intelligence-based curriculum content	Digital literacy and ethical use of AI	Responsible use of AI tools, critical evaluation of AI-generated information, data privacy awareness, algorithmic bias awareness, and development of ethical decision-making in technology use
Purposeful physical activity	Structured movement-based learning activities	Classroom-based physical activity, movement breaks, active learning tasks, coordinated physical-cognitive activities, and planned motor activities linked to educational objectives
Purposeful physical activity	Health-oriented and self-regulatory physical activity	Goal-directed exercise, monitoring physical activity, self-evaluation of activity patterns, stress-reducing movement tasks, and activities designed to improve emotional regulation
Teaching-learning strategies	AI-assisted active learning	Problem-based learning, project-based learning, inquiry-oriented activities, intelligent tutoring, learning analytics-based feedback, and collaborative tasks supported by educational technologies
Teaching-learning strategies	Embodied and experiential learning	Learning through movement, physical simulation of concepts, activity-based problem solving, cooperative movement tasks, and linking bodily experience with cognitive learning
Assessment and feedback	Intelligent assessment	Continuous assessment, AI-supported formative evaluation, automated feedback, progress dashboards, and personalized performance reports
Assessment and feedback	Self-assessment and reflective evaluation	Learning journals, self-monitoring checklists, peer feedback, reflection on physical and psychological progress, and evaluation of self-regulated learning strategies
Supportive learning environment	Teacher and school support	Teacher facilitation, professional development in AI use, supportive classroom climate, school-based mental health support, and coordination between teachers, counselors, and physical education staff
Supportive learning environment	Technological and physical infrastructure	Access to digital platforms, learning management systems, safe physical spaces, activity-friendly classrooms, wearable or monitoring tools where available, and equitable access to technology
Expected educational and psychological outcomes	Learning self-regulation	Goal setting, strategic planning, time management, effort regulation, metacognitive monitoring, and academic self-evaluation
Expected educational and psychological outcomes	Mental health and psychological well-being	Reduced stress, improved emotional balance, stronger sense of purpose, positive interpersonal relations, increased self-acceptance, and greater psychological vitality

The results of the qualitative analysis showed that the proposed curriculum model was composed of several interrelated dimensions rather than a single technological or physical education component. The experts emphasized that artificial intelligence should not be used merely as a technical supplement to teaching, but should be integrated into the curriculum in a purposeful and pedagogically meaningful way. They also highlighted that physical activity should not be limited to traditional exercise or sport sessions, but should be designed as a structured educational and

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psychological mechanism for supporting attention, emotional regulation, motivation, and student engagement. Accordingly, the extracted model included philosophical and goal-oriented foundations, AI-based curriculum content, purposeful physical activity, teaching-learning strategies, assessment and feedback mechanisms, supportive learning environments, and expected educational and psychological outcomes. The integration of these dimensions indicated that the curriculum model should simultaneously address cognitive learning, self-regulated learning behaviors, mental health, and psychological well-being. Therefore, Table 1 shows that the designed model was multidimensional, learner-centered, technology-supported, health-oriented, and grounded in the interaction between intelligent educational systems and purposeful bodily activity.

Table 2

Descriptive Statistics, Reliability, and Validity Indices of the Main Quantitative Variables

Variable	Mean	Standard deviation	Skewness	Kurtosis	Cronbach's alpha	Composite reliability	Average variance extracted
Artificial intelligence-based curriculum components	3.86	0.58	-0.42	0.31	0.91	0.93	0.64
Purposeful physical activity components	3.79	0.61	-0.36	0.27	0.89	0.91	0.61
Learning self-regulation	3.68	0.64	-0.28	0.18	0.88	0.90	0.59
Mental health	3.74	0.66	-0.33	0.22	0.87	0.89	0.57
Psychological well-being	3.71	0.63	-0.30	0.20	0.90	0.92	0.62

The descriptive findings presented in Table 2 indicated that the mean scores of all main variables were above the theoretical midpoint of the scale, suggesting that students generally evaluated the components of the proposed curriculum model positively. The highest mean score belonged to the artificial intelligence-based curriculum components, which showed that students perceived AI-supported learning tools, adaptive educational content, intelligent feedback, and personalized learning pathways as useful and relevant to their learning experience. The mean score of purposeful physical activity components was also above the midpoint, indicating that students recognized the educational and psychological value of structured movement-based activities, active learning, and health-oriented physical activity within the curriculum. The mean scores of learning self-regulation, mental health, and psychological well-being also showed favorable levels among the students. The skewness and kurtosis values were within the acceptable range of -2 to +2, indicating that the distributions of the variables did not seriously violate the assumption of normality. In addition, Cronbach's alpha coefficients ranged from 0.87 to 0.91, and composite reliability coefficients ranged from 0.89 to 0.93, confirming the internal consistency and reliability of the measurement instruments. The average variance extracted values were all above 0.50, which supported the convergent validity of the constructs. Overall, these findings showed that the measurement model had acceptable descriptive, reliability, and validity characteristics and was suitable for further confirmatory and structural analysis.

Table 3

Confirmatory Factor Analysis and Model Fit Indices for the Measurement and Structural Models

Model	χ^2	df	χ^2/df	GFI	AGFI	CFI	TLI	RMSEA	SRMR
Measurement model	681.47	312	2.18	0.913	0.895	0.944	0.936	0.056	0.046
Structural model	724.36	328	2.21	0.908	0.889	0.941	0.932	0.057	0.049
Final modified model	697.82	326	2.14	0.917	0.901	0.951	0.944	0.054	0.043

As shown in Table 3, the confirmatory factor analysis results supported the adequacy of the measurement model. The ratio of chi-square to degrees of freedom was 2.18 for the measurement model, which was lower than the commonly accepted threshold of 3 and indicated an acceptable model fit. The goodness-of-fit index and adjusted goodness-of-fit index were close to or above acceptable values, while the comparative fit index and Tucker-Lewis

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index were both above 0.90, confirming the acceptable comparative fit of the model. The root mean square error of approximation was 0.056, and the standardized root mean square residual was 0.046, both of which indicated an acceptable error level. The structural model also demonstrated acceptable fit, with χ^2/df equal to 2.21, CFI equal to 0.941, TLI equal to 0.932, RMSEA equal to 0.057, and SRMR equal to 0.049. After minor theoretically justified modifications, the final model showed improved fit indices. In the final modified model, χ^2/df decreased to 2.14, CFI increased to 0.951, TLI increased to 0.944, RMSEA decreased to 0.054, and SRMR decreased to 0.043. These results indicated that the proposed curriculum model based on artificial intelligence and purposeful physical activity had an acceptable empirical structure and that the relationships among the latent constructs were supported by the quantitative data.

Table 4

Standardized Direct Effects among the Main Constructs of the Final Structural Model

Path	Standardized coefficient β	Standard error	Critical ratio	p-value	Result
Artificial intelligence-based curriculum components → Learning self-regulation	0.41	0.052	7.82	<0.001	Supported
Purposeful physical activity components → Learning self-regulation	0.29	0.049	5.94	<0.001	Supported
Artificial intelligence-based curriculum components → Mental health	0.32	0.055	5.86	<0.001	Supported
Purposeful physical activity components → Mental health	0.37	0.053	6.98	<0.001	Supported
Artificial intelligence-based curriculum components → Psychological well-being	0.22	0.050	4.43	<0.001	Supported
Purposeful physical activity components → Psychological well-being	0.19	0.047	4.06	<0.001	Supported
Learning self-regulation → Psychological well-being	0.31	0.051	6.13	<0.001	Supported
Mental health → Psychological well-being	0.34	0.054	6.35	<0.001	Supported

The structural coefficients reported in Table 4 showed that all direct paths in the final model were statistically significant. Artificial intelligence-based curriculum components had a positive and significant effect on learning self-regulation, indicating that students who perceived the curriculum as more intelligent, adaptive, feedback-oriented, and personalized reported higher levels of goal setting, planning, self-monitoring, strategy use, and academic self-evaluation. Purposeful physical activity also had a positive and significant effect on learning self-regulation, showing that structured physical activity, movement-based learning, and self-monitored activity tasks contributed to students' ability to regulate their learning behaviors. In relation to mental health, both artificial intelligence-based curriculum components and purposeful physical activity had significant positive effects. This finding suggested that personalized learning support, reduction of learning confusion through intelligent feedback, active classroom experiences, and stress-reducing physical activities could improve students' psychological adjustment and perceived mental health. The direct effects of artificial intelligence-based curriculum components and purposeful physical activity on psychological well-being were also significant, although these effects were smaller than their effects on learning self-regulation and mental health. This indicated that part of the influence of the curriculum model on psychological well-being may occur indirectly through strengthening self-regulation and mental health. Finally, learning self-regulation and mental health both had significant positive effects on psychological well-being, confirming that students with stronger self-regulatory capacities and better mental health experienced higher levels of autonomy, purposefulness, personal growth, positive relations, and self-acceptance.

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Table 5

Explained Variance, Indirect Effects, and Total Effects in the Final Curriculum Model

Dependent variable or effect	R^2 or standardized effect	p-value	Interpretation
Learning self-regulation	0.48	<0.001	Artificial intelligence-based curriculum components and purposeful physical activity explained 48% of the variance in learning self-regulation
Mental health	0.43	<0.001	Artificial intelligence-based curriculum components and purposeful physical activity explained 43% of the variance in mental health
Psychological well-being	0.57	<0.001	Artificial intelligence-based curriculum components, purposeful physical activity, learning self-regulation, and mental health explained 57% of the variance in psychological well-being
Artificial intelligence-based curriculum components → Psychological well-being through learning self-regulation	0.13	<0.001	Significant indirect effect
Artificial intelligence-based curriculum components → Psychological well-being through mental health	0.11	<0.001	Significant indirect effect
Purposeful physical activity components → Psychological well-being through learning self-regulation	0.09	<0.001	Significant indirect effect
Purposeful physical activity components → Psychological well-being through mental health	0.13	<0.001	Significant indirect effect
Total effect of artificial intelligence-based curriculum components on psychological well-being	0.46	<0.001	Significant total effect
Total effect of purposeful physical activity components on psychological well-being	0.41	<0.001	Significant total effect

The results presented in Table 5 showed that the final curriculum model had considerable explanatory power. Artificial intelligence-based curriculum components and purposeful physical activity together explained 48% of the variance in learning self-regulation, which indicated that nearly half of the differences in students' self-regulatory learning behaviors could be explained by the educational and activity-based components of the model. These findings suggested that when students receive adaptive content, intelligent feedback, structured learning pathways, and purposeful physical activity opportunities, they are more likely to develop stronger self-monitoring, planning, motivation regulation, and learning management skills. The model also explained 43% of the variance in mental health, showing that the integration of artificial intelligence and purposeful physical activity can meaningfully contribute to students' psychological adjustment. Furthermore, the full model explained 57% of the variance in psychological well-being, which represented a strong explanatory value for an educational-psychological curriculum model. The indirect effects were also statistically significant. Artificial intelligence-based curriculum components influenced psychological well-being indirectly through both learning self-regulation and mental health. Purposeful physical activity also had significant indirect effects on psychological well-being through these two mediating variables. These findings demonstrated that the designed curriculum model enhanced psychological well-being not only directly, but also indirectly by improving students' capacity for self-regulated learning and strengthening their mental health. The total effects showed that artificial intelligence-based curriculum components had a total standardized effect of 0.46 on psychological well-being, while purposeful physical activity had a total standardized effect of 0.41. Therefore, both central components of the curriculum model played important roles in explaining students' educational and psychological outcomes.

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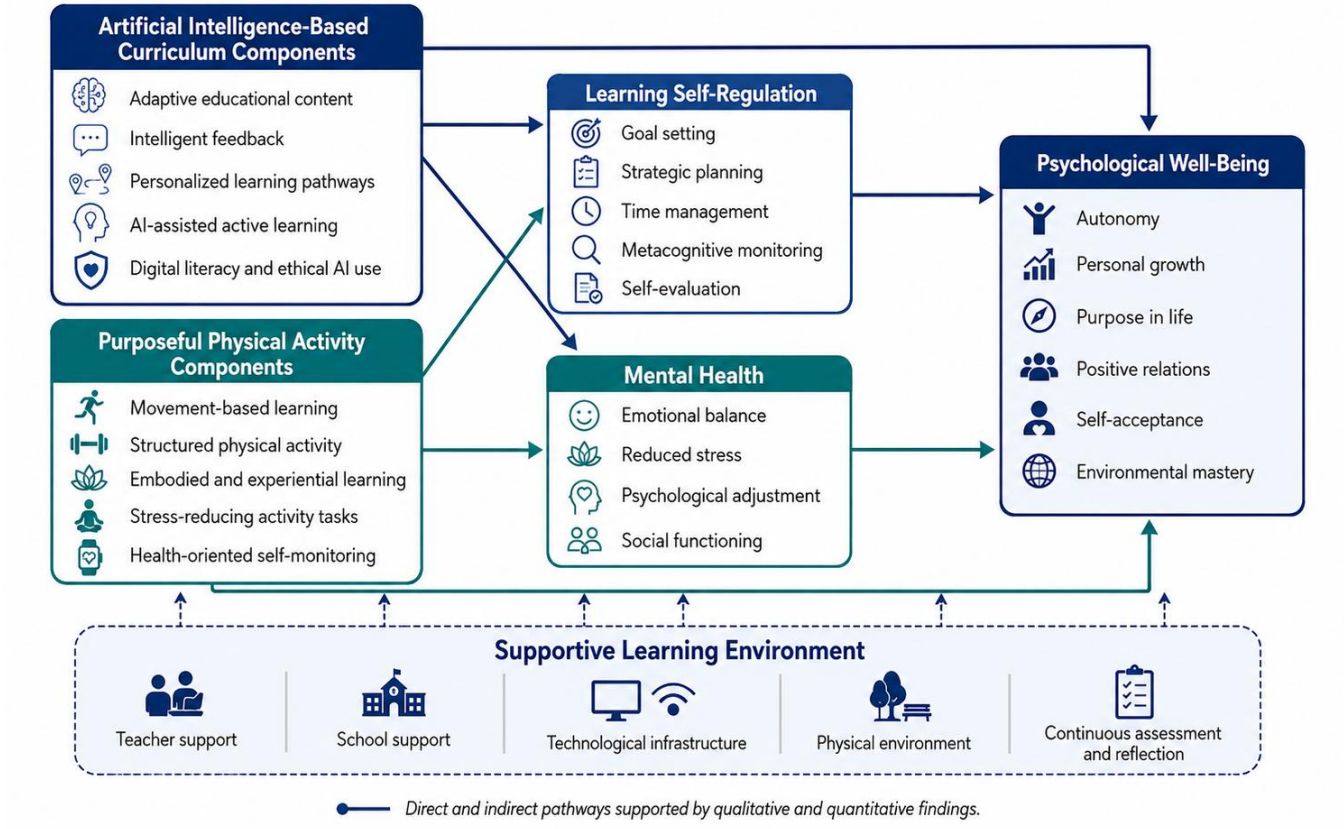
Table 6

Final validated curriculum model based on artificial intelligence and purposeful physical activity for enhancing learning self-regulation, mental health, and psychological well-being among students.



The final model showed that the curriculum based on artificial intelligence and purposeful physical activity is a comprehensive and integrated educational framework that links intelligent learning environments, adaptive teaching strategies, activity-based learning, continuous feedback, and student-centered support mechanisms with self-regulatory and psychological outcomes. In this model, artificial intelligence functions as a mechanism for personalization, monitoring, feedback, and adaptive guidance, while purposeful physical activity functions as a mechanism for embodied learning, emotional regulation, stress reduction, motivation enhancement, and cognitive activation. The model demonstrated that these two curriculum foundations directly improve learning self-regulation, mental health, and psychological well-being. In addition, the model showed that learning self-regulation and mental health act as important internal processes through which the curriculum can promote deeper psychological well-being. Based on the qualitative and quantitative findings, the final validated model can be considered an empirically supported curriculum framework for designing educational programs that respond to students' academic, technological, physical, emotional, and psychological needs in contemporary schools.

4. Discussion

The present study aimed to design and validate a curriculum model based on artificial intelligence and purposeful physical activity with emphasis on enhancing learning self-regulation, mental health, and psychological well-being among students. The findings indicated that the final model consisted of several interrelated dimensions, including philosophical and goal orientation, artificial intelligence-based curriculum content, purposeful physical activity, teaching-learning strategies, assessment and feedback, supportive learning environment, and expected educational and psychological outcomes. This structure shows that the designed curriculum model is not limited to the technical use of artificial intelligence or the inclusion of

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physical activity as a separate educational component; rather, it is an integrated framework in which technology, movement, cognition, emotion, health, and well-being are organized around the developmental needs of students. The qualitative findings showed that experts considered intelligent personalization, adaptive educational content, ethical AI use, movement-based learning, embodied experience, self-assessment, and supportive school conditions to be essential elements of the curriculum. This finding is consistent with the view that contemporary education requires an integrated approach that connects digital transformation with human-centered development, psychological support, and social functioning (Cai, 2024; Maden et al., 2023; Ravenscroft et al., 2022).

The descriptive findings showed that students evaluated the artificial intelligence-based curriculum components positively, and this dimension obtained the highest mean score among the main constructs. This result suggests that students perceive adaptive educational content, intelligent feedback, personalized learning pathways, and AI-assisted active learning as meaningful supports for their educational experience. This finding can be explained by the fact that AI-based learning environments can reduce the distance between students' individual learning needs and the curriculum by offering more flexible, responsive, and personalized learning opportunities. Previous studies have similarly emphasized that artificial intelligence can support flipped teaching, dynamic evaluation, educational robots, intelligent mental health education, and psychological assessment in educational settings (Chen, 2023; Jia, 2026; Li, 2022; Shan & Yu, 2021; Zhang & Wang, 2022). Therefore, the positive evaluation of AI-based curriculum components in the present study reflects the increasing relevance of intelligent educational systems in students' academic and psychological development.

The findings also showed that purposeful physical activity was recognized as an important component of the proposed curriculum model. This result indicates that students and experts perceived physical activity not merely as physical education or sport participation, but as a purposeful educational strategy connected to learning engagement, emotional regulation, stress reduction, motivation, and well-being. This finding is supported by studies showing that physical education and sport-related reforms can contribute to students' physical and mental health development (Tang & Wang, 2025). In addition, perceived variety support in physical education has been found to influence students' learning engagement through motivational processes, which supports the present finding that purposeful physical activity can strengthen student participation and self-regulatory learning behaviors (Miao et al., 2024). The integration of mindfulness into physical education has also been described as an opportunity for developing students' mental health, suggesting that movement, awareness, and psychological adjustment can be productively combined in school curricula (Delgado-Montoro et al., 2022; Sheinman & Russo-Netzer, 2021).

The confirmatory factor analysis and structural equation modeling results indicated that the proposed model had acceptable empirical fit. The final modified model showed favorable fit indices, including acceptable values for the chi-square to degrees of freedom ratio, comparative fit index, Tucker-Lewis index, root mean square error of approximation, and standardized root mean square residual. These results confirm that the theoretical structure extracted from the qualitative phase was supported by the quantitative data. In other words, the relationships among AI-based curriculum components, purposeful physical activity, learning self-regulation, mental health, and psychological well-being were not only conceptually meaningful, but also statistically validated. This finding is important because it demonstrates that a curriculum model designed around intelligent learning and purposeful movement can provide a coherent educational-psychological structure. This is consistent with prior research suggesting that technology-based educational systems, AI-supported learning environments, and intelligent assessment models can contribute to educational quality and psychological support when they are embedded in a structured pedagogical framework (Chen, 2025; Dai, 2024; Zhang & Yang, 2025).

One of the most important findings of the study was the significant direct effect of artificial intelligence-based curriculum components on learning self-regulation. This result indicates that students who experienced or perceived stronger AI-based curriculum support reported higher levels of goal setting, strategic planning, time management, metacognitive monitoring, and self-evaluation. This finding can be explained by the capacity of AI systems to provide personalized feedback, adaptive assignments, learning analytics, and progress monitoring. Such features can help students become more aware of their learning strengths and weaknesses and can encourage them to regulate their learning strategies more effectively. Previous research has emphasized the role of digital technologies in promoting metacognition, self-consciousness, and future-oriented learning competencies (Drigas et al., 2023). Likewise, the

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application of AI in flipped classrooms, educational robots, and health-related teaching has shown that intelligent technologies can increase interaction, support individualized learning, and improve educational responsiveness (Razak et al., 2023; Shan & Yu, 2021; Zhang & Wang, 2022). Therefore, the present finding supports the idea that AI-based curriculum design can strengthen students' self-regulated learning capacities.

Purposeful physical activity also had a significant direct effect on learning self-regulation. This finding shows that movement-based learning, structured physical activity, embodied learning, and health-oriented self-monitoring may improve students' capacity to regulate their learning behavior. Physical activity can support self-regulation through several mechanisms, including improved attention, increased motivation, reduced restlessness, better emotional control, and strengthened goal-directed behavior. When students participate in purposeful movement tasks, they may learn to monitor bodily states, regulate effort, persist in tasks, cooperate with peers, and reflect on performance. These processes are closely connected to academic self-regulation. The finding is consistent with evidence that variety-supportive physical education enhances engagement by activating motivational pathways (Miao et al., 2024). It also aligns with research emphasizing the contribution of physical education, mindfulness, and embodied practices to mental health and self-awareness (Delgado-Montoro et al., 2022; Sheinman & Russo-Netzer, 2021). Thus, purposeful physical activity should be regarded as a curriculum strategy that supports both bodily and cognitive regulation.

The structural results further showed that both artificial intelligence-based curriculum components and purposeful physical activity had significant effects on mental health. This finding suggests that a curriculum combining intelligent support and purposeful movement can reduce psychological pressure and improve emotional balance, psychological adjustment, and social functioning. AI-based systems may contribute to mental health by identifying learning difficulties early, reducing uncertainty, providing immediate feedback, offering individualized learning support, and connecting students with appropriate educational or psychological resources. This result is aligned with studies that have examined AI-based mental health education, computer technology-based mental health teaching systems, and dynamic evaluation models for student mental health (Chen, 2023; Dai, 2024; Li, 2022). In addition, AI-powered emotional intelligence and mindfulness applications have shown potential for supporting students' emotional functioning, particularly in contexts of heightened stress (Sturgill et al., 2020, 2021). These studies support the present conclusion that artificial intelligence can contribute to students' mental health when used within an educationally responsible framework.

The effect of purposeful physical activity on mental health was also significant and relatively strong. This finding is theoretically expected because purposeful physical activity can reduce stress, improve mood, support emotional regulation, and increase social interaction. In school contexts, physical activity may also reduce academic fatigue and create opportunities for positive peer relationships and active engagement. The present result is consistent with research highlighting the role of physical education, sports reform, mindfulness-based movement, and mental health-oriented physical activity in supporting student well-being (Delgado-Montoro et al., 2022; Tang & Wang, 2025; Wang et al., 2021). It also aligns with the idea that mental health promotion should be embedded in educational systems rather than treated as an external intervention. Embedding brain health in the curriculum has been identified as a meaningful direction for schools, especially when teachers understand health as part of learning readiness and student development (Siette et al., 2026). Therefore, the present study supports a curriculum approach in which physical activity functions as a health-promoting and psychologically protective educational mechanism.

Another important finding was that learning self-regulation and mental health had significant direct effects on psychological well-being. This result indicates that students who are more capable of regulating their learning and maintaining better mental health are more likely to experience autonomy, personal growth, purpose in life, positive relations, self-acceptance, and environmental mastery. This finding is consistent with positive psychology frameworks that conceptualize well-being as multidimensional and connected to engagement, meaning, accomplishment, relationships, and psychological resources (Donaldson et al., 2022). It also aligns with positive higher education approaches that emphasize empowering students through strategies that strengthen meaning, engagement, and psychological functioning (Li, 2025). From this perspective, learning self-regulation is not only an academic skill, but also a psychological resource that helps students experience competence, agency, and purpose. Similarly, mental health is not merely the absence of distress, but a foundation for flourishing and positive functioning.

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The indirect effect results showed that artificial intelligence-based curriculum components and purposeful physical activity influenced psychological well-being through learning self-regulation and mental health. This means that the curriculum model improves well-being not only through direct pathways, but also by strengthening internal developmental processes. AI-based curriculum components can improve well-being by helping students become more autonomous, organized, reflective, and confident learners. Purposeful physical activity can improve well-being by reducing stress, improving emotional balance, supporting motivation, and strengthening social participation. These mechanisms are consistent with school-based interventions promoting social capabilities, strengths-based well-being programs, and systems-informed approaches to flourishing in educational and professional settings (Ansari & Rizvi, 2023; Corrigan et al., 2025; Naples & Tuckwiller, 2021). The findings also align with research on digital innovation and emotional training, which emphasizes that technology is most effective when combined with emotional, social, and adaptive competencies (Hack-Polay et al., 2023).

5. Conclusion

Overall, the findings of the present study suggest that curriculum design should move beyond fragmented interventions and adopt integrated models that simultaneously address learning, technology, movement, mental health, and well-being. The proposed model confirms that artificial intelligence and purposeful physical activity can operate as complementary foundations of a modern curriculum. Artificial intelligence contributes personalization, feedback, adaptive learning, data-informed assessment, and digital support, while purposeful physical activity contributes embodiment, stress reduction, motivation, engagement, emotional regulation, and social participation. Together, these components create a curriculum environment that strengthens self-regulated learning, supports mental health, and promotes psychological well-being. The results therefore extend previous research by bringing together domains that have often been studied separately: AI-supported education, mental health education, physical activity, mindfulness, positive psychology, and student well-being (Jia, 2026; Maden et al., 2023; Ravenscroft et al., 2022; Siette et al., 2026).

6. Limitations & Suggestions

Limitations. The present study had several limitations that should be considered when interpreting the findings. First, the quantitative sample was limited to secondary school students in Tehran, and this may restrict the generalizability of the results to students in other cities, rural areas, different educational systems, or other age groups. Second, the study relied on self-report questionnaires for measuring learning self-regulation, mental health, and psychological well-being, which may be affected by response bias, social desirability, and students' subjective perceptions. Third, although the study used a mixed-methods design and structural equation modeling, the quantitative phase was cross-sectional, and therefore causal interpretations should be made with caution. Fourth, the designed model was validated statistically, but its practical implementation in real classroom settings was not examined through a longitudinal intervention. Finally, access to artificial intelligence tools, technological infrastructure, teacher readiness, and school resources may differ across educational environments, and these contextual differences may influence the feasibility and effectiveness of the proposed curriculum model.

Suggestions for future research. Future studies should examine the proposed curriculum model in different educational levels, geographical regions, and school contexts in order to test its generalizability and cultural adaptability. It is also recommended that researchers conduct longitudinal and experimental studies to evaluate the actual impact of implementing this curriculum model on students' learning self-regulation, mental health, psychological well-being, academic performance, physical activity behavior, and classroom engagement over time. Future research could also compare different versions of the model, such as AI-intensive, physical activity-intensive, and fully integrated versions, to determine which components have the strongest effects on specific student outcomes. In addition, qualitative follow-up studies with students, teachers, parents, school counselors, and administrators could provide deeper insight into the practical barriers and facilitators of implementation. Researchers should also investigate issues such as ethical AI use, data privacy, teacher professional development, digital equity, and the role of school culture in supporting the successful application of the model.

Suggestions for practice. Educational policymakers, curriculum designers, school administrators, and teachers can use the findings of this study to develop integrated

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curricula that respond to students' academic, technological, physical, and psychological needs. Schools should not treat artificial intelligence tools, physical activity programs, mental health education, and self-regulated learning strategies as separate initiatives; instead, these elements should be organized within a coherent curriculum framework. Teachers should receive professional training on how to use AI-based educational tools ethically and pedagogically, how to interpret learning feedback, and how to combine digital learning with active and movement-based classroom strategies. Schools should also provide supportive learning environments that include technological infrastructure, safe physical spaces, continuous assessment, reflective activities, teacher support, and access to counseling services. In practice, the proposed model can help schools design learning experiences that are more personalized, active, emotionally supportive, health-oriented, and developmentally meaningful for students.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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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Authors' Contributions

All authors equally contributed to this article.

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