Research on the Application and Strategies of AI Empowerment in Sanda Technique Teaching and Correction in Higher Education under the Guidance of Educational Reform

Donghui Tan[1,*], Zherao Le[2]
[1] *School of Physical Education and Art, Jiangxi University of Science and Technology, Ganzhou, Jiangxi, China*
[2] *School of Science, Jiangxi University of Science and Technology, Ganzhou, Jiangxi, China*
**Corresponding Author*

Abstract: Under the context of "Five-Education Integration" and Educational Digital Transformation, this study addresses the issue of insufficient precision and low efficiency in artificial motion correction in Sanda (Chinese Kickboxing) teaching at higher education institutions. Given the exploratory demands of the early stage of educational reform, which emphasizes "small-scale entry point and easy implementation," this research aims to explore the initial application path of AI motion recognition technology in correcting core Sanda techniques, verify its technical feasibility and practical effectiveness, and provide replicable pilot strategies for the integration of sports teaching technology in the early stage of educational reform. A total of 30 non-physical education undergraduate students from the Sanda elective course at Jiangxi University of Science and Technology were selected as participants. The experimental group and control group (15 students each) were randomly assigned based on "random sampling and baseline level matching." There were no significant differences between the two groups in terms of gender composition, sports foundation, previous technique standardization, or physical fitness (P>0.05), ensuring balanced and comparable baseline data. This study employed experimental and mixed research methods, with an experimental period of 8 class sessions (1 teaching cycle). The experimental group adopted the "AI motion recognition-assisted + manual guidance" correction model, where a lightweight motion recognition tool was used to capture core movements such as the straight punch and roundhouse kick in real-time. After quantifying and comparing the movements, immediate correction suggestions were provided. The control group used the traditional "teacher demonstration - manual error correction" model. Data was collected through motion standardization scoring, error correction duration statistics, teacher-student feedback questionnaires, and semi-structured interviews. Statistical analysis was conducted using SPSS 26.0. After the intervention, the experimental group showed a significantly higher improvement in core technique standardization compared to the control group, with a notable reduction in error correction time, demonstrating the effectiveness of the technological application. Both teachers and students exhibited a high level of acceptance of AI motion recognition technology, with teachers reporting that it effectively reduced the burden of individualized guidance. The study indicates that this technology, through precise quantification and real-time feedback, can break through traditional teaching bottlenecks. It is recommended that, in the early stage of educational reform, core technique correction should be used as an entry point, with a lightweight solution promoted for integration.

Keywords: AI Motion Recognition; Higher Education Sanda Teaching; Motion Correction; Educational Reform; Pilot Application

1. Introduction

Under the dual impetus of Five-Education Integration and Educational Digital Transformation, physical education in higher education institutions is undergoing a reform toward greater precision and individualization. In the early stage of Educational Reform, more emphasis is placed on resolving teaching bottlenecks through a small-scale entry point and easy implementation approach[1]. Sanda (Chinese Kickboxing), as a discipline that integrates traditional Wushu with modern sports, faces significant shortcomings in both technical inheritance and teaching practice. The conventional pedagogy heavily relies on the model of "teacher demonstration–student imitation–manual correction". However, classroom teaching by instructors is constrained by limited observation perspectives, which hinders the correction of technical movements such as Uppercut, Side Kick, and Roundhouse Kick. Consequently, corrective feedback often suffers from strong subjectivity, delayed error judgment, and inconsistent standards, making it difficult to ensure students' motion standardization. Furthermore, given the substantial variability in students' physical fitness and foundational skill levels, traditional instruction lacks individualized guidance, making it challenging to achieve personalized training. This disparity severely limits the potential for quality improvement and efficiency enhancement in teaching outcomes [2]. Additionally, during the initial phase of educational reform, resources are limited. To avoid complex systemic restructuring, there is an urgent need for low-cost and highly effective solutions that integrate technology seamlessly [3]. The integration of AI motion recognition technology provides essential support in addressing the aforementioned challenges. Leveraging its core advantages—real-time pose capture, quantitative comparison and analysis, and instant feedback recommendations—AI aligns precisely with the instructional needs of Sanda. This integration not only compensates for the limitations of manual correction in terms of accuracy and efficiency but also facilitates individualized teaching through data-driven analysis that accounts for students' personal differences. Moreover, through pilot applications on a small scale, the feasibility of such technology can be rapidly validated in the early stages of Educational Reform, thereby accumulating practical experience for the subsequent digital transformation of physical education. This approach promotes the deep integration of Sanda instruction with modern educational technology, advancing quality improvement and efficiency enhancement in physical education under the framework of Five-Education Integration [4].

2. Core Needs of Technique Correction in Sanda Instruction

The core needs of technique correction in Sanda instruction focus on facilitating students' mastery of standardized movements through scientific and efficient methods, thereby consolidating technical foundations. Simultaneously, these needs align with the early-stage reform orientation characterized by "small-scale entry point and high effectiveness." Fundamental Sanda techniques, such as the Straight Punch, Roundhouse Kick, and Hook, demand high levels of standardization and continuity. Even subtle deviations in movement range, force generation sequence, or body posture may not only compromise technical execution but also significantly increase the risk of sports-related injuries. Therefore, the primary requirement of technical correction is to establish a unified and quantifiable standard, eliminating the reliance on teachers' subjective judgment based on personal experience in traditional instruction. This enables precise identification of movement deviations and root cause analysis [5]. Secondly, correction must exhibit real-time responsiveness. If errors in student movements are not promptly identified and addressed during practice, they may lead to the formation of muscle memory, making subsequent correction significantly more difficult. This necessitates that feedback be synchronized with the pace of practice, delivering targeted guidance at the moment of action completion or within a very short time frame, thereby assisting students in rapidly adjusting their body posture [6]. At the same time, there exists considerable individual variability among students in terms of physical fitness, motor skill foundations, and cognitive comprehension. Some students may suffer from inaccuracies in force application points, while others may experience movement distortion due to limited flexibility. As such, corrective methods must accommodate individualized adaptation, avoiding a "one-size-fits-all" approach. Instead, they should provide differentiated solutions tailored to each student's specific technical shortcomings [7]. Moreover, during the initial phase of Educational Reform, both instructors and students often exhibit limited acceptance of and proficiency with technological tools. Therefore, correction methods must also possess qualities of simplicity and adaptability. They should be implementable through lightweight solutions, seamlessly integrating with existing traditional teaching workflows without imposing additional instructional burdens. Ultimately, by delivering precise, real-time, and individualized correction, such approaches can effectively support students in rapidly improving their action compliance, thereby laying a solid foundation for subsequent technical advancement and practical combat application [8].

3. Application Principles of AI Motion Recognition Technology

The application of AI motion recognition technology in the correction of Sanda teaching primarily relies on computer vision and deep learning algorithms to establish an operational framework of "collection–analysis–comparison–feedback," precisely tailored to meet the practical needs of technical instruction in Sanda [9]. The foundational principle involves using lightweight hardware—such as high-definition cameras and portable sensors—as data acquisition interfaces to capture, in real-time, the body posture of students when performing key techniques such as the straight punch and roundhouse kick. Through object detection algorithms, the system rapidly locates critical skeletal keypoints including the torso and limbs, thereby generating dynamic skeletal models. On this basis, motion feature extraction techniques are employed to convert the core elements of Sanda techniques—such as the force generation sequence, joint angles, movement range of limbs, and center of gravity shift trajectories—into quantifiable digital features. Simultaneously, a pre-established standard motion template library for Sanda is invoked. This template library is constructed from the technical data of professional athletes and encompasses standardized parameter intervals for various techniques [10]. By employing deep learning models to compare student motion features against standard templates, the system can precisely identify both the dimensionality and degree of deviation—for instance, excessive elbow flexion during a straight punch or insufficient hip rotation during a roundhouse kick. Furthermore, the algorithm traces the root causes of these deviations [11]. Ultimately, the technology transforms abstract numerical analyses into intuitive, visualized feedback—such as motion overlap comparison charts and textual correction suggestions—which are delivered in real-time to the instructional setting. This enables an immediate response cycle of “technique execution–deviation recognition–precision guidance,” thereby overcoming the subjective limitations of traditional manual correction. Moreover, through a data-driven and standardized approach, it fulfills the precision and immediacy requirements of Sanda technique correction. This system also aligns with the low-cost, easy-to-implement, practice-oriented demands of the early stages of Educational Reform, and can be deployed without the need for complex equipment. (As shown in table 1)

Table 1. Core Technical Parameters

Technical Module	Specific Indicators	Adaptability Description
Skeletal Joint Localization	17 keypoints; localization error ≤ 2 mm	Covers core joints involved in limb force generation in Sanda
Motion Comparison Speed	Single-frame processing time ≤ 50 ms	Meets the real-time feedback requirement
Template Library Size	20 sets of standard data for each: Straight Punch, Roundhouse Kick, Hook, Side Kick	Matches core technique training in the experimental phase
Hardware Requirements	Standard PC + 2–3 4K cameras	Conforms to lightweight deployment specifications

4. Pilot Application Plan for AI Motion Recognition Technology

The pilot application plan of AI motion recognition technology centers on the principles of "lightweight implementation, low-burden integration, and high-efficiency validation," aligning with the initial phase of educational reform characterized by limited resources and small-scale exploratory trials. In terms of technology selection, the plan prioritizes low-cost and user-friendly tool combinations. The software component adopts the open-source framework OpenPose in conjunction with basic commercial motion analysis software, eliminating the need for complex customized development. The system is operable on standard instructional computers, effectively lowering the technical entry barrier. Hardware configuration is tailored to fundamental instructional needs: for a class size of approximately 30 students, 2–3 4K high-definition cameras are deployed, strategically positioned at the side and oblique front of the training area to ensure comprehensive coverage of four core technical movements—Straight Punch, Roundhouse Kick, Hook, and Side Kick—without blind spots. This setup avoids the need for additional expensive sensors or wearable devices [12]. The construction of the standard motion template library is based on standardized movements demonstrated by professional Sanda coaches. Through multi-angle video capture and movement decomposition, key quantifiable parameters—such as joint angles, force generation sequence, and center of gravity shift trajectories—are extracted to form visual comparative models. At the same time, parameter adjustment flexibility is reserved, allowing for appropriate optimization of standard thresholds based on student group characteristics (e.g., limited foundational skills among university elective course participants) [13]. The pilot process is seamlessly integrated into the conventional teaching rhythm. One class session prior to instruction is allocated for inputting standard motion templates and conducting baseline technical movement tests for students. The system automatically establishes individualized learning profiles, clarifying the initial level of motion standardization. During instruction, a "group practice + real-time correction" model is employed. Groups of 5–6 students take turns performing techniques, while the AI system captures movements in real time and compares them against the standard templates. Deviations are displayed synchronously on a screen, identifying specific issues (e.g., "Roundhouse Kick hip rotation angle less than 30°") along with correction diagrams. Instructors concentrate on providing individualized guidance for issues not covered by the system. After class, students may upload self-practice videos via mobile devices or computers. The system conducts secondary analyses and generates weekly training reports that specify areas for improvement. Teachers, in turn, review the aggregated class data to adjust the instructional focus of subsequent sessions. The plan also emphasizes operational simplicity. A one-time, one-hour centralized training session is provided in advance for instructors to ensure proficiency in equipment setup, data monitoring, and basic troubleshooting. Students are not required to learn additional operational procedures; they simply engage in regular practice, during which the system autonomously captures their movements. The entire plan integrates smoothly with the traditional teaching workflow, without imposing additional instructional burdens on either teachers or students. Simultaneously, the system records key metrics such as motion compliance rate, duration of error correction, and user feedback from both instructors and students. These data provide empirical support for subsequent effectiveness evaluation and strategic optimization. (As shown in figure 1)

Figure 1. AI Motion Capture + Instructor Guidance

5. Experimental Design

5.1 Experimental Subjects

The experimental subjects consisted of 30 students enrolled in the 2025 cohort of the Sanda elective course at Jiangxi University of Science and Technology. All participants were undergraduate students from non-physical education majors, with no prior professional training in Sanda, aligning with the core demographic targeted in the initial stage of Sanda teaching reform in higher education (see Table 2). To ensure fairness and validity of the experiment, a grouping strategy combining random sampling and baseline level matching was employed, evenly dividing the 30 participants into an experimental group and a control group, with 15 students in each group. Prior to grouping, data collection included a preliminary movement test—covering four core techniques: Straight Punch, Roundhouse Kick, Hook, and Side Kick—along with a basic information questionnaire to gather data on gender, athletic background, and physical fitness. Independent Samples t-test results confirmed no significant difference ($P > 0.05$) between the two groups across key indicators, establishing comparability. The motion standardization scores from the preliminary test were jointly assessed by three instructors using a unified evaluation rubric, where Movement Range, Force Generation Sequence, and Postural Stability each accounted for 30%, and Movement Fluency accounted for 10%. Endurance was assessed through standardized scoring of the 800-meter run. All data were subjected to Statistical Analysis using SPSS 26.0 to ensure baseline equivalence across groups. This provided a reliable foundation for evaluating the effect of the Independent Variable—AI-based motion recognition-assisted correction—on the teaching outcomes.(As shown in table 3)

Table 2. Instructional Implementation Process

Teaching Stage	Duration	Experimental Group Procedure	Control Group Procedure
Fundamental Explanation	1 session	Instructor demonstration + AI template preview	Instructor demonstration + verbal explanation of key techniques
Segmental Practice	4 sessions	Grouped training → AI real-time capture → deviation prompts → instructor support	Grouped training → visual error correction by instructor
Integrated Training	2 sessions	Full movement practice → weekly AI-generated report	Full movement practice → centralized instructor feedback
Comprehensive Evaluation	1 session	AI preliminary assessment + instructor verification scoring	Independent scoring by instructor

Table 3. Basic Information and Baseline Equivalence Verification of Experimental Subjects

Indicator Dimension	Experimental Group (15 students)	Control Group (15 students)	Equivalence Verification Result
Gender Composition	9 males, 6 females (male-to-female ratio 3:2)	8 males, 7 females (male-to-female ratio 8:7)	No significant difference (P = 0.78)
Sports Background Distribution	12 with no background, 3 with amateur experience (20% with background)	11 with no background, 4 with amateur experience (27% with background)	No significant difference (P = 0.63)
Average Scores in Preliminary Action Compliance	Straight Punch: 62.3, Roundhouse Kick: 58.7, Hook: 65.2, Side Kick: 60.1 (Overall: 61.6)	Straight Punch: 61.8, Roundhouse Kick: 59.2, Hook: 64.7, Side Kick: 59.8 (Overall: 61.4)	No significant difference (P = 0.92)
Physical Fitness – 800m Endurance Test Score	78.5 (out of 100)	77.9 (out of 100)	No significant difference (P = 0.85)

5.2 Experimental Variables

In the configuration of experimental variables, the independent variable is the method of movement correction. The experimental group adopted a hybrid model combining AI-based motion recognition with manual assistance, while the control group relied solely on manual correction. The dependent variables included: the compliance rate of standardized movements, the duration required for error correction, and learning satisfaction. To eliminate interference from extraneous variables, the instructional content, class hours (eight sessions, 90 minutes each, as detailed in Table 4), instructor (same teacher for both groups), and training venue (fixed Sanda training hall) were all held constant. Additionally, a standardized teacher guidance workload protocol was implemented: each instructor's guidance time per subgroup (5 students per group) was limited to 15 minutes, with feedback frequency controlled at one intervention per three practice rounds, ensuring equal instructional input for both groups.

5.3 Experimental Procedures

The experiment was conducted in an orderly manner across the three instructional stages: pre-class, in-class, and post-class. Prior to the class, both the experimental group and the control group completed baseline assessments of fundamental techniques. Simultaneously, AI-based standard technique templates were recorded for the experimental group. During the class sessions, teaching was implemented following the pre-designed pilot protocol, with synchronous data collection. After class, both groups underwent performance assessments for technique compliance. Additionally, students completed satisfaction questionnaires, and teachers participated in interviews to gather qualitative feedback. Data collection and analysis incorporated both quantitative and qualitative approaches. In the quantitative domain, the technique compliance rate was determined through AI scoring corroborated by instructor review, while correction duration was measured using a timing-based method. For qualitative data, questionnaire ratings and interview transcripts were coded and analyzed, providing comprehensive support for validating the experimental outcomes.

5.4 Experimental Content

The experiment focused on four core techniques of Sanda: the Straight Punch, Roundhouse Kick, Hook, and Side Kick. The total duration was eight instructional sessions, each lasting 90 minutes. The emphasis was placed on standardized technique instruction and precise correction. Both the experimental and control groups received identical instructional content and training intensity, with the only difference being the method of technique correction. The instructional process followed a four-phase progression: "Fundamental Explanation – Segmental Drills – Integrated Training – Comprehensive Evaluation." In the first instructional session, the same instructor provided standard demonstrations of the core techniques and detailed explanations of the technical essentials, clarifying standardized requirements such as the force generation sequence and joint posture. Students in both the experimental and control groups simultaneously engaged in foundational imitation drills. The subsequent six sessions were dedicated to targeted correction training. Each group was divided into rotating subgroups of five students, with each subgroup engaging in a 15-minute practice session followed by a 5-minute rest before switching to the next group. During practice, the experimental group was monitored using pre-installed high-definition cameras that captured real-time motion data. The AI motion recognition system synchronously extracted key parameters, such as joint angles and force generation timing. These were quantitatively compared against the standard motion templates, and immediate feedback was presented on a computer interface. This feedback included visualized correction suggestions (e.g., posture overlay comparison images, textual guidance). For individual-specific issues not fully addressed by the system—such as deviations caused by limited body flexibility—teachers provided supplementary individualized guidance. In contrast, the control group received corrections based on the instructor’s visual observation and experiential judgment, using traditional methods such as verbal cues and hands-on demonstrations to correct movement errors.

Table 4. Instructional Comparison Between Control Group and Experimental Group

Comparison Dimension	Control Group (Without AI Assistance)	Experimental Group (With AI Assistance)	Core Performance Differences
Improvement in Motion Standardization	Minimal improvement; relies heavily on teacher's subjective judgment; limited enhancement in action compliance	Significant improvement; AI-based quantitative correction (e.g., joint angles); higher compliance rate	Eliminates subjective human limitations; far superior efficiency in enhancing motion standardization
Time Required for Error Correction	Prolonged correction; errors become habitual, increasing difficulty of later remediation	Shorter correction time; AI provides real-time feedback (single-frame processing ≤50ms), reducing error consolidation	Real-time feedback improves correction efficiency and reduces the likelihood of error memory formation
Teacher’s Individualized Guidance Load	Heavy workload; difficult to address individual differences; requires full-time attention for each group (5 students)	Reduced workload; AI handles basic error correction, allowing teachers to focus on individualized issues	Enables teachers to concentrate on targeted guidance, enhancing instructional precision
Technique Compliance Rate	Low compliance; subjective scoring with inconsistent standards; poor mastery of core techniques	High compliance; AI preliminary assessment combined with teacher verification; consistent quantitative scoring	Minimizes subjective influence; objectivity and accuracy of scoring greatly surpass the control group

6. Analysis of Core Issues in the Application of AI Motion Recognition Technology in Sanda Teaching

In the early stages of the educational reform, the application of AI motion recognition technology in Sanda teaching faced multiple practical constraints. The core challenges are interwoven across three primary dimensions: technological adaptation, pedagogical integration, and resource support. Due to the limitations in the selection of lightweight equipment at the outset of the reform, combined with the explosive force and complex limb trajectories inherent in Sanda techniques, the accuracy of motion recognition is highly susceptible to environmental interference. Factors such as deviations in camera angles, variations in lighting conditions, or differences in student clothing colors can all result in missed detections or misjudgments of skeletal keypoints. This issue is particularly pronounced for high-amplitude dynamic techniques such as the roundhouse kick and side kick, where inaccuracies in quantifying the force generation sequence are more likely to occur. Moreover, a number of instructors lack experience in digital pedagogy, which impairs their ability to effectively tune system parameters, interpret data, and troubleshoot basic malfunctions. On the student side, receptivity to the visualized real-time feedback interfaces varies considerably. Those with weaker foundational skills may experience cognitive overload, leading to resistance or frustration, thereby exacerbating the challenges of technological adaptation. These interrelated issues underscore the necessity for a more nuanced and context-aware implementation strategy when integrating AI motion recognition technology into Sanda instruction under the guidance of educational reform. At the level of teaching integration, there exists a disconnect between technological applications and traditional instructional workflows. The correctional feedback generated by AI systems is predominantly standardized data output, making it difficult to precisely identify the root causes of movement distortion that stem from individual differences, such as insufficient flexibility. Furthermore, these systems fail to provide targeted adjustment strategies, necessitating additional individualized guidance from instructors, thus falling short of the goal of “reducing teaching burden through technology.” Some instructors also exhibit a tendency toward “emphasizing technology over pedagogy,” placing excessive reliance on system-generated feedback while neglecting in-person interactive instruction. As a result, technological tools risk becoming mere “error-correction machines,” which undermines the fundamental educational mission of cultivating students both in skill and character. From the perspective of resource support, the initial phase of the educational reform is constrained by limited funding and technical infrastructure. There is an absence of long-term mechanisms for equipment maintenance, software updates, and data security management. In the event of hardware malfunctions or system lag, there is typically no prompt response mechanism in place, which directly disrupts instructional continuity. Additionally, the lack of a dedicated professional technical support team means that individualized technical challenges encountered by instructors during implementation often go unresolved in a timely manner, further limiting the depth and effectiveness of AI technology integration in Sanda teaching.

7. Optimization Strategies

In response to core challenges encountered in the early stages of educational reform—namely technology adaptation, instructional integration, and resource assurance—the optimization strategies must adhere to the principles of “lightweight implementation, low-cost adaptation, and high-efficiency integration,” ensuring a precise alignment between technological applications and instructional needs. In terms of technology adaptation, priority should be given to enhancing recognition accuracy through preliminary scenario debugging. This involves pre-setting multi-angle shooting schemes tailored to the characteristics of Sanda movements, avoiding areas with direct lighting, and standardizing student training attire to minimize environmental interference. Additionally, AI algorithm parameters should be fine-tuned for key techniques such as the Straight Punch and Roundhouse Kick, with a focus on improving the specificity of dynamic trajectory tracking and the quantification of force generation sequences. The system interface should be streamlined, centering core functionalities within three primary modules: "Motion Capture – Deviation Alerts – Correction Suggestions." To facilitate operational efficiency, instructors should undergo 1–2 short, hands-on training sessions, supported by a user-friendly, illustrated instruction manual to rapidly gain proficiency in equipment calibration and data interpretation. For students, feedback presentation should be simplified, relying mainly on intuitive motion comparison diagrams and concise textual prompts to avoid information overload [14]. At the level of instructional integration, a collaborative model of "AI-assisted + teacher-led" teaching should be established. The AI system is designated to focus on the standardization and error correction of fundamental technical movements, while teachers concentrate on addressing complex issues stemming from individual student differences. Prior to class, instructors can analyze learning analytics data generated by the system to pre-identify students' key weaknesses. During instruction, targeted guidance is provided based on AI-generated feedback. Meanwhile, the system's quantitative data should be translated into accessible pedagogical language, ensuring a smooth alignment between technological feedback and instructional context. This approach prevents the tendency toward "emphasizing technology over pedagogy," safeguarding the core educational objective of cultivating virtue and fostering talent. In terms of resource assurance, the foundational application framework should be constructed using open-source software and existing teaching equipment to minimize financial investment. A three-tiered support mechanism—comprising "teacher feedback – basic technical troubleshooting – technical support from the university's IT department"—should be implemented to ensure prompt response to equipment malfunctions and system lag issues. Periodic collection of user feedback from teachers and students will support the development of lightweight optimization and iterative upgrade plans, enabling continuous enhancement of technological compatibility without requiring complex system overhauls. This ensures the stable deployment and practical effectiveness of AI applications in the early phase of educational reform, even under conditions of limited resources.

8. Conclusion

Anchored in the core orientation of "small-scale entry point, easy implementation" during the early stage of Educational Reform, this study addresses the critical issues in Sanda instruction within higher education, specifically the limited precision and low efficiency of manual motion correction. It explores the application pathways and pilot strategies of AI motion recognition technology in the correction of core technical movements. Through a controlled group experiment involving 30 non-physical education undergraduates from Jiangxi University of Science and Technology, core techniques such as the straight punch and roundhouse kick were used as training focal points. A lightweight technical solution was employed to establish a teaching model characterized by "AI-assisted, human-led" instruction. The results demonstrated that this approach significantly improved motion standardization and reduced the time required for correcting errors. Moreover, it clarified the appropriate scenarios and essential boundaries for technology integration in the early phase of educational reform. The theoretical contributions of this study confirm the compatibility between AI technology and the initial reform stage of Sanda instruction, constructing a preliminary research framework and enriching the theoretical discourse on the digital transformation of physical education. On the practical level, the pilot implementation plan, outcome analysis report, and core strategic framework developed in this research offer a replicable operational blueprint for integrating technology into Sanda elective courses for non-sports majors, especially in regional science and engineering universities with similar student profiles at the early stage of educational reform. This study not only addresses the inherent limitations of traditional teaching methods—such as restricted observational perspectives and limited instructional bandwidth—but also offers a new pathway for quality improvement and efficiency enhancement in physical education under the framework of "Five-Education Integration," through a low-cost yet highly effective pilot model. It is important to acknowledge that the pilot was conducted on a relatively small scale and over a short duration. Future research should expand the sample size and extend the experimental period to further investigate the integration of AI technologies with practical combat training. Incorporating multimodal data such as electromyographic (EMG) signals and pressure sensors could enhance recognition accuracy, facilitating deeper application of AI in Sanda instruction and propelling the digital transformation of physical education toward higher-quality development.

References

[1] Wang Jianjun, Li Xiaotong, Zhang Liguo. Research on the Reform Path of College Physical Education Curriculum under the Perspective of "Five-Education Integration".

China Sport Science, 2021, 41(5):78-85.

[2] General Administration of Sport of China. 2023 White Paper on Physical and Mental Health of Chinese College Students. Beijing: People's Sports Publishing House, 2023:45-52.

[3] Zhang Bingbing, Zhao Baishan. Sanda Action Recognition and Evaluation Method Based on Skeletal Keypoints. Microprocessors, 2023, 44(6):36-39.

[4] Hu Ti, Min Hang. Application Research on the Empowerment of Physical Education Teachers' Professional Development through Generative Artificial Intelligence. Journal of Shenyang Sport University, 2025, 44(1):1-8.

[5] Xu Weikang. The Legitimacy Dilemma and Response of Artificial Intelligence in Sports Refereeing. China Sport Science, 2022, 42(11):90-97.

[6] He Lei. Research on Signal Acquisition and Recognition Method of Intelligent Protective Gear under Impact. Shenyang University of Technology, 2022.

[7] Yang Wanpeng, Li Qing, Lei Ming. Research on Feature-Level Fusion LSTM-CNN Method for Human Action Recognition. Electronic Measurement Technology, 2021, 44(17):173-180.

[8] Xu Haibo. Innovative Pathways of Integrating Artificial Intelligence into the Reform of Physical Education Teaching in Colleges and Universities. Journal of Lishui University, 2024, 46(2):123-128.

[9] Meng Xiangpu, Li Shuo, Yuan Mingzhe, et al. Human Skeleton-Based Action Recognition: A Review and Prospects. Information and Control, 2025, 54(1):1-27.

[10] Li Sen. Research on the Application Strategies of Artificial Intelligence in the Reform of College Physical Education Teaching. Hubei Open Vocational College, 2024, 37(9):167-168.

[11] Shen Liang, Zhang Bo, Chen Xiangwei. Practical Implication, Theoretical Interpretation and Implementation Path of Chinese-Characteristic Physical Education Curriculum under the Perspective of "Five-Education Integration". Journal of Shanghai University of Sport, 2024.

[12] Zhang Yu. Research on the Application of AI Technology in Physical Education Teaching in Primary and Secondary Schools. Journal of The Chinese Society of Education, 2022(5):89-93.

[13] Shao Mingjun, Ding Yi, Zhang Zhanping, et al. Research on the Physical Health Status of College Students. New Sports, 2025(10):98-100.

[14] Liu W, You D, Fu Z, et al. Sanda Training Program Based on Multi-Sensor Data Fusion in the Internet of Things Environment. International Transactions on Intelligent Systems, 2023, 47:1-15.

