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Empowering Adolescent Baduanjin Instruction through Intelligent Action Recognition: Model Construction and Campus Promotion

Peilin Wang*

Southwest University, Chongqing, China

Abstract

This study addresses four practical difficulties in campus-based Baduanjin instruction for adolescents: inconsistent movement standards, insufficient real-time correction in class, weak continuity of after-class practice and highly subjective learning evaluation. The purpose is to explore how intelligent action recognition can support Baduanjin teaching and provide a feasible framework for the school-based dissemination of Health Qigong. A literature review, policy analysis, logical analysis and application design were used to examine school physical education digitalization, the campus promotion of Health Qigong, the health effects of Baduanjin and the application of human pose estimation in sports education. On this basis, an AI-assisted teaching model was constructed according to the realities of school physical education. The study proposes a closed-loop model consisting of pre-class standard resource preparation, in-class action recognition and correction, post-class practice tracking and multidimensional learning evaluation. It also presents an implementation pathway that integrates curriculum embedding, teacher empowerment, platform support, school-family collaboration and risk governance. Intelligent action recognition can assist teachers by identifying body key points, detecting movement deviations and generating visual feedback, while providing students with evidence for continuous improvement. The core value of this technology is to enhance teachers' observation, feedback and assessment capacity rather than to replace teachers. Future pilot teaching, quasi-experimental research and mixed-method studies are needed to test the effectiveness, cost and generalizability of the proposed model.

Keywords

Baduanjin; intelligent action recognition; AI-assisted teaching; campus promotion; Health Qigong.

1. Introduction

School physical education is an important pathway for fostering students' physical and mental development. The policy document Opinions on Comprehensively Strengthening and Improving School Physical Education in the New Era emphasizes the educational principle of health first. It asks schools to coordinate academic learning with physical exercise and to help young people enjoy sport, strengthen fitness, build character and develop willpower through physical activity [1]. This policy orientation shows that school physical education is no longer limited to bodily training. It also carries the functions of health promotion, personality formation and cultural education.

The Compulsory Education Physical Education and Health Curriculum Standard (2022 Edition) further stresses a competency-based approach. It values the integrated development of motor ability, healthy behavior and sports morality. Related interpretation of the curriculum standard points out that the new standard is guided by goals, problems and innovation, which provides

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a clearer curriculum basis for introducing traditional Chinese physical activities into school physical education [2]. Against this background, Baduanjin, as a representative traditional Chinese exercise, has a practical foundation for entering the school curriculum.

At the same time, education digitalization is changing how teaching is organized. The Ministry of Education proposed the strategic action for education digitalization in its 2022 work priorities and called for the digital transformation and intelligent upgrading of education [3]. Artificial intelligence has therefore begun to enter school physical education, especially in teaching feedback, learning assessment and resource construction. Its value should not remain at the level of equipment renewal. It should also support teaching processes, learning feedback and evaluation improvement.

Baduanjin is an important form of Health Qigong. Its movement structure is relatively stable, its exercise intensity is moderate and it combines bodily practice with traditional cultural education. Research on its historical development and value realization suggests that Baduanjin has formed a stable practice system over time and has value in fitness, health cultivation and cultural communication [4]. For adolescents, the movements are gentle, the space requirement is low and the organization cost is small. These features make Baduanjin highly adaptable to campus settings.

Existing studies show that Baduanjin training can have positive effects on the physical and psychological well-being of college students [5]. A systematic review and meta-analysis of Tai Chi and Qigong for adolescents also indicates that traditional mind-body exercises may improve psychological status in this group [6]. However, much of the existing work focuses on health promotion effects. Less attention has been paid to practical teaching questions in school settings, such as how to teach movements more accurately, correct errors more quickly, maintain practice after class and evaluate learning more objectively.

In actual teaching, Baduanjin appears soft and simple, but it still requires standards for hand position, footwork, trunk extension, center-of-gravity transfer, breathing rhythm and movement connection. When adolescent learners rely only on teacher demonstration and collective imitation, they may remember the sequence but fail to perform it accurately. They may practice in class but not continue after class, and teachers may give an overall score without recording the learning process. Intelligent action recognition, based on camera capture, human key-point detection, movement trajectory analysis and feedback prompts, has attracted attention in sport analysis, action recognition and physical activity feedback [7]. Studies on artificial intelligence in physical education also suggest that AI should enhance teachers' observation, feedback, assessment and resource organization instead of replacing teachers [8].

Based on these issues, this paper constructs an AI-assisted Baduanjin teaching model for adolescents and proposes pathways for campus promotion. The paper does not report invented teaching experiments or statistical results. Its main contribution is to offer a framework that can be tested, revised and verified in future school practice. Baduanjin not only supports coordination, flexibility and balance, but may also help regulate emotion, reduce stress and improve attention. As school physical education reform deepens, it is meaningful to explore how intelligent action recognition can support the teaching and dissemination of Baduanjin in schools.

2. Research Methods and Design Basis

2.1. Research Methods

This study uses four methods: literature review, policy analysis, logical analysis and application design.

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The literature review was used to examine studies on the health effects of Baduanjin, adolescent mind-body exercise, school physical education digitalization, AI in physical education and human pose estimation. The main search terms included Baduanjin, Health Qigong, adolescent health, school physical education digitalization, AI-assisted physical education, human pose estimation, action recognition and movement feedback.

Policy analysis was used to extract institutional requirements related to school physical education reform, education digitalization, AI-enabled teaching and the protection of minors' information. The analysis focused on curriculum construction, traditional sports on campus, AI-supported teaching and student data governance.

Logical analysis was used to summarize the practical problems in campus-based Baduanjin teaching for adolescents and to explain why intelligent action recognition can reasonably enter the teaching process.

Application design was used to build the teaching model, evaluation system and implementation pathway. The model proposed in this paper is a theoretical and application-oriented design. It does not involve real student recruitment, teaching intervention or statistical significance testing.

2.2. Design Principles

The construction of an AI-assisted Baduanjin teaching model for adolescents should follow four principles.

The first principle is teacher leadership. An AI system can provide action recognition, deviation prompts and process records, but it cannot replace teachers' comprehensive judgment of movement quality, classroom order, learning state and safety risk. Physical education is a bodily and situational practice. Teachers remain the central actors in classroom organization, movement explanation, emotional support and safety management.

The second principle is technical assistance. Intelligent action recognition should serve teaching goals rather than turn the class into a technology-scored performance. System output should be concise, interpretable and actionable, and it should not increase the burden on teachers and students. Research on the boundaries of AI-empowered school physical education warns that technology should not replace teacher judgment and should not over-datafy students' bodily activity [9].

The third principle is process evaluation. The learning effect of Baduanjin is not a single performance result. It is formed by movement standardization, practice continuity, error correction and self-reflection. Evaluation should focus on changes across stages and should attend to movement understanding, practice habits and self-regulation.

The fourth principle is safety and compliance. Movement videos, body posture data and practice records of minors involve personal information protection. Data collection should follow the principles of minimum necessity, informed consent, de-identification, transparency and teacher final judgment.

3. Practical Problems in Campus-based Baduanjin Teaching for Adolescents

3.1. Difficulty in Unifying Movement Standards

Baduanjin has a relatively stable movement routine, but students' understanding of movement standards may differ across teachers, classes and practice environments. For example, the movement “Two Hands Hold up the Heavens to Regulate the Triple Energizer” requires not only raising both arms, but also lifting the trunk, relaxing the shoulders and coordinating breathing.

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The movement “Drawing the Bow to Shoot the Hawk” is not simply an arm-opening action. It also requires stable stance, aligned knees and ankles and an upright body.

For adolescent learners, the challenge is not only remembering the movement order. They also need to understand movement routes, force direction and body control. Therefore, school-based Baduanjin teaching needs a clear, stable and reusable movement standard in addition to traditional demonstration and explanation.

3.2. Insufficient Real-time Correction in Class

In class teaching, a teacher needs to demonstrate, explain, organize, patrol and evaluate at the same time. When dozens of students practice together, the teacher cannot continuously observe every detail of every student. Small deviations in hand height, knee direction, center-of-gravity change and movement rhythm are especially easy to miss. Classroom correction often focuses on obvious errors, while small but repeated deviations receive less attention.

The standardization of Baduanjin movements is sometimes hidden behind a seemingly correct posture. Some students appear to complete the action, yet they may have problems in shoulder relaxation, trunk alignment or center-of-gravity transfer. If such deviations remain uncorrected, movement quality may decline and students may not fully understand the exercise.

3.3. Weak Continuity of After-class Practice

Baduanjin learning depends on repeated practice and movement consolidation. In traditional teaching, after-class practice often stays at the level of assigned tasks. Teachers have difficulty knowing whether students practice, how often they practice, whether movements regress and whether errors reappear.

Research on school physical education digitalization argues that the value of digital technology is not the simple addition of devices. Its value lies in reconstructing teaching processes through data, resources and platforms [10]. If after-class practice can be recorded, fed back and tracked, Baduanjin teaching may extend from a single classroom event to a continuous learning process.

3.4. Subjective Learning Evaluation

In practice, Baduanjin assessment often relies on teachers' visual observation, classroom display and final scoring. This type of evaluation is easy to operate, but it does not fully show how students move from unfamiliarity to mastery or from inaccurate performance to gradual standardization. Students also find it hard to see their own improvement trajectory.

For traditional sports projects, evaluation should not only judge whether students can perform a complete routine. It should also examine movement understanding, practice engagement, error correction and mind-body experience. Baduanjin teaching should avoid reducing evaluation to a one-time performance score. It needs a process-based, developmental and multi-participant evaluation system.

4. Technical Logic of Intelligent Action Recognition in Baduanjin Teaching

Intelligent action recognition is not simply a tool for scoring student movements. It is an observation and feedback tool based on human pose estimation and movement feature analysis. Studies show that deep learning-based human body pose estimation can provide visual support and evidence for physical movement feedback [11]. A typical workflow includes video capture, body key-point detection, action segmentation, posture feature extraction, comparison with standard templates, deviation prompting and teaching feedback.

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4.1. Technical Process

Table 1: Technical process of intelligent action recognition

Technical link	Main function	Role in Baduanjin teaching
Video capture	Capture student movements through cameras, tablets or mobile devices.	Obtain images or videos of in-class and after-class practice.
Key-point detection	Extract key points such as shoulders, elbows, wrists, hips, knees and ankles.	Judge hand position, stance, trunk angle and body midline.
Action segmentation	Identify the opening posture, fixed posture, transitions and closing posture.	Analyze movement rhythm and connection.
Deviation analysis	Compare student movements with a standard template or teacher demonstration.	Find insufficient range, unstable rhythm or incomplete movement.
Feedback generation	Output simple prompts, major errors and improvement suggestions.	Support teacher correction and student self-adjustment.
Process recording	Summarize practice frequency, duration and movement changes.	Support process evaluation and after-class tracking.

The key point of this process is not full automation. Its purpose is to turn movement details that teachers cannot observe at the same time into visible, interpretable and usable teaching information. For school physical education, the system should have a low operating threshold. If its functions are too complex, teachers may be less willing to use it.

4.2. Recognition Priorities for Baduanjin Movements

Table 2: Recognition priorities and feedback directions for Baduanjin movements

Baduanjin movement	Recognition priorities	Common problems	Feedback direction
Two Hands Hold up the Heavens to Regulate the Triple Energizer	Height of both hands, elbow extension and trunk alignment.	Bent arms, raised shoulders and backward leaning.	Prompt arm extension, shoulder relaxation and upright posture.
Drawing the Bow to Shoot the Hawk	Stability of stance, opening range of arms and shoulder-elbow coordination.	Unstable stance, insufficient arm opening and inward knee collapse.	Prompt knee-ankle alignment and full arm opening.
Separate Heaven and Earth to Regulate Spleen and Stomach	Height of one arm, vertical stretching and body tilt.	Poor upper-lower limb coordination and body leaning.	Prompt stretching direction and stable center of gravity.
Wise Owl Gazes Backward	Range of head and neck rotation and trunk stability.	Turning only the head, or moving too fast.	Prompt rotation range and rhythm control.
Sway the Head and Shake the Tail to Expel Heart Fire	Trunk rotation, center-of-gravity transfer and knee stability.	Excessive twisting and unstable center of gravity.	Prompt slower movement and stable lower limbs.

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Two Hands Hold the Feet to Strengthen Kidney and Waist	Forward trunk flexion, knee condition and spinal extension.	Collapsed back and forced downward pressing.	Prompt gradual practice and avoidance of overstretching.
Clench the Fists and Glare Fiercely to Increase Strength	Punching route, punching speed and lower-limb stability.	Weak punching and upper-body shaking.	Prompt a clear punching route and core stability.
Bouncing on the Toes Seven Times to Dispel Diseases	Heel-raising height, landing buffer and body balance.	Heavy landing and body swaying.	Prompt light rising, light landing and stable balance.

These indicators are not designed to replace teacher scoring mechanically. They provide observation points for teachers. Students of different school stages and physical conditions should not be forced into one identical range of movement. Teachers should make final judgments by considering safety, movement quality and individual development level.

5. Construction of the AI-assisted Teaching Model for Adolescent Baduanjin

This study constructs a closed-loop model consisting of pre-class standard resource preparation, in-class action recognition and correction, post-class practice tracking and multidimensional learning evaluation. The model takes teacher instruction as the core, AI as a support tool and students' continuous practice and self-improvement as the goal.

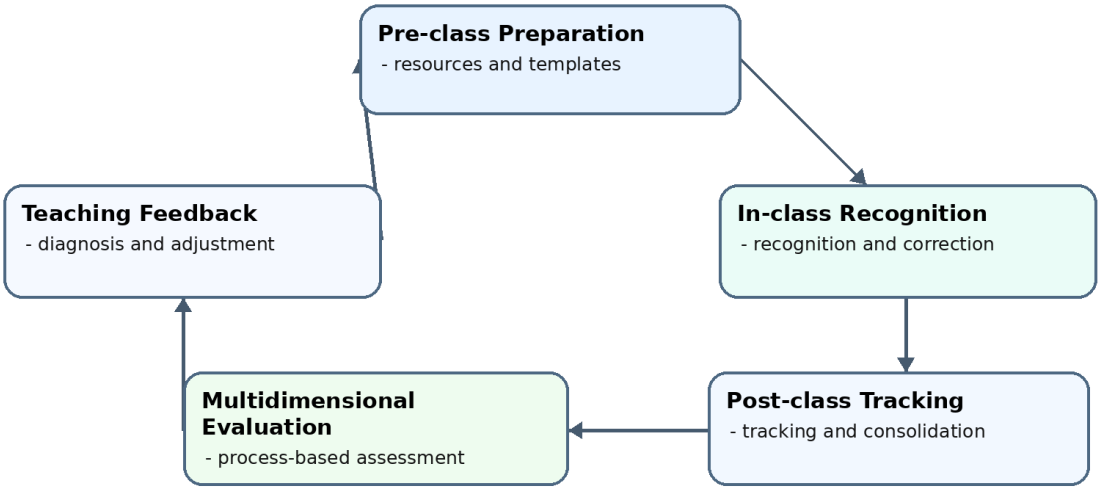

Figure 1: Closed-loop teaching improvement model based on action recognition and multidimensional evaluation

As shown in Figure 1, the model uses pre-class, in-class, after-class and evaluation feedback as its main line. It forms a cycle of resource preparation, action recognition, practice tracking, multidimensional evaluation and teaching improvement.

5.1. Pre-class: Standard Resource Preparation

The core task before class is to build unified, clear and reusable teaching resources. Teachers may prepare or select standard demonstration videos, movement explanations, examples of common errors, rhythm prompts and safety notes for the eight movements of Baduanjin. Schools or teachers can provide these resources through class platforms, campus terminals or curriculum resource libraries.

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AI can support resource structuring and standard template preparation in this stage. Teachers can divide a standard action into opening, movement, fixed posture and closing, and mark key observation points such as wrist height, elbow angle, knee direction, trunk inclination and rhythm. Students can watch these resources before class and form an initial understanding of movement order and basic requirements.

Pre-class resource construction is not only material preparation. It also provides the basis for later action recognition, classroom correction and process evaluation. A stable movement reference allows system recognition and teacher feedback to share the same standard.

5.2. In-class: Action Recognition and Correction

The classroom stage is the core of the model. Teachers first demonstrate movements and explain key points. They then organize students to practice in parts and as a complete routine. During practice, the AI system recognizes posture and prompts deviations, turning common errors into observable information.

The division of labor between teacher and system should be clear. The system identifies problems, while the teacher explains them. The system prompts deviations, while the teacher decides whether the deviations need correction. The system records the process, while the teacher organizes further practice. For example, in teaching “Drawing the Bow to Shoot the Hawk”, the system may show that some students have inward knee collapse or insufficient arm opening. The teacher can then decide whether to give common instruction to the whole class or provide group correction to certain students.

This teaching arrangement does not change the practical nature of physical education. Instead, it strengthens teachers' observation capacity and feedback efficiency. The value of AI is not to make students obey a machine score. Its value is to help teachers discover problems more quickly, locate problems more accurately and organize correction more promptly.

5.3. Post-class: Practice Tracking

The focus after class is to extend the teaching chain. Students can complete independent Baduanjin practice check-ins through mobile devices or campus terminals. The system records practice frequency, practice duration, movement completion and repeated deviations. For problems that appear repeatedly, the system may generate brief prompts, such as insufficient arm lifting, unstable center-of-gravity transfer or excessively fast rhythm.

After-class tracking should not become an additional burden or a ranking mechanism that creates anxiety. A better approach is to emphasize individual growth. Students should be able to see their own changes in a specific movement. For example, a student may have poor balance in “Bouncing on the Toes Seven Times to Dispel Diseases” during the first practice. After several practices, the degree of body sway may decline. The system can feed this change back to the student and teacher as evidence for developmental evaluation.

5.4. Evaluation: Multidimensional Learning Evaluation

Baduanjin evaluation should shift from a single final performance score to process-based evaluation. Data from the AI system should be only one source of evidence. It should not become the sole basis for judgment. This paper suggests a multidimensional evaluation system composed of teacher evaluation, system records, student self-evaluation and peer evaluation.

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Table 3: Multidimensional learning evaluation system

Primary indicator	Secondary indicators	Main evaluation subjects	Suggested weight
Movement standardization	Posture accuracy, movement continuity and rhythm stability.	Teacher evaluation and system prompts.	40%
Learning participation	Classroom engagement, cooperative practice and task completion.	Teacher evaluation and peer evaluation.	20%
Practice continuity	After-class practice frequency, duration and completion quality.	System records and teacher review.	20%
Self-improvement	Error correction, stage changes and reflection records.	Student self-evaluation and teacher evaluation.	20%

The core of this system is not to reduce Baduanjin learning to a single score. It uses process data to supplement teacher experience. For adolescent learners, evaluation should serve movement improvement, habit formation and mind-body development rather than simple comparison between students.

6. Campus Promotion Pathways

6.1. Curriculum Embedding: From Activity Display to Regular Teaching

The campus promotion of Baduanjin should not remain at the level of short-term display activities or festival performances. It should gradually enter physical education and health courses, after-school services, large-break activities and student clubs. A feasible approach is to begin with one grade, one class or one club, build a stable teaching resource package and classroom process, and then expand to the school level.

In course arrangement, Baduanjin can be designed as a teaching unit of four to six lessons. The first one or two lessons can focus on movement cognition and segmented learning. The middle lessons can focus on complete practice and correction. The final lesson can include display, evaluation and reflection. Schools with better conditions can also include the historical origin, health ideas and etiquette of Baduanjin to support traditional sports culture education.

6.2. Teacher Empowerment: Improving Project Teaching and Digital Teaching Ability

Whether AI-assisted teaching can be implemented depends not only on the availability of equipment. It also depends on whether teachers can translate system prompts into teaching actions. Research on AI in physical education suggests that future teacher training should pay attention to technical understanding, classroom integration and teaching strategy adjustment [12].

Teacher training should therefore include two dimensions. One is Baduanjin teaching ability, including movement standards, teaching steps, common errors, safety protection and differentiated guidance. The other is digital teaching ability, including system operation, data understanding, feedback explanation, privacy protection and classroom integration. Schools should not simply require teachers to use a platform. They should help teachers understand when to use it, to what extent to use it and how to prevent technology from disturbing teaching.

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6.3. Platform Support: Low Threshold, School Adaptation and Maintainability

Campus platform construction should not pursue an overly large and complete system at the beginning. For most schools, the initial system only needs four core functions: standard resource access, key movement recognition, practice process recording and evaluation information summary. If a school starts with complex data analysis, detailed rankings and large-scale management, teachers' use cost may rise and real implementation may be weakened.

A gradual platform development path is more practical. The first stage can solve the problems of resource unification and classroom-assisted correction. The second stage can add after-class practice tracking and personal growth records. The third stage can explore school-level data summaries, cross-class teaching improvement and shared curriculum resources.

6.4. School-family Collaboration: Extending Practice without Transferring Teaching Responsibility

Baduanjin requires little space and can be practiced at home. Schools can provide parents with brief practice guidance and safety notes. Parents may remind, accompany and pay attention to safety. However, school-family collaboration does not mean transferring professional teaching responsibility to parents. Movement explanation, correction standards and evaluation judgment should remain led by teachers.

A reasonable approach is to assign two or three short after-class practice tasks each week, with each practice lasting eight to twelve minutes. Parents only need to remind students to finish the practice. They do not need to give professional scores. The practice records generated by the system can be reviewed by teachers regularly, and common problems can be addressed in later classes.

6.5. Risk Governance: Protecting Minors' Data in Advance

When intelligent action recognition enters school, it must address image collection, posture data processing and algorithmic evaluation boundaries for minors. The Personal Information Protection Law of the People's Republic of China requires personal information processing to follow the principles of legality, legitimacy, necessity and good faith [13]. Therefore, when schools collect student movement videos, posture data and practice records, they should clearly define the purpose, use scope, storage period and management responsibility.

The Regulations on the Protection of Minors in Cyberspace set special requirements for online protection, personal information protection and cyber environment governance for minors [14]. Accordingly, AI-assisted Baduanjin teaching should observe five boundaries. First, only movement data directly related to teaching should be collected. Second, local processing, blurring or de-identified storage should be preferred. Third, individual movement videos and system scores should not be disclosed. Fourth, system feedback should be an auxiliary source for teacher evaluation, not the only basis. Fifth, schools should explain data collection purposes, use scope, storage time and withdrawal mechanisms to students and guardians.

7. Discussion

The value of intelligent action recognition in Baduanjin teaching can be understood in three aspects.

First, it can improve the standardization of traditional sports teaching. Baduanjin does not pursue competitive difficulty, but its movement routes, body posture and rhythm still require clear guidance. Through key-point recognition and deviation prompts, the AI system can help teachers identify common problems in hand position, stance, trunk posture and center-of-gravity control.

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Second, it can strengthen the process orientation of school physical education. Traditional physical education assessment often emphasizes results and neglects the learning process. Action recognition and practice records can show the trajectory from first learning to gradual improvement. When used appropriately, process data can enhance students' self-feedback and help teachers adjust subsequent teaching.

Third, it can support the shift of Baduanjin promotion from temporary activity to regular curriculum content. If Baduanjin is used only as a display project, participation may remain short-term. If it is supported by curriculum resources, classroom correction, after-class tracking and evaluation feedback, it is more likely to become a stable traditional sports component in school physical education.

The proposed model also has clear boundaries. Intelligent action recognition is affected by camera angle, light condition, student position, clothing occlusion and multi-person scenes. Recognition results may contain errors. Baduanjin also includes breathing, intention, relaxation and tension changes and cultural experience. These dimensions cannot be fully captured by visual recognition. Therefore, AI-assisted teaching should not be understood as a complete replacement for Baduanjin instruction. It should be positioned as an auxiliary tool for classroom observation and process evaluation.

The integration of intelligent action recognition with traditional Health Qigong teaching also provides a possible route for the digital inheritance of excellent traditional Chinese sports. By building standard movement resource libraries, digital learning records and intelligent feedback mechanisms, schools can improve the standardization and dissemination efficiency of traditional exercise teaching.

8. Conclusion

Intelligent action recognition can enhance movement observation, deviation detection and timely feedback in Baduanjin teaching. In response to inconsistent movement standards, insufficient in-class correction, weak after-class practice continuity and subjective evaluation, the technology can provide teachers with more visible teaching support and students with more timely learning feedback through body key-point recognition, movement feature analysis and process recording.

This paper constructed an AI-assisted Baduanjin teaching model for adolescents that includes pre-class standard resource preparation, in-class action recognition and correction, post-class practice tracking and multidimensional learning evaluation. The model is led by teachers and supported by intelligent action recognition. It connects resource construction, classroom teaching, after-class practice and learning evaluation into a closed loop, thereby providing a practical framework for the digital transformation of Baduanjin teaching.

This paper also proposed a campus implementation pathway that combines curriculum embedding, teacher empowerment, platform support, school-family collaboration and risk governance. The school-based promotion of Baduanjin should proceed gradually. It should improve curriculum resources, strengthen teachers' digital literacy, optimize platform functions and protect minors' data before deeply integrating intelligent action recognition with school physical education.

This study is a model construction and application design study. It has not conducted real teaching experiments. Therefore, it cannot directly prove that the model significantly improves students' movement quality or health level. Future research may use action research, quasi-experimental research or mixed methods across different school stages and school resource conditions to test the applicability, implementation cost and actual teaching effects of the model.

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