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Research on the Reconstruction and Practice of University Orienteering Curriculum System from the Perspective of MTE Three-dimensional Empowerment

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Abstract: Against the background of comprehensive physical education reform, university orienteering courses are plagued by undifferentiated teaching content, superficial digital teaching application and result-oriented single evaluation, which leads to students' weak learning motivation and ineffective individualized instruction. This study constructs an MTE three-dimensional empowerment framework including Motivation stimulation, Technology empowerment and Evaluation guarantee to reconstruct the whole orienteering curriculum system from stratified content design, lightweight digital teaching and multi-dimensional process evaluation. A semester-long controlled teaching experiment is conducted with 400 students divided into experimental class and control class. Quantitative data and qualitative interview results show that the three-dimensional collaborative reform significantly reduces students' learning weariness, raises the skill mastery rate by 20.5 percentage points and lifts curriculum satisfaction above 90%. The low-cost digital tools cut teachers' data processing workload by over 66%, and differentiated all-process evaluation balances the development of students with different physical and logical strengths. The proposed integrated reform paradigm is low-cost and replicable, which provides theoretical framework and operable practice reference for outdoor physical education curriculum innovation in universities.

1. Introduction

The national policy document Opinions on Comprehensively Strengthening and Improving School Physical Education in the New Era advocates the educational concept of "health first" and promotes all-round innovation in physical education curriculum content, teaching methods and evaluation mechanisms[1]. As a featured general physical education course, orienteering integrates map reading, route planning, team cooperation and outdoor physical training, possessing dual educational value of intellectual cultivation and physical fitness improvement[6]. Nevertheless, regular orienteering teaching in universities is trapped in three typical drawbacks. First, uniform

teaching tasks fail to match students' varied athletic foundations, resulting in weariness among beginners and lack of challenges for advanced learners[2]. Second, information technology is merely used for timing checkpoints rather than supporting data-driven precise teaching, forming a superficial digitalization dilemma[7]. Third, assessment excessively relies on final race completion time, ignoring learning process and personal progress, thus failing to sustain students' continuous participation motivation[4].

Existing domestic studies mostly focus on stratified teaching design, digital equipment application or process evaluation optimization separately, lacking an integrated reform model linking learning motivation, digital technology and curriculum evaluation[5]. Most teaching reform schemes rely on high-cost professional equipment, setting high thresholds for popularization[10]. Given the above contradictions, this research establishes an integrated MTE three-dimensional empowerment framework, deeply integrating motivation stimulation, lightweight digital support and differentiated evaluation guarantee to build a brand-new complete orienteering curriculum system. A controlled teaching experiment is carried out to verify the reform effect, exploring a low-cost and replicable path for outdoor physical education curriculum reform in universities[3].

2. Core Concepts and Theoretical Logic

2.1 Connotation Definition of MTE Three-dimensional Empowerment

1) Motivation stimulation (M): Taking stratified gradient curriculum content as the carrier, matching learning demands of three groups including beginners, intermediate learners and advanced students, and supporting hierarchical incentive mechanisms to eliminate students' weariness and activate autonomous learning willingness fundamentally[2].

2) Technology empowerment (T): Relying on students' personal smart terminals, free AI teaching tools and campus online teaching platforms, lightweight upgrading is conducted on existing checkpoint devices to build a closed digital teaching loop covering pre-class preview, in-class data analysis and after-class personalized feedback, supplying data support for stratified teaching and multi-dimensional evaluation [3,9].Relevant practice has proved that free lightweight digital tools can effectively reduce the procurement cost of intelligent sports teaching equipment[10].

3) Evaluation guarantee (E): Establishing a differentiated and full-process multi-dimensional evaluation system covering physical ability, strategic thinking, teamwork and progress amplitude. Scientific evaluation reversely regulates learning motivation and forms a closed loop for continuous improvement of teaching quality[4].

2.2 Collaborative Operation Logic of MTE Three Dimensions

M, T and E form a circular supporting relationship. Motivation stimulation acts as the core goal of curriculum reform, and stratified curriculum content lays the implementation foundation for digital teaching and multi-dimensional evaluation[2]. Technology empowerment serves as the intermediate supporting carrier, solving difficulties in identifying student levels and quantifying process evaluation through collecting full-cycle learning data[8]. Evaluation guarantee works as the long-term adjustment mechanism, optimizing stratified teaching tasks and digital guiding strategies based on multi-dimensional assessment results[4]. The three dimensions jointly construct a self-consistent curriculum operation system of "content stratification – digital support – evaluation feedback – content iteration".

3. Three Core Teaching Dilemmas of Traditional Orienteering Courses

3.1 Lack of Gradient Curriculum Content and Insufficient Students' Learning Gain

Uniform teaching tasks cannot adapt to gaps in students' athletic ability. Students with weak physical conditions feel frustrated by complicated map reading and route planning, while students with outstanding athletic ability lack challenging training under repeated basic drills[2]. In addition, overemphasis on speed and physical indicators ignores comprehensive literacy training such as route strategy, outdoor emergency handling and team cooperation, making students unable to perceive the diversified educational value of orienteering[6].

3.2 Formalized Digital Application and Lack of Data Support for Precise Teaching

Common electronic checkpoint devices only record total race time, failing to collect refined learning data such as route deviation and checkpoint staying duration reflecting map-reading and planning ability[8]. Teachers have to sort out training data manually after class, which is time-consuming and inefficient[3]. Various teaching tools are isolated from each other without linkage among online preview, trajectory analysis and after-class review. Digital devices are only used for timing in final exams, unable to support individualized teaching[5].

3.3 Competition-oriented Evaluation System and Absent Process Tutoring Mechanism

Final outdoor test scores account for an excessively high proportion of total grades, while process indicators including class participation, phased progress and group cooperation occupy low weights[4]. Without regular periodic assessments, teachers cannot locate students' weaknesses in map reading and route planning timely. Evaluation results are only released at the end of the semester, leading to accumulated learning problems and a vicious cycle of "declining motivation – weak skills – failing assessment".

4. Reconstruction Path of Orienteering Curriculum System Guided by MTE Three-dimensional Empowerment

4.1 Dimension M: Construction of Three-level Gradient Curriculum Content to Stimulate Learning Motivation by Layers

A three-tier teaching content system consisting of basic adaptation layer, ability improvement layer and interest expansion layer is constructed with matched hierarchical incentive mechanisms to cover learning demands of all students, as shown in Table 1[2].

Table 1 Three-level Gradient Curriculum Content and Incentive Design of Orienteering

Tier	Target Students	Core Teaching Content	Supporting Incentive Mechanism
Basic Adaptation Layer	Absolute beginners & students with poor physical fitness	Basic map reading, scale recognition, short-distance individual campus check-in, fundamental checkpoint rules	Obtain basic credits after finishing tasks and issue basic proficiency certificates
Ability Improvement Layer	Students mastering basic map-reading skills	Comparative route planning, distance calculation, medium-long distance practical campus orienteering	Extra points for skill advancement, priority to participate in classroom route scheme discussion
Interest Expansion Layer	Students with strong athletic ability or outstanding logical thinking	Team orienteering competitions, theme fun check-in, simple outdoor emergency practice	Special honors of "Logic Star" and "Cooperation Star"

The three tiers progress step by step. The basic layer guarantees all students to master fundamental skills, the improvement layer meets advanced learning demands, and the expansion layer explores students' unique strengths. The hierarchical content design lowers learning barriers and enhances classroom acquisition for students at all levels.

4.2 Dimension T: Construction of Lightweight Digital Teaching Closed Loop to Support Precise Teaching

Following the principle of low-cost implementation, the digital teaching chain is built through simple hardware upgrading, free AI analysis tools and campus online teaching platforms[3,9]. Before class, electronic maps and VR scene materials are pushed online for preview. During class, upgraded checkpoint devices synchronously collect trajectory data, and AI tools automatically generate analysis reports of students' skill weaknesses[8]. Within 24 hours after training, personalized improvement suggestions are delivered to students via online platforms, which store training data throughout the semester. Digital tools realize automatic data statistics, greatly reducing teachers' manual workload and providing objective quantitative evidence for stratified teaching and process evaluation[10].

4.3 Dimension E: Design of Differentiated Full-process Multi-dimensional Evaluation System

Breaking the single competition-oriented assessment mode, a multi-dimensional evaluation system with "stratified indicators, full-cycle tracking and instant feedback" is established[4]. Firstly, differentiated indicator weights are set: students with weak physical conditions but strong logical thinking are given higher weight on route planning, while students with excellent physical fitness are assessed more on practical competition indicators. Secondly, assessment covers the whole learning process, with total grades composed of class participation (20%), periodic tests (30%), team cooperation (20%) and final comprehensive assessment (30%). Thirdly, an instant feedback and tutoring mechanism is built. Learning data generated by digital equipment realizes same-training feedback, and targeted group tutoring is arranged for students with prominent weaknesses. The complete evaluation indicator system is displayed in Table 2.

Table 2 Comprehensive Evaluation Indicator System of Orienteering under MTE Framework

Primary Dimension	Secondary Evaluation Indicator	Weight	Evaluation Method
Theoretical Foundation	Map reading, scale knowledge, orienteering rules	10%	Online quizzes
Special Skills	Route planning, checkpoint searching, trajectory optimization	30%	AI trajectory data + on-site practical operation
Process Performance	Class attendance, pre-class preview, after-class autonomous practice	20%	Online platform records
Comprehensive Literacy	Team cooperation, problem-solving, outdoor emergency handling	20%	Teacher observation + group mutual evaluation
Progress Amplitude	Difference of periodic improvement, effect of autonomous correction	20%	Comparative analysis of multi-stage training data

5. Teaching Experiment Design and Analysis of Reform Effects

5.1 Experimental Scheme Design

A total of 400 students selecting general physical education orienteering courses in a university are selected as research objects, divided into an experimental group (200 students adopting MTE

three-dimensional empowerment reform mode) and a control group (200 students receiving traditional unified teaching mode). The experiment lasts for a complete semester. The experimental group fully implements three-dimensional systems including stratified curriculum, lightweight digital teaching and multi-dimensional process evaluation, while the control group adopts uniform teaching content, manual data statistics and one-off final assessment. At the end of the semester, skill tests, curriculum satisfaction questionnaires and teacher workload statistics are uniformly conducted to compare teaching effects of the two modes.

5.2 Quantitative Experimental Results and Analysis

Table 3 Comparison of Core Teaching Indicators between Experimental Group and Control Group

Observation Indicator	Control Group (Traditional Teaching)	Experimental Group (MTE Three-dimensional Empowerment)	Variation Range
Comprehensive skill mastery rate	67.00%	87.50%	+20.50%
Proportion of students with insufficient learning motivation	38.00%	14.20%	-23.80%
Overall curriculum satisfaction	62.30%	91.40%	+29.10%
Average single-class data processing time for teachers/h	8.60	2.90	-5.70

Data in Table 3 verify the remarkable improvement of teaching quality brought by the MTE three-dimensional empowerment curriculum system. Stratified teaching effectively relieves students' learning weariness and reduces the proportion of demotivated students below 15%[2]. Digital technology drastically cuts teachers' burden of manual data statistics, and multi-dimensional full-process evaluation greatly improves students' recognition of the course[4].

Table 4 Comparison of Average Course Scores of Students with Different Characteristics

Student Type	Average Score of Control Group	Average Score of Experimental Group	Score Improvement Value
Strong physical ability, average planning ability	72.3	84.6	12.3
Weak physical ability, excellent planning ability	61.5	83.2	21.7
Balanced comprehensive ability	70.8	86.1	15.3

As shown in Table 4, under the traditional unified evaluation mode, students with outstanding route planning ability but poor physical fitness obtain low scores. The differentiated evaluation system in the MTE framework balances weights of physical performance and strategic thinking, fully explores strengths of students with different characteristics, narrows score gaps and realizes diversified educational goals.

5.3 Qualitative Implementation Effects

First, the three-dimensional integrated framework realizes full-chain teaching coordination, avoiding fragmentation problems caused by separate implementation of stratified teaching, digitalization and evaluation reform, and forming a stable and sustainable curriculum operation mode. Second, the whole reform scheme mainly relies on existing campus equipment and free online tools, with low one-time hardware upgrading investment and no long-term operation and

maintenance costs, suitable for general undergraduate and private universities with limited education funds[7,10]. Third, the pre-class – in-class – after-class digital closed loop breaks time-space restrictions of outdoor teaching. Online preview and after-class autonomous review expand teaching scenarios and make up for insufficient in-person tutoring time in outdoor courses[3].

To further verify the practical value of the MTE three-dimensional empowerment model, the research organized semi-structured interviews with 12 course teachers and 36 students of different learning levels after the semester experiment. From the teacher interview feedback, all instructors pointed out that the stratified three-tier teaching content clarified the differentiated teaching objectives, and the automatic data output function of lightweight digital tools eliminated repetitive manual sorting work every week. In the past, teachers needed to spend nearly one whole day sorting checkpoint records, student route mistakes and score data after each outdoor training; now the platform can generate complete analysis reports within 10 minutes, so teachers can shift more energy to targeted tutoring and classroom activity design rather than trivial data statistics. Teachers also mentioned that the differentiated multi-dimensional evaluation standard fundamentally changed the single scoring logic dominated by running speed, and no longer appeared the phenomenon that students with strong logical thinking but poor physical fitness got extremely low comprehensive scores, which greatly balanced the fairness of curriculum assessment[4].

Student interview results further confirm the positive effect of motivational hierarchical design. Beginner students with weak physical fitness said the basic adaptation layer reduced their sense of frustration in learning, and the credit and certificate incentive mechanism made them have clear learning goals every class[2]. Students in the interest expansion layer reflected that team orienteering competitions and emergency practice tasks brought strong sense of achievement, and the setting of "Logic Star" and "Cooperation Star" encouraged them to actively discuss route planning schemes with teammates[6]. In addition, the whole-process tracking evaluation allowed students to view their own progress data at any time, clearly recognize their deficiencies in map reading or distance calculation, and take the initiative to complete online simulated training after class. Many students mentioned that they no longer regarded orienteering as a simple running course, but a comprehensive course integrating thinking training, team communication and outdoor survival skills, which significantly deepened their recognition of the dual physical and mental educational value of orienteering. This group of interview materials forms complementary qualitative evidence with the quantitative data in Tables 3 and 4, fully proving that the MTE reform not only improves objective teaching indicators, but also optimizes students' subjective learning experience and teachers' teaching experience from multiple dimensions.

6. Practical Problems and Optimization Strategies in Implementation

6.1 Practical Deficiencies

Firstly, some middle-aged and elderly teachers lack proficiency in operating digital tools, failing to make full use of AI trajectory analysis and online evaluation modules[5]. Secondly, unstable signals of mobile phones and checkpoint devices under rainy outdoor weather lead to missing partial training data[8]. Thirdly, it is difficult to organize simultaneous stratified teaching tasks, and teachers cannot provide balanced guidance for three student tiers in large-size classes[2].

6.2 Long-term Optimization Countermeasures

1) Establish regular campus training mechanisms for digital teaching, compile simple operation manuals and set up technical assistance teams composed of young teachers to improve all

instructors' digital application capacity[5].

2) Switch to indoor simulated map training on rainy days, matching paper maps with online simulated check-in mini-programs to guarantee complete collection of learning data and avoid limitations of outdoor environment[9].

3) Implement a stratified teaching assistant system, selecting outstanding students from the expansion layer to assist teachers in map-reading tutoring for students in the basic layer and ease the pressure of large-class teaching guidance[2].

7. Conclusions and Popularization Value

7.1 Research Conclusions

1) The MTE three-dimensional empowerment framework constructed targeting three major pain points including insufficient curriculum stratification, formalized digitalization and competition-oriented evaluation has strong practical adaptability. The collaborative linkage of motivation stimulation, technology empowerment and evaluation guarantee can systematically solve core drawbacks of traditional orienteering teaching[5].

2) The three-level gradient curriculum design matches learning demands of college students with diverse foundations and characteristics, effectively reducing learning weariness and lifting students' comprehensive skill mastery rate by 20.5 percentage points to significantly improve classroom learning motivation[2].

3) The lightweight low-cost digital scheme requires no large-scale professional equipment procurement. It can automatically collect multi-dimensional training data and reduce teachers' single-class data processing time from 8.6 hours to 2.9 hours, providing objective data support for stratified teaching and multi-dimensional evaluation to realize precise teaching[3,10].

4) The differentiated full-process multi-dimensional evaluation system weakens the single competition-oriented assessment standard, covering multi-literacy dimensions including physical ability, logical thinking, teamwork and progress amplitude. Curriculum satisfaction rises to 91.40%, constructing a sustainable physical education closed loop for talent cultivation[4].

7.2 Popularization and Application Value

1) Economic popularization value: The whole reform scheme depends on existing campus resources with low one-time investment and recyclable application. It can be implemented in public universities, private universities and vocational colleges, solving the industry-wide problem of high cost in outdoor physical education curriculum reform[7,10].

2) Curriculum migration value: The MTE three-dimensional empowerment logic is not only applicable to orienteering, but also transferable to other outdoor general physical education courses such as campus running, outdoor expansion and hiking.

3) Theoretical value: This study improves the integrated reform theoretical model of "motivation – technology – evaluation" for outdoor physical education, supplying empirical cases for integrated research of physical education informatization and teaching evaluation reform[5].

7.3 Research Limitations and Future Prospects

The experimental samples of this study are only from a single undergraduate university with limited coverage of student source types. Cross-university joint experiments can be carried out in follow-up research to optimize framework adaptation for different school-running types. General free AI tools are adopted in the research, with limited targeted analysis functions for professional

orienteering scenarios[9]. Lightweight exclusive map analysis mini-programs can be developed in the future to strengthen data analysis pertinence. Long-term tracking of students' extracurricular physical activity data for 1 to 2 academic years can be conducted to explore the long-term influence of the MTE reform model on cultivating students' lifelong sports awareness[1].

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