

Article

A Study on Training Methods for Basic Traditional Chinese Archery Techniques Among College Students

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Abstract: Traditional Chinese archery is a vital carrier of traditional sports culture, bearing profound heritage and wisdom. Its popularization in universities is significant for cultural continuation and cultivating students' comprehensive qualities. While college students possess strong learning abilities and positive acceptance of traditional culture, practical training in basic archery skills faces prominent challenges. These include non-standard movement execution, weak training targeting, a disconnection between methods and students' physical characteristics, and a lack of scientific guidance for injury prevention. Based on the technical system of traditional Chinese archery and human biomechanics, this study focuses on core techniques such as thumb string pulling, posture kinetic chain construction, dynamic aiming, and release coordination. By considering the cognitive rules, physical development, and academic schedules of college students, this paper systematically explores hierarchical training content, targeted implementation paths, and scientific management mechanisms. The research constructs a stage-based training system of 'adaptation-basic-improvement' and optimizes the training methods for core technical elements. Furthermore, it improves supporting systems, including training load scheduling, psychological regulation, sports injury prevention, and campus safety management. Ultimately, this study provides practical references for the standardized development of traditional archery education in universities, helping students master basic techniques efficiently while promoting the contemporary inheritance of traditional archery culture.

Keywords: traditional archery; training methods; biomechanics; cultural inheritance; physical education

1. Introduction

Traditional Chinese archery is an integral part of the nation's rich cultural heritage. It has evolved from ancient military skills, ritual practices, and folk sports, forming a comprehensive technical system and cultural connotation through thousands of years of inheritance and development. This discipline embodies refined sports techniques involving human body coordination and force control, while also reflecting cultural values such as "harmony between man and nature," "sincerity and concentration," and "unity of knowledge and action." It serves as a significant medium for cultivating moral character and physical fitness [1]. In recent years, with the ongoing promotion of traditional Chinese culture, traditional archery has been introduced into university campuses, becoming a novel form of physical and cultural education. This initiative has garnered widespread attention and active participation among college students. Incorporating traditional archery into university physical education not only enriches the curriculum but also provides a unique avenue for students to engage with and inherit traditional culture. Furthermore, it plays a vital role in fostering students' willpower, focus, and cultural identity.

Despite its growing popularity, the current methods for training traditional archery in universities exhibit significant limitations. Most training programs rely on traditional experience-based models, which replicate the methods used by professional archery

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teams or ancient ceremonial practices without adequately addressing the specific needs of college students. College students often face challenges such as limited academic schedules, restricted training time, and varying levels of physical fitness and foundational skills [2]. Additionally, their core strength and muscle control are generally weaker compared to professional athletes, making it difficult for them to meet the demanding force requirements and high-intensity training modes of traditional methods. These issues result in non-standard movement patterns, low training efficiency, increased risk of sports injuries, and poor training adherence, ultimately failing to achieve the intended goals of cultural inheritance and physical fitness improvement.

To address these challenges, conducting in-depth research on the training methods for basic traditional archery techniques tailored to college students is essential. This study focuses on the foundational technical training of traditional Chinese archery, integrating its technical system with biomechanical principles while considering the cognitive and physical characteristics of college students. The aim is to develop scientifically sound and practical training content, implementation strategies, and management mechanisms [3]. By moving away from the traditional "one size fits all" approach, this research seeks to establish a targeted training system specifically designed for college students. Such a system would provide theoretical and practical support for the standardized, scientific, and sustainable development of traditional archery in universities. Ultimately, this approach aspires to achieve a harmonious integration of traditional archery culture with the physical and cultural education of college students.

2. Analysis of the Basic Technical Training System of Traditional Chinese Archery

2.1. Constituent Elements of the Traditional Chinese Archery Technical System

The technical system of traditional Chinese archery is a comprehensive and cohesive framework developed through extensive practical experience. It centers on practical operation and integrates three key elements: equipment characteristics, fundamental movement standards, and adaptability adjustments. Rather than being a mere combination of archery equipment and mechanical movements, it represents a unified interaction of "equipment-human-movement," tailored to human physical attributes and practical application contexts. This system embodies the qualities of practicality, adaptability, and cultural continuity.

2.1.1. Equipment Characteristics: Adaptive Improvement Based on Traditional Craft

The equipment used in traditional Chinese archery is crafted using time-honored techniques, with materials and structures designed to align with the force characteristics of the human body and the practical demands of archery. The traditional bow, as the central piece of equipment, employs wood, horn, and tendon as its primary materials, embodying the classic "composite bow" craftsmanship of traditional Chinese archery. For campus training purposes, the back of the bow is constructed from resilient maple or Cornus wood to ensure adequate toughness, while the bow's surface is reinforced with water buffalo horn, known for its excellent compressive strength, to enhance the bow's load-bearing capacity. Additionally, the back of the bow is layered with highly elastic bull tendon to improve its flexibility, with the bow's tension adjusted to match the strength levels of college students, thereby preventing difficulties associated with excessive force requirements from overly strong bow tension. The finger guard, a critical piece of protective equipment, is typically made from durable bone or leather [4]. Its inner side is designed with grooves that align with the bowstring, facilitating secure fastening and effectively preventing thumb injuries caused by bowstring friction and recoil, particularly for beginners. Unlike the heavier and larger designs of traditional finger guards intended for professional archers, the finger guards for college students are optimized in size to suit the hand shapes of younger users. This ergonomic design enhances both comfort and usability, making the equipment more suitable for training purposes.

2.1.2. Basic Movement Norms: Simplification and Optimization Based on Practicality

The basic movement norms of traditional Chinese archery emphasize the principle of "simplicity and practicality," eliminating redundant and overly intricate ceremonial elements from ancient archery, such as complex salutations and ritual movements, which are unsuitable for campus training. Instead, the focus is on retaining the core technical aspects of archery [1]. These norms are designed based on the mechanics of human body movement, with adjustments made to align with the physical development characteristics of college students. For instance, the standing posture has been modified to replace the rigid foot positioning requirements of traditional military archery with a more relaxed and natural stance, accommodating the generally weaker core strength of college students. Similarly, the bow-holding and string-pulling techniques have been simplified by removing complex force transmission steps, emphasizing the standardization of basic movements and the development of muscle memory. This approach facilitates easier mastery and helps students form correct movement habits during short-term training sessions.

2.1.3. Adaptability Adjustment: Individualized Design Based on Student Differences

Adaptability adjustment is a crucial aspect of integrating traditional archery techniques into college student training, as it overcomes the limitations of standardized equipment and training methods. Regarding equipment, adjustments are made to the bow tension, finger guard size, and arrow weight based on individual differences in gender, physical strength, hand shape, and foundational skills. This ensures that each student uses equipment tailored to their specific characteristics. In terms of movement, the difficulty and force requirements are modified according to students' learning progress and mastery of techniques. A progressive training approach, transitioning from simple to complex and from light to heavy, is employed to prevent movement distortion or resistance caused by overly demanding requirements. For training schedules, arrangements are made in alignment with students' academic commitments, avoiding peak periods of classes and examinations. A "short time, high frequency" training model is adopted to accommodate the fragmented spare time typical of college students [4].

2.2. Biomechanical Analysis and Movement Characteristics of Basic Techniques

The basic techniques of traditional Chinese archery align with fundamental principles of human biomechanics, with each movement designed to optimize force transmission and maintain body balance [5]. The biomechanical analysis of these techniques must consider the practical training scenarios of college students and their physical characteristics, such as limited core strength, reduced muscle control, and poor coordination. This approach ensures a more tailored and effective analysis rather than relying solely on theoretical deductions from professional archery techniques. The core techniques of traditional archery include standing, bow holding, string pulling, and releasing, each of which exhibits distinct biomechanical characteristics and specific movement requirements.

2.2.1. Standing Posture: Balance Foundation Based on Center of Gravity Stability

The standing posture serves as the foundation of archery techniques, with its core biomechanical requirement being the maintenance of stability in the body's center of gravity. The standard standing posture involves keeping the body upright, positioning the feet shoulder-width apart, aligning the center of gravity between the forefoot and heel of both feet, and slightly bending the knee joints (approximately 15-30 degrees). This posture adheres to the principles of human balance mechanics: the slightly bent knee joints create a "buffer structure" that effectively absorbs the impact force generated by the bow's rebound during arrow release, preventing loss of balance due to recoil. Positioning the center of gravity in the middle of the feet ensures static stability during aiming and string pulling, making it particularly suitable for college students with weaker core

strength. This reduces the difficulty of maintaining balance and minimizes body shaking caused by an unstable center of gravity [6].

2.2.2. Bow Holding Posture: Force Reduction Based on Muscle Load Optimization

The bow holding posture is a crucial element in ensuring the even transmission of pushing force, with its core biomechanical objective being the reduction of arm muscle load and the maintenance of force stability. The standard posture involves naturally extended arms that are relaxed rather than stiff, elbows slightly abducted to form an angle of approximately 120-150 degrees with the upper arm, and wrists kept relaxed and straight. This design optimizes the muscle load of the upper limbs: the natural extension of the arms prevents excessive tension in the biceps and triceps; the slight abduction of the elbows creates a reasonable angle between the bow and the body, ensuring the pushing force is evenly transmitted to the bow and avoiding localized stress or deformation of the bow body; the relaxed wrist prevents rigid force at the wrist joint, reducing wrist muscle fatigue while promoting the evenness and stability of the pushing force [7]. This posture is particularly suitable for college students who may have limited arm muscle strength and are prone to muscle fatigue.

2.2.3. String Pulling and Releasing Movements: Coherence Based on Force Continuity

The string pulling and releasing movements are fundamental aspects of archery technique, with their primary biomechanical requirement being the achievement of continuous and uniform force transmission while avoiding movement deformation caused by excessive or deliberate force [2]. The string pulling movement, particularly the thumb string pulling method in traditional Chinese archery, necessitates the application of force in an even and gradual manner. The pulling hand must retract to the fixed positioning point (jaw "phoenix eye" position) along a straight line, ensuring that the force generated by the back and core muscles is evenly transmitted to the fingers and the bowstring. This approach minimizes the overuse of arm strength, reducing muscle fatigue and preventing movement distortion. The releasing movement requires the fingers to naturally extend in response to the bowstring's recoil force, allowing the bowstring to detach from the thumb without deliberate force or hesitation. The transition between string pulling and releasing must be seamless and fluid, forming a cohesive force transmission chain from "core muscle - upper limb - finger - bowstring - arrow." This movement design simplifies the traditionally complex force requirements, making it more suitable for college students, who often exhibit limited body coordination and insufficient force control. This approach facilitates the development of proper force rhythm and the establishment of correct movement habits.

3. Development of Training Methods for Basic Traditional Chinese Archery Techniques for College Students

3.1. Classification of Training Content Based on the Stages of Motor Skill Development

The development of motor skills is a gradual process encompassing "cognitive, associative, and automated" stages. The training content for basic techniques in traditional archery must align with the objective principles of motor skill development [8]. Considering the diverse academic schedules of college students, significant individual differences in physical foundations, and limited training time, this research moves away from the traditional "one size fits all" training model. Instead, it categorizes the training content into three stages: the initial stage, the transition stage, and the improvement stage. This hierarchical and progressive approach to training content aims to facilitate the step-by-step acquisition and enhancement of students' archery motor skills.

3.1.1. Initial Stage: Equipment Adaptation and Basic Motion Perception

The initial stage is the cognitive stage of motor skills, and the primary training goal is to help students adapt to traditional archery equipment, establish a basic understanding

of archery movements, and develop initial muscle memory for standard movements. This stage is designed for beginners with no prior foundation in archery, and the training cycle typically lasts 2-3 weeks. For equipment selection, lightweight traditional bows with a tension of approximately 34 pounds are used, paired with leather finger guards that fit the students' hand sizes, and blunt arrows with low hardness are chosen to ensure safety and simplify equipment operation. The training content focuses on practicing the two fundamental movements of standing and bow holding, without emphasizing movement speed or shooting accuracy. In the early phase, string pulling and releasing movements are not included. The training method employs "decomposition training" of individual movements, with each movement practiced repeatedly to help students develop correct body posture awareness and initial muscle memory [9]. Simultaneously, coaches guide students in becoming familiar with the performance and usage of traditional archery equipment, such as the proper grip of the bow handle, the correct way to wear the finger guard, and the sensation of the bowstring's tension. This helps students quickly adapt to the equipment and overcome any unfamiliarity. Training sessions at this stage are limited to 40-60 minutes each, conducted 2-3 times per week, to prevent muscle fatigue or aversion to training caused by excessive workload.

3.1.2. Transition Stage: Movement Coordination and Force Coordination

The transition stage, also referred to as the association stage of motor skills, focuses on achieving coordination among various basic movements. The primary training objective is to master the core technique of thumb string pulling and establish the fundamental coordination of force transmission across different movement links [6]. This stage typically spans 4-6 weeks and is designed for students who have already acquired the basic standing and bow-holding movements and completed equipment adaptation. Building on the foundational movements from the initial stage, the training incorporates core technical exercises such as thumb string pulling, positioning, and initial releasing, enabling the integration of the "standing - bow holding - string pulling - positioning" movement chain. Considering the dispersed academic schedules of college students, a "short-term multiple times" training approach is adopted, with sessions scheduled during evenings or weekends to avoid peak class hours. Each session is strictly limited to one hour, with moderate increases in training intensity, conducted 3-4 times per week. During the training process, coaches emphasize guiding students to master the correct force application for thumb string pulling, ensuring coordination between the upper limbs and core muscles, and promptly correcting improper force habits, such as excessive reliance on arm brute force. Additionally, basic releasing exercises are conducted using an empty bow or short-distance, low-precision targeting to help students develop a foundational perception of the connection between string pulling and releasing movements, thereby laying the groundwork for subsequent advancements in shooting techniques.

3.1.3. Improvement Stage: Movement Standardization and Stability

The improvement stage represents the automation phase of motor skills, where the primary training goal is to achieve the standardization and stability of archery movements. This includes mastering the coordination of dynamic aiming and releasing, as well as developing automatic muscle memory for standardized movements. Typically lasting 6-8 weeks, this stage is designed for students who have already acquired the basic movement chain, thumb string pulling techniques, and fundamental force coordination. The training shifts away from simple repetitive practice of basic movements, focusing instead on movement standardization and stable force transmission. Additionally, it incorporates the "virtual shooting, real shooting" training concept from Xibe archery, a traditional and practical archery style, and includes exercises such as static aiming, coherent releasing, and short-distance targeting (10-15 meters). During training, coaches provide targeted corrections for common movement deviations, such as stiff bow-holding arms, misaligned positioning, or excessive finger force during release. Students are

encouraged to prioritize movement consistency and standardization over long-range shooting or high accuracy. Training sessions at this stage can be extended to 60-90 minutes, conducted 3-4 times per week, with intensity adjusted to align with students' physical endurance and skill levels [10]. This approach ensures that the training remains within the physical limits of college students and avoids overtraining.

3.2. Training Methods for Core Technical Elements

The core technical elements of traditional Chinese archery basic training include the construction of a basic posture kinetic chain, the force generation structure training for thumb string pulling techniques, the coordination training of dynamic aiming and releasing, and the identification and correction of common incorrect movements. These four elements are essential for mastering the basic techniques of traditional archery. Training methods must be tailored to the physical characteristics and specific needs of college students, ensuring strong focus and practical applicability [4].

3.2.1. Establishing the Kinetic Chain for Basic Postures

The establishment of the basic posture kinetic chain is a core prerequisite for traditional archery training. It involves forming a complete force transmission and body balance chain from the lower limbs to the core, then to the upper limbs and fingers through the standardization of standing, bow holding, and other basic postures. Unlike traditional training methods that focus solely on standardizing individual postures, this approach integrates the physical characteristics of college students to optimize the connection of the kinetic chain [11]. This ensures both practicality and operability of the posture while avoiding kinetic chain disconnection caused by rigid posture requirements.

The training is based on the simplified and adapted "Five Levels and Three Supports" archery technique of the Xibe ethnic group. This classic posture system is characterized by simplicity, practicality, and strong adaptability, making it highly suitable for college student training. In standing posture training, students are instructed to stand sideways to the target with feet shoulder-width apart, the center of gravity balanced between the feet with a slight forward lean, and knees slightly bent but not overextended. This prevents issues such as body bending or rigid force application caused by overstraight knees. For bow holding posture training, the bow-holding arm is adjusted in coordination with the standing posture: the arm is naturally extended without stiffness, the elbow is slightly abducted, the wrist is relaxed and straight, and the pushing force of the bow-holding hand is evenly transmitted to the bow handle. To help students quickly master a stable bow-holding posture, an initial training method called "leaning against a tree for arm support" is employed. In this method, students lean their bow-holding arm against a tree trunk to stabilize the arm posture and repeatedly practice the bow-holding force method. This helps them gradually develop muscle memory before transitioning to independent bow holding [12].

The establishment of the kinetic chain must adhere to the principle of "step by step." First, the stability of the standing posture kinetic chain (lower limbs to core) is achieved [5]. This is followed by transitioning to the force application of the bow-holding posture (core to upper limb) and finally extending to the coordination of the whole body's core support. This gradual process forms a complete force transmission pathway from the lower limbs to the fingers. Throughout the training, unnecessary ceremonial movements from traditional methods are entirely omitted. The training content is streamlined to focus on core postures and force application, aligning with the physical strength and training rhythm of college students. This ensures that each movement link is naturally connected, the force is evenly transmitted, and a stable and practical basic posture kinetic chain is formed.

3.2.2. Training of Force Generation Structures in the Thumb-Draw Technique

The thumb string pulling method is the core string pulling technique of traditional Chinese archery, distinct from the three-finger string pulling method of Western archery. It is characterized by strong force control and high stability during string release. Training the force generation structure of the thumb string pulling method aims to help students master the three key phases of "hooking - pushing - positioning" and achieve seamless connection and even transmission of force between these phases. Considering the weaker strength and limited force control ability of college students, this training method abandons overly rigid force requirements and uniform standards found in traditional training, optimizing the connection training of each phase for greater adaptability.

Equipment preparation forms the foundation: students wear leather finger guards tailored to their hand size, with the inner groove of the finger guard precisely fitted to the bowstring. This ensures stability when hooking the string and effectively protects the thumb from injury. During the hooking phase, the key training point is the correct grip of the bowstring. The pulp of the right thumb (for right-handed students) hooks the bowstring tightly, while the index finger lightly presses the outer side of the thumb for auxiliary positioning. The middle, ring, and little fingers naturally curl into the palm, remaining relaxed without excessive tension. Excessive finger tension can lead to wrist stiffness or string slippage, which is a common error among college students during initial training [13]. Coaches need to correct such mistakes promptly.

In the pushing phase, the core requirement is seamless connection with the hooking action. The pushing action must synchronize with the hooking action. The left thumb presses firmly against the middle of the bow handle, while the palm closely attaches to the bow handle to ensure grip stability. The arm remains naturally straight but not stiff, with the elbow slightly abducted and aligned with shoulder level, forming a stable pushing force structure. Lightweight traditional bows with a tension of 32-34 pounds are used to reduce the difficulty of force application, avoiding arm tremors or pushing force deviation caused by excessive force. This approach aligns with the arm strength level of college students [14].

In the positioning phase, the focus is on the integrated connection of the previous two actions. The string-pulling hand slowly retracts to the fixed "phoenix eye" position at the jaw along a straight line, with the bowstring lightly touching the face. The facial expression remains relaxed, and the pushing hand maintains steady forward pushing force throughout the string-pulling process, without reducing force or altering posture. Training employs the method of "slow movement and controlled force," allowing students to practice the three phases repeatedly at a slow speed. This enables them to experience the continuity of force transmission between each phase and accurately master hooking strength, pushing stability, and positioning accuracy. This training method effectively prevents common issues such as positional deviation or force disconnection among college students, making it highly suitable for daily training scenarios in universities and accommodating students' physical endurance limits.

3.2.3. Training for Coordination Between Dynamic Aiming and Release

Dynamic aiming and release coordination is a key technical aspect of achieving accurate shooting in traditional archery. This approach moves beyond the static aiming methods commonly used in traditional training, aligning more closely with real-world archery scenarios and the training characteristics of college students, such as shorter concentration spans and the need for improved action coordination. The primary training objective is to help students master the coordinated application of force during aiming and releasing, maintain stability in body posture and force during dynamic aiming, and achieve a seamless and natural connection between aiming and releasing.

To ensure safety and reduce the difficulty of training, close-range target positions within 15 meters are used, paired with blunt arrow cloth curtain targets. This setup minimizes the risk of injury from high-speed arrows and alleviates the psychological

pressure students may experience with long-range targeting. Training is conducted in two stages: stable positioning training and dynamic aiming and releasing connection training. During stable positioning training, students complete the full movement sequence of "standing - bow holding - string pulling - positioning" and maintain a stable body posture and force state for 5-10 seconds. This stage aims to develop students' ability to maintain balance and stability, laying the groundwork for dynamic aiming. Building on stable positioning, dynamic adjustments are gradually introduced. Students make minor modifications to their standing posture, such as slight foot movements or slow body rotations, while maintaining the aiming state. This approach prevents stiffness or shifts in the center of gravity caused by prolonged static aiming and enhances students' adaptability to dynamic aiming environments.

The connection between aiming and releasing adheres to the traditional archery concept of "grasping and admiring," which emphasizes the natural integration of these actions without deliberate separation or pauses. During aiming, coaches guide students to maintain steady breathing using abdominal breathing techniques to stabilize their rhythm and focus on aligning the target with the bow tip, avoiding distractions from excessive attention to the arrow or bowstring. During releasing, the fingers relax naturally with the recoil force of the bowstring, allowing the bowstring to detach from the thumb without deliberate finger force or abrupt movements [15]. This natural force transmission is crucial for preventing movement deformation, and coaches must repeatedly demonstrate and correct this process.

Considering the shorter concentration spans of college students, the training employs a "short-term multiple practice" method. Each practice group consists of 5-8 shooting attempts, with rest intervals of 2-3 minutes between groups to prevent movement disconnection caused by attention fatigue. Additionally, coaches encourage students to engage in "self-perception of movement deviations." After each shooting attempt, students review their aiming and releasing movements, identify issues such as force incoordination or posture deviations, and gradually develop muscle memory for standard movements through repeated practice. This training method aligns with the cognitive characteristics of college students and fits well within the typical training scenarios and patterns of universities.

3.2.4. Identification of Common Errors and Strategies for Immediate Correction

During traditional archery training, college students often exhibit incorrect movements due to factors such as insufficient physical strength, weak movement memory, poor force control, and inaccurate training perception. Identifying and promptly correcting these common errors are essential for ensuring proper movement standardization and enhancing training efficiency. Unlike traditional methods that merely point out errors and enforce rigid corrections, this research employs a progressive optimization strategy of "recognition - guidance - consolidation," which emphasizes targeted error correction and aligns with the training characteristics and acceptance levels of college students.

The four most common incorrect movements observed in traditional archery training among college students include: stiff bow-holding arms, where the bow-holding arm is overly straight or tense, causing muscle fatigue and uneven pushing force; offset positioning, where the string-pulling hand fails to retract to the fixed "phoenix eye" position, resulting in force transmission deviation and shooting inaccuracy; excessive finger force during release, where deliberate finger force leads to string slippage or arrow flight deviation; and body center of gravity deviation during string pulling, where leaning forward or backward disrupts body balance and the kinetic chain [16].

In the error recognition stage, the coach observes the student's body posture, force application, and movement coherence throughout the training process, adhering to the principle of "observation in the whole process and correction after the movement." Instead of interrupting the student's training rhythm upon noticing errors, the coach records the incorrect performance and provides precise feedback after the student completes a set of

movements (5-8 shooting attempts). This approach minimizes psychological resistance caused by frequent interruptions and ensures constructive feedback based on actual performance [17].

During the guidance correction stage, the coach avoids simple negation or rigid instructions, such as "your movement is wrong" or "you must do this." Instead, the coach combines basic training methods with guided self-perception techniques. For example, students with stiff bow-holding arms are guided to lean the bow-holding arm against a tree trunk, relax the elbow joint, adjust the arm's force state, and gradually transition to independent bow-holding movements. Similarly, students with offset positioning are encouraged to perform "slow pulling and positioning" exercises, pulling the string slowly at a low speed to repeatedly find the correct mandibular positioning point and develop accurate positioning memory. This approach helps students understand the root causes of their errors and equips them with effective correction strategies, making the process more impactful than rigid instruction.

In the consolidation improvement stage, once the student corrects an incorrect movement, the coach arranges short-term targeted consolidation exercises (10-15 minutes) focusing on the corrected aspect. The student practices the corrected standard movement repeatedly to strengthen muscle memory. During this process, the coach monitors the student's movements and promptly addresses any recurring errors, effectively preventing the "correcting and repeating mistakes" phenomenon. This comprehensive error correction process aligns with the cognitive and physical characteristics of college students, ensuring a standardized foundation for their subsequent technical advancement.

4. Organization, Implementation and Process Regulation of Traditional Archery Training for College Students

The scientific training method is central to traditional archery training for college students, while standardized organization, implementation, and process regulation ensure the effective application of these methods. Considering the academic schedules, physical characteristics, and campus training conditions of college students, this research establishes a comprehensive training management system. This system includes training phase division and load scheduling, psychological regulation and attention training, sports injury prevention, and campus safety management, all aimed at ensuring the scientific, standardized, and safe execution of traditional archery training in universities [17].

4.1. Division of Training Phases and Load Scheduling

The division of training phases and the scientific scheduling of training load are essential for achieving progressive training in traditional archery, directly influencing the effectiveness of training and students' persistence. This study aligns closely with the academic schedules and physical characteristics of college students, dividing the entire traditional archery training process into three phases: adaptation period, basic period, and improvement period. It replaces the conventional fixed training load model with the principle of "phased progression and individual adaptation," ensuring that the training load matches the physical endurance of college students and minimizes conflicts between training and academic commitments.

4.1.1. Adaptation Period: Light Load and High Frequency for Equipment and Movement Adaptation

The adaptation period represents the initial phase of training, aligning with the motor skill cognitive stage of students. This stage spans a training cycle of 2-3 weeks and is designed for all beginners. The primary objective is to assist students in becoming familiar with traditional archery equipment and basic movements, while establishing foundational training perceptions. The load scheduling adheres to the principle of "light weight, high frequency, low intensity": training utilizes the lightest traditional bow (30-34

pounds), focusing solely on fundamental standing and bow-holding movements without engaging in string-pulling or releasing exercises. Each training session is limited to 60 minutes, conducted three times a week during evening hours when academic pressure is minimal. The intensity remains low, emphasizing the standardization of movements rather than the quantity of practice. Coaches concurrently explain the basic principles of force generation in archery and the proper use of equipment, aligning with the cognitive patterns of college students new to traditional archery. This light-load training approach effectively prevents muscle fatigue or resistance caused by excessive initial loads, thereby establishing a solid foundation for subsequent training stages [11].

4.1.2. Basic Period: Moderate Load and Standardization for Movement Consolidation

The basic period serves as the core stage of training, aligning with the motor skill association phase of students. This stage spans a training cycle of 4-6 weeks and targets students who have completed equipment and movement adaptation. The primary goal is to consolidate the basic movement chain, master thumb string-pulling techniques, and achieve fundamental coordination of body force. Building on the adaptation period, the training load is moderately increased. The training content expands to encompass the complete movement chain of "standing - bow holding - string pulling - positioning - releasing," with the number of practice groups for empty bow and string pulling appropriately increased (each session includes 8-10 practice groups). Theoretical explanation time is reduced, while practical training is increased to over 80%, enabling students to develop muscle memory for standard movements through repeated practice [2, 7]. Training frequency is adjusted to four times a week, with sessions scheduled to avoid conflicts with major academic periods, such as morning classes, professional courses, and examination weeks. This ensures that training does not interfere with academic responsibilities. The training load during this stage is tailored to the physical endurance of college students following the adaptation period, with a focus on achieving standardization and consolidation of basic movements.

4.1.3. Improvement Period: Flexible Load and Individualization for Technical Improvement

The improvement period represents the advanced stage of training, aligning with the motor skill automation phase of students. This stage spans a training cycle of 6-8 weeks and targets students who have already mastered the basic movement chain and achieved fundamental force coordination. The primary training objective is to enhance movement standardization and stability, develop dynamic aiming and releasing coordination techniques, and establish automatic muscle memory for standardized movements. The load scheduling adheres to the principle of "flexible adjustment and individual adaptation," moving beyond repetitive practice of a single movement. Training content incorporates short-distance shooting exercises (5-10 meters) combined with simple target positioning on campus. Coaches address individual movement deficiencies based on students' actual training performance. Training loads are adjusted according to students' movement proficiency and physical capabilities—students with better physical fitness and faster mastery may experience increased intensity and shooting distances, while those with lower physical fitness and slower progress focus on consolidating basic movements with stable loads. Training sessions are moderately extended to 60-90 minutes each, conducted 3-4 times per week, and scheduled during weekend spare time to avoid interfering with students' rest and study schedules. This flexible load scheduling approach accounts for the individual differences among college students, effectively enhancing the specificity and efficiency of training.

4.2. Psychological Regulation and Attention Training During the Training Process

Traditional archery is a sport that integrates physical movement with psychological discipline, demanding high levels of psychological stability and focused attention from

participants. College students often face significant academic pressure, which can lead to emotional fluctuations. Additionally, the characteristics of youth make it easier for their attention to become scattered, directly impacting the effectiveness of training and the standardization of movements. Consequently, psychological regulation and attention training are essential components of traditional archery training for college students. These efforts should be tailored to the psychological traits of college students, incorporate the core essence of traditional archery culture, and be innovatively designed to align with campus training practices.

4.2.1. Psychological Regulation: Based on the Traditional Archery Concept of "Sincerity"

The psychological regulation of traditional archery training adopts the core essence of traditional archery culture, "sincerity," as its guiding principle. "Sincerity" represents the fundamental moral requirement of traditional Chinese archery, emphasizing that archers should maintain a sincere heart, stable emotions, and consistent movements throughout the archery process. This concept aligns closely with the psychological regulation needs of college students, moving beyond the singular psychological suggestion approach in traditional training by integrating psychological regulation into the entire training process [1].

Psychological regulation is primarily conducted during training intervals, characterized by short durations and strong practicality [15]. Coaches guide students through simple breathing exercises, encouraging them to sit quietly for 3-5 minutes, close their eyes, engage in deep abdominal breathing, adjust their breathing rhythm, and manage their emotions. For students who experience impatience, anxiety, or frustration due to shooting errors, coaches avoid criticism or blame, instead guiding them to view mistakes constructively. By emphasizing the traditional archery concept of "focusing on the process rather than the result," students are encouraged to understand that the core of training lies in mastering standard movements rather than pursuing shooting accuracy, thereby alleviating psychological pressure caused by errors. Additionally, coaches foster a relaxed and harmonious training environment by organizing small-scale interactive activities among students, such as mutual demonstrations of movements and error corrections. These activities help reduce the isolation and tension of individual training, promoting a positive training mindset.

4.2.2. Attention Training: Combined with Campus Training Scenarios for Practical Cultivation

Attention training is essential for improving students' movement standardization and shooting stability [3, 13]. It aims to develop students' ability to concentrate on archery movements while disregarding external distractions. The attention training in college students' traditional archery practice avoids the use of complex professional equipment and fully integrates the characteristics of campus training scenarios, ensuring strong practicality and operability.

The core of attention training involves guiding students to focus on the details of their movements. Throughout the training process, the coach encourages students to concentrate on each aspect of archery movements, such as the sensation of the bow handle in the palm, the tension of the bowstring, the position of the string-pulling hand, and the alignment of the bow tip with the target. This approach helps students avoid distractions caused by external factors, such as conversations among peers or movements in the surrounding environment. Additionally, the coach intentionally introduces minor environmental disturbances during training, reflecting the realities of campus training environments, which are rarely completely quiet. For instance, other students may practice nearby, or a small number of people may pass by the training area. These scenarios help students develop the ability to maintain focus on their movements even in non-quiet environments, making the training more applicable to real-world situations.

During the training process, the coach adheres to the principle of "timely intervention and gentle guidance." If a student's attention is observed to be distracted, such as by looking around or thinking about unrelated matters, the coach pauses the practice to guide the student in adjusting their breathing and refocusing their attention before resuming the session. This approach avoids rushing through the training process [9]. Furthermore, the coach does not place undue emphasis on shooting accuracy during the training. Instead, the focus is on the standardization of movements and the stability of the students' state, which reduces psychological pressure and supports the development of attention concentration.

4.3. Mechanisms for Sports Injury Prevention and Campus Safety Management

Sports injuries are a significant factor affecting the continuity of college students' traditional archery training. Due to the nature of archery movements, which involve repetitive upper limb actions, prolonged muscle tension, and the recoil force of the bowstring, students are susceptible to rotator cuff strain and finger joint wear during training. In severe cases, these issues may lead to wrist joint injuries and back muscle fatigue. Considering the campus training environment and the physical characteristics of college students, this research replaces the conventional "heavy protective equipment, light prevention" training model with a comprehensive "prevention first, full process control" mechanism for sports injury prevention and campus safety management [9]. This approach aims to ensure the safety of students throughout the training process.

4.3.1. Sports Injury Prevention Mechanism: Full Process Prevention from Pre-Training to In-Training

The sports injury prevention mechanism encompasses the entire training process, including pre-training warm-up, in-training guidance, and real-time monitoring. It emphasizes "source prevention and process control" while moving away from the traditional reliance solely on protective equipment to prevent injuries.

Pre-training targeted warm-up involves coaches organizing students to perform 10-15 minutes of specific warm-up activities targeting areas prone to injury, such as the rotator cuff, finger joints, wrist joints, and back muscles. Complex professional warm-up movements are replaced with gentle and effective exercises, including slow stretching, joint circumduction, and muscle relaxation. Each movement is maintained for 15-20 seconds to ensure full activation of the rotator cuff muscles, finger joints, and upper limb muscles, reducing muscle viscosity and minimizing injury risks. For instance, rotator cuff warm-ups utilize small amplitude and slow-speed arm circumduction, while finger joint warm-ups involve simple finger stretching and gripping methods that are easy to perform [10].

In-training scientific guidance and real-time monitoring require coaches to observe students' force movements and physical conditions throughout the training process [4]. Coaches promptly correct improper force techniques that may lead to injuries, such as excessive arm brute force when pulling the bow, stiff wrist joints, or incorrect string-pulling posture. Students are guided to use their back and core muscles for exertion rather than relying solely on upper limb muscles, effectively reducing strain on the shoulder rotator cuff and upper limb muscles. Additionally, coaches provide finger guards and wrist guards tailored to the hand shapes of college students, ensuring proper usage to prevent direct friction from the bowstring on finger joints and excessive tension on wrist joints. Coaches also monitor students' physical feedback in real time, encouraging them to report any soreness or discomfort in the shoulders, fingers, or back promptly, and take immediate measures such as rest and massage when necessary.

4.3.2. Campus Safety Management System: Standardized Management Based on Campus Training Conditions

The campus safety management system serves as a crucial framework for implementing sports injury prevention measures. It is designed based on the actual conditions of campus training, emphasizing simplicity, practicality, and comprehensive coverage throughout the process [5].

Establishing a coach on-duty system is essential. Coaches remain present throughout the entire training process, providing safety guidance and handling emergencies [2, 9]. Training sessions are prohibited without the presence of a coach, thereby preventing accidents caused by unsupervised student practice.

A student physical feedback system is also implemented. Before each training session, students complete a simple physical status form to report any muscle soreness, joint discomfort, or other physical issues. Coaches adjust training intensity or recommend rest for students experiencing discomfort, and immediately halt training for those with significant pain to prevent secondary injuries.

An equipment regular inspection system is established to ensure the safety and functionality of training tools. Coaches routinely inspect items such as traditional bows, finger guards, and arrows, checking for issues like worn bowstrings, loose bow handles, damaged finger guards, or compromised arrow integrity. Faulty equipment is promptly replaced to prevent accidents. Additionally, the weight and tension of traditional bows are periodically adjusted to match students' physical fitness levels, minimizing injuries caused by improper equipment adaptation.

Campus training safety rules are formulated to define clear safety norms during training. These include prohibitions against random movement in training areas, pointing bows and arrows at individuals, and shooting without coach approval. Training sites are equipped with basic first-aid supplies, such as band-aids, safflower oil, and muscle relaxation cream, to address minor injuries promptly [6]. For severe injuries, coaches coordinate with the school infirmary or hospital to ensure timely medical attention and safeguard student safety.

5. Conclusion

Traditional Chinese archery, as a significant component of the nation's traditional sports culture, holds substantial educational and cultural value in its promotion and integration within university campuses. The foundational technical training of traditional archery for college students is not merely a process of imparting sports skills but also serves as a vital means to foster cultural identity, resilience, and comprehensive personal development. Addressing practical challenges such as inconsistent movement execution, insufficiently targeted training, and a disconnect between training methods and students' characteristics in current college-level traditional archery training, this research adopts the traditional archery technical system and biomechanical principles as its theoretical foundation. It further considers the cognitive patterns, physical development traits, and academic schedules of college students to systematically develop a scientific and well-structured basic technical training system tailored for traditional Chinese archery.

This research introduces three key innovations in training methodology: first, it moves beyond the conventional "one size fits all" approach by segmenting the training content into three stages aligned with the motor skill development phases of college students, enabling hierarchical and progressive training that adheres to the natural progression of motor skill acquisition and meets the practical training needs of students. Second, it focuses on the four core technical elements of traditional archery, designing targeted training methods that align with the physical characteristics of college students. This includes optimizing the kinetic chain for foundational postures, refining the force generation structure for thumb string-pulling techniques, enhancing coordination in dynamic aiming and releasing, and implementing error correction strategies for common movement mistakes, thereby improving the precision and practicality of training. Third, it establishes a comprehensive training management system encompassing training load scheduling, psychological regulation, sports injury prevention, and campus safety management. This ensures the scientific, standardized, and safe execution of training

while addressing challenges such as balancing training with academic commitments, managing psychological fluctuations, and mitigating sports injury risks during campus training.

The application of this scientifically designed training method enables college students to acquire the fundamental techniques of traditional Chinese archery more efficiently and systematically, significantly enhancing training outcomes and fostering sustained participation. Additionally, the integration of traditional archery's cultural essence into the training process allows students to gain a deeper understanding and appreciation of traditional Chinese culture through practical engagement, thereby cultivating cultural identity and national self-confidence. The findings of this research offer actionable theoretical and practical guidance for the standardized development of traditional archery education in universities, laying a robust foundation for its long-term growth and integration into campus life.

Future research on traditional archery training for college students can be expanded in several directions. One avenue involves conducting long-term studies to track training outcomes and continuously refine methods based on practical feedback. Another involves incorporating modern scientific and technological tools, such as motion capture systems and biomechanical testing equipment, into traditional archery training to enable quantitative analysis of students' movements and further enhance the scientific rigor of training. With the collaborative efforts of educators and researchers, traditional Chinese archery can be more effectively preserved and promoted within university campuses, becoming a vital component of physical and cultural education. This will contribute to the holistic development of college students and the enduring transmission of traditional Chinese culture.

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