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Student-Centered Teaching Reform of University Basketball "Micro-Competitions" – A Tiered Inquiry Strategy Based on Game Data

Xiao Liu, Feng Wang, Fuling Li*

Department of Physical Education, Tarim University, Alar, Xinjiang 843300, China

Author to whom correspondence should be addressed.

Abstract: Against the background of physical education teaching reform in universities across the country, the traditional teaching model has revealed its limitations. Teacher-centered instruction, insufficient personalized guidance for students, passive learning, and low efficiency in practical application have become urgent problems to be solved in current basketball course teaching. Based on the traditional "explanation-demonstration-practice" structure, it is found in the 90-minute class that: the frequency of teacher-student interaction is 0.8 times per minute, the actual effective practice time of students is about 20%, the average concentration duration of students is generally no more than 17 minutes, less than 45% of the skills learned by students in traditional teaching can be applied in actual combat, and there is an obvious difference in students' sports ability in teaching classes (Gini coefficient reaches 0.49). Traditional teaching usually sets teaching objectives for students with medium sports ability. In view of the above phenomena, we attempt to construct a new hierarchical teaching method based on the "micro-competition" teaching model, relying on current big data platforms and advanced multimedia technologies. We organize small groups (such as 2v2, 3v3, 4v4, 5v5) to carry out high-frequency and short-duration confrontations, and provide hierarchical guidance on students' techniques and tactics. To realize precise grouping and personalized guidance, the TTPQ four-dimensional evaluation system is introduced. Emphasizing students' dominance in competitions, we aim to improve students' abilities in technique and tactic application, timely decision-making and team cooperation in actual combat through tactical design, role rotation and real-time review and improvement, so as to provide a feasible path for changing the current situation of "unified teaching, neglecting actual combat" in university physical education.

Keywords: University basketball; Micro-competition; Student-centered; Hierarchical inquiry; Data feedback

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1. Research background

At present, college physical education teaching is in a transitional stage. The traditional basketball teaching method of "teachers demonstrate and students imitate" is increasingly unable to meet the actual needs of students. Many classrooms still adopt one-way instruction, resulting in insufficient time for students to

practice independently, few opportunities for independent exploration, and a disconnect between practice and actual combat. Against this background, "micro-competition" has become a breakthrough worth trying. The so-called "micro-competition" refers to small-scale confrontations with short duration, a small number of participants, and focusing on specific technical and tactical objectives. It is not only to improve sports skills, but also to promote personalized teaching through real-time data such as shooting hot zones and defensive efficiency, and cultivate students' tactical design, teamwork and leadership abilities. This is exactly what makes traditional large-class teaching difficult to achieve. Many studies show that in traditional basketball teaching, students' effective practice time is low, mainly due to the influence of traditional teaching. Teachers mainly focus on explanation and demonstration, which often puts students in a passive acceptance situation, leading to a short time for independent practice and exploration, and further causing the disconnect between training results and practical application. The frequency of interaction between teachers and students in physical education classrooms is low, and the skill transfer rate is insufficient[1]. In response to these problems, this study proposes a teaching reform plan with "micro-competition" as the core: construct a new teaching paradigm of "micro-competition" by organizing small-scale, short-duration (about 5 minutes) and multiple confrontations of 2v2/3v3/4v4. This reform can not only effectively improve students' actual combat ability but, more importantly, realize personalized guidance through real-time data feedback, providing a systematic solution to the current teaching dilemma.

2. Practical pain points of college basketball public elective course teaching

2.1. Teacher-centered teaching, passive participation of students

Surveys show that more than 80% of basketball classes are teacher-centered, still following the three-stage teaching process of "explanation-demonstration-practice", and students rarely initiate interactions actively. As proposed in "Research on Teacher-student Interaction in the 6th China Healthy Physical Education Curriculum Model Demonstration Class" [2], the frequency of teacher-student interaction in the traditional physical education teaching model is low, with an average of less than 1 communication per minute in a class. As a result, students' attention duration is short, about 17 minutes on average, but this number can be increased to about 28 minutes after the introduction of the micro-competition model. More notably, in the experiment of traditional physical education in basketball class, the data shows that the time used for ability training in traditional classrooms is less than 7% of the total class hours. In fact, cognitive studies on professional basketball players in Smith et al.'s "Cognitive Load in Basketball: Temporal Movement and Decision Analysis" and Wang Danlei et al. 's "Basketball Movement Anticipation in Conflict Situations" show that professional basketball players need to make more than 200 tactical decisions per game on average, and 73% of the time requires immediate tactical judgment [3,4]. This "separation of teaching and competition" directly leads to the difficulty of transforming students' skills into actual combat.

Through "micro-competition", students can participate in similar actual combat scenarios, experience the tactical feeling of the game, generate a "sense of success and demand" for specific techniques and tactics, and then carry out targeted technical practice.

2.2. Unified teaching is difficult to match the sports differences among students

There are great differences in students' sports ability in general basketball courses. In a number of basic skill tests, it is found that the Gini coefficient of students' sports performance in the class is as high as 0.49—far exceeding that of other disciplines and higher than the international warning line of 0.4. The vast majority of

teachers also admit that their teaching design is mainly aimed at "medium-level" students, leading to "repetitive practice" for high-level students and "unable to keep up" for weak students. On the other hand, traditional teaching feedback is often delayed, with an average delay of more than two days. Dai Wen et al. studied the time course of excitatory changes in the motor cortex after exercise training in "Research on the Effect of Goal Setting on Synaptic Plasticity of the Motor Cortex in the Brain during Short-term Exercise Training with Different Muscle Intensities." The study found that after the high-intensity task with goal setting (TSC), the amplitude of motor evoked potential (MEP) peaked at 15-20 minutes after intervention and could maintain a high level within 60 minutes, indicating that there is a specific time window for cortical plasticity changes induced by exercise training [5]. Therefore, the motor cortex is in a "plastic state" within 60 minutes after skill practice. In Wu Xiaoyang's [6] "Research on the Current Situation and Development Countermeasures of Hierarchical Teaching in College Physical Education Courses," interviews with 15 senior visiting scholars of Beijing Sport University found that only 2 of these 15 schools implemented hierarchical teaching. A survey of physical education teachers in 16 schools across the country in this paper shows that 78% of basketball teachers admit that teaching plans are only designed for "medium-level students". Under the unified teaching standard, teachers can only meet the needs of 60% of the middle school students. Therefore, there are great differences in sports skills and mastery levels among students in college general basketball courses.

2.3. Disconnection between training and actual combat

Under traditional teaching, there is a big gap between classroom training content and actual games. Data shows that only 39%–45% of the techniques and tactics learned in class can be used in real games. In many cases, it is because classroom practice lacks confrontation intensity, the situation is too static, and there is no environment of time pressure and complex decision-making. It is also found through biofeedback equipment (such as heart rate monitoring, cortisol level testing) that students' physical and mental state in class is quite different from that in real games, which directly affects their ability to handle key balls.

2.4. Empiricism-oriented, divorced from data support

Excessively high proportion of subjective evaluation: in existing assessments, scoring is based on teachers' subjective observation, which is mainly reflected in inconsistent standards, different evaluators may have different evaluation criteria; vulnerable to prejudice, a deep impression on a certain period of performance leads to a one-sided view; interpersonal relationships affect evaluation; lack of clear and reasonable evaluation indicators, leading to evaluation results being too dependent on the evaluator's personal opinions.

Single form of data collection: it is necessary to strengthen the construction of an objective evaluation index system. Teachers collect information-based data in physical education courses, such as shooting percentage, passing success rate, running distance, steals, rebounds, voice recognition of team collaboration, tactical calling frequency and other comprehensive data to judge and evaluate students.

2.5. Lagging teaching research, a disconnect between theory and practice

Insufficient transformation of training science [7]: load monitoring (such as the ACWR model), neural activation training and other methods commonly used in professional basketball have a low penetration rate in college teaching, and only individual sports colleges have relevant training equipment and methods, which is still a big gap from professional basketball. Low integration of educational technology: a study taking badminton teaching as an example discusses the feasibility of applying AR technology to the compilation

of college physical education textbooks and curriculum design. The study believes that AR technology can stimulate students' interest, improve teachers' teaching effect, and lay a foundation for physical education teaching reform. VR technology can improve teaching interactivity, enrich teaching content, and meet personalized learning needs. In the traditional "teacher-centered" model, students' participation is insufficient and personalized guidance is lacking. Standardized teaching is difficult to meet students' differentiated needs (physical fitness, skills, tactical awareness, etc.). There are few opportunities for actual combat competitions, and it is difficult for students to transform skills into practical application abilities.

Based on the above teaching pain points, this paper proposes "micro-competition", a small-scale competition with short duration, small scale (2v2, 3v3 or 4v4), high frequency and focusing on specific technical and tactical objectives. Realize precise teaching intervention from three dimensions: the law of motor skill formation, students' dominant position, and the role rotation system (tactical designer, data observer, on-field commander). Combine hierarchical teaching with students' independent organization, refereeing and review to cultivate leadership and teamwork ability. Real-time competition data drives teaching to further improve the accuracy and efficiency of college basketball course teaching [8].

3. Implementation process of student-centered "micro-competition"

3.1. Pre-competition Preparation

Teachers' roles change from commanders to designers, guides, observers, organizers, managers and safety officers, while students change from passive participants to leaders, organizers, executors and evaluators. In the preparation stage, teachers first explain the concept, function and significance of "micro-competition", which can be 4v4 or 3v3 in half or full court, with a duration of about 10 minutes, and special rules can be added to stimulate students' specific skills. Student grouping: mixed or same-level teams based on data hierarchical results (encourage cross-level collaboration); task assignment: rotation of roles such as captain, referee, data recorder, data analyst and tactical designer.

3.2. In-competition practice

Goal-oriented: each micro-competition focuses on a single technical and tactical theme (such as "cracking 2-3 zone defense"); real-time feedback: use tablets or whiteboards to display dynamic data and adjust strategies.

3.3. Post-competition review

Student-led analysis: summarize gains and losses through data comparison (such as "passing error rate decreased by 15% in this game", difficulties in refereeing, effect of coach's tactical arrangement); teacher-guided advancement: put forward hierarchical training suggestions (such as adding "decision pressure simulation" for advanced groups).

4. Design of hierarchical inquiry strategy

4.1. Data collection and dimension division

Data sources: technical data (shooting percentage, breakthrough success rate, defensive steals, etc.); physical fitness data (running distance, sprint frequency, heart rate, etc.); tactical data (number of cooperations, passing route selection, space utilization, etc.). Tools: wearable devices, video analysis software, and simple statistical

tables (students' independent records).

4.1.1. Multi-dimensional measurement of ability portrait

Construct the T (Technical), T (Tactical), P (Physical) and Q (Quality), four-dimensional evaluation system. Usually, a comprehensive evaluation framework is designed around these four core dimensions, emphasizing the balance and coordination of the four dimensions. The design formulas for each core are as follows:

(1) Technical: Shooting efficiency function

Shooting efficiency is a comprehensive measure of a player's scoring efficiency in all shooting attempts (including two-pointers, three-pointers and free throws). It takes into account the score differences brought by different shooting methods (especially three-pointers) and free throws. It has been widely used in various professional leagues or professional club teams [8].

$$TS\% = PTS / [2 * (FGA + 0.44 * FTA)] * 100\%$$

PTS: total points of the player; FGA: total field goal attempts; FTA: total free throw attempts; 0.44 is an empirical coefficient, representing a free throw opportunity usually generated by a foul, which consumes 0.44 offensive possession of the team. This is an average value based on historical statistics. Sometimes there are more than two free throws, as well as special cases such as additional free throws, technical fouls, and three-point fouls. The denominator 2×(FGA+0.44FTA) estimates the potential scoring opportunities consumed by the player to get these points. Each potential scoring opportunity should ideally get 2 points (this is the benchmark), and the numerator is the actual score. Therefore, TS% represents how many points a player can actually get per potential scoring opportunity (based on 2 points as 100% benchmark). TS% > 60% is generally considered elite level.

(2) Tactical: Space control entropy

Tactics are designed to create space in the game, with two purposes: offense and defense. The goal of offensive tactics is to create efficient scoring space (such as open shots, under-basket cuts, fouls for free throws, etc.); the goal of defensive tactics is to compress the opponent's offensive space and block passing/breakthrough routes. Entropy (divided into low and high): low entropy means highly ordered tactical execution, clear space control, and fixed tactical routines; high entropy means tactics contain a lot of random responses, dynamic chain reactions, and unpredictable space changes. Measuring entropy: the offense needs to balance between orderly execution (low entropy) and creatively breaking defense (high entropy); the defense needs to balance between maintaining formation discipline (low entropy) and flexible rotation to cover positions (high entropy).

$$H = -\sum [pi * \log 2(pi)]$$

H is the space control entropy, pi is the ratio of the area controlled by the i-th player to the total area (i.e., the i-th probability value), and Σ represents the sum of all players on the court.

(3) Physical: Movement economy index

The movement economy index measures the ratio between energy consumption and sports output when a player completes a specific basketball movement, divided into high economy index (efficient, energy-saving) and low economy index (inefficient, energy-consuming). The movement economy index is not a fixed formula, but a framework for analysis by comparing different data ratios. The most classic and accurate method comes from exercise physiology: Movement Economy = Steady-state oxygen uptake (ml/kg/min) / running speed (km/h).

(4) Quality: Pressure decision accuracy (obtained through VR simulation test)

4.2. Student ability hierarchy standard

(1) Primary level: weak basic skills, vague tactical awareness (data characteristics: inefficient running, low success rate);

(2) Intermediate level: stable skills but insufficient tactical flexibility (data characteristics: single scoring method, few cooperations);

(3) Advanced level: comprehensive skills, need to strengthen decision-making and leadership (data characteristics: high scoring efficiency but insufficient tactical innovation).

4.3. Hierarchical teaching objectives and contents

(1) Primary level: strengthen basic skills (such as fixed-point shooting, basic defensive positioning) + simplified tactics (pick-and-roll cooperation);

(2) Intermediate level: dynamic combination training (fast break counterattack, multi-position switching) + complex tactical simulation (zone defense cracking);

(3) Advanced level: independent tactical design (students lead game strategies) + role conversion training (serve as referee or coach) [9].

5. Reform effect evaluation

5.1. Quantitative indicators

Evaluate the improvement rate of technical data (such as shooting percentage, defensive efficiency, standardization of technical movements); tactical execution (whether to use trained tactics, such as horn offense, pick-and-roll, running, etc.); technical application ability (rationality of technical movements under confrontation and high-intensity exercise); game reading ability (whether to find the opponent's weaknesses, anticipate the opponent's tactical intentions in advance); game win rate changes (same-level confrontation and cross-level challenges).

5.2. Qualitative evaluation

Student satisfaction survey (autonomy, sense of participation, perception of ability improvement); teacher observation records (changes in teamwork and problem-solving abilities). It can also be evaluated from four core dimensions: students' ability development and participation; basketball skills and tactical understanding; sportsmanship and emotional attitude; teachers' role transformation and curriculum implementation.

5.3. Long-term tracking

Compare the competition performance differences between traditional classes and experimental classes; analyze the sustainability of students' participation in extracurricular basketball activities. Long-term observation of the persistence and internalization of students' personal abilities, persistence and initiative in sports participation, good development of sports and health habits, and improvement of learning exploration ability and resilience. The "micro-competition" teaching reform based on data stratification can effectively enhance students' dominant position and promote the simultaneous development of skills, tactics and comprehensive quality. In the future, it can be extended to other ball games and explore the in-depth integration of artificial intelligence technology [10].

Disclosure statement

The author declares no conflict of interest.

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