The Impact of Science and Technology Innovation on the Training Management of Athletes

Tianzhuo Luo*

Zhuhai Oriental Yinghua International Academy, Zhuhai, China

*Corresponding author: luotianzhuo@ldy.edu.rs

Abstract. With the rapid development of modern science and technology, innovative technical means are becoming more and more widely used in sports training. This article describes the current development trend of sports science and technology innovation at home and abroad, and systematically investigate the application of biomechanical testing, physiological and biochemical monitoring, artificial intelligence algorithms, virtual reality simulation and other cutting-edge technologies in the field of sports training. It analyzes the role of science and technology innovation in improving the scientific level of sports training, innovating training means and methods, preventing sports injuries, and assisting in training decision-making through the method of case study. The study concludes that scientific and technological innovation has become a key variable in promoting the leapfrog development of competitive sports, and a modernized training system of “scientific training, intelligent training, and data training” should be accelerated in the future, so as to help China's competitive sports achieve a qualitative leap with the advancement of science and technology.

Keywords: case study method; scientific and technological innovation; sports training; training management.

1. Introduction

Competitive sports are an important manifestation of the comprehensive national strength. With the vigorous development of modern Olympic sports, competitive sports programs have presented unprecedented requirements on athletes' physical quality, technical and tactical skills, and psychological ability. To achieve greater breakthroughs by being “faster, higher, stronger”, it is difficult to rely solely on hard training. Scientific and technological innovation is becoming a key to winning the competitive advantage. It is of great significance to examine the current situation and development trend of the application of scientific and technological innovation in competitive sports training, analyze its impact on the change of sports training mode, training efficiency, scientific decision-making support, in order to promote China's competitive sports to realize the innovation-driven development, and to accelerate the progress from being "large" to being "competitive". The article mainly focuses on three issues. The first is the main areas in which science and technology innovation is applied to sports training, the sencond is the positive impacts on improving the level of training management, and the third one is on how to further promote the training management in the future to be more scientific, informatization, and intelligentization. By reviewing the major experiences of science and technology-assisted competitive sports from other nations, and analyzing the role of science and technology innovation in optimizing athletes' technical and tactical, physical and psychological training, this paper aims to prospect the development of the in-depth integration of modern information technology and traditional sports training. In this article, the literature review method is used to investigate the current situation of research on the application of science and technology innovation in sports training, the case study method is used to illustrate the typical cases of science and technology-enabled training in diving and short-track speed skating, and the theoretical analysis method is used to explore the changes in training concepts brought about by technological advances. The text is composed of three parts, including the first part, which summarizes the current status of the application of science and technology in various fields of sports training, the second part, which analyzes the positive impacts of scientific and technological innovations, and the third part,

which looks forward to the vision of the future of science and technology-enabled development of competitive sports.

2. Case Analysis

2.1. Reasons for the Case Selection

Diving and short track speed skating are the traditional advantageous programs in China. The study of its scientific and technological innovation application practice is of leading significance in exploring the development path of “science and technology for sports” and promoting the scientific training level of other programs as a whole. At the same time, both programs have very high requirements for athletes' technical accuracy and body coordination, and the use of scientific and technological means is broad and representative.

2.2. Case of Science and Technology Application in Diving Program

Diving is an advantageous program in China. However, with the continuous improvement of the difficulty coefficient, it is difficult to meet the demand of precise training by relying solely on the athlete's feeling and the coach's visual inspection to control the movement.

2.2.1 Diving simulation system

Through motion capture, three-dimensional modeling and other technologies, it collects the kinetic parameters of each jumping link of the athletes, constructs digital athlete models, benchmarks the movements of outstanding athletes, and repeatedly simulates and corrects them, so as to realize the scientific training assisted by data, guided by models, and boosted by the system.

2.2.2 Physical fitness and injury monitoring and early warning system

The system uses multi-dimensional physical fitness test to obtain athletes' functional data, assess their fatigue level and injury risk, accurately diagnose the recovery process of injuries and illnesses by means of medical imaging, biochemical monitoring, and formulate personalized rehabilitation training plans to reduce the rate of training injuries.

2.2.3 VR virtual simulation platform

With VR technology, the real environment of the diving platform can be simulated, so as to let the players exercise in realistic visual scenes, and overcome the plight of the epidemic restriction on practical training. By using a variety of technical means such as scientific monitoring, intelligent analysis and virtual simulation, the Chinese diving team has greatly improved its training level and successfully defended its title and renewed its legend at the Tokyo Olympics.

2.3. Case of Intelligent Assisted Refereeing for Short-Track Speed Skating

Short track speed skating is a high-risk program in the Winter Olympics, in which players chase and overtake in high-speed skating and have frequent physical contact and it is very easy to cause controversial penalties, which brings great challenges to the refereeing work.

2.3.1 Intelligent assisted penalty system

With artificial intelligence, computer vision and other technologies, it captures and analyzes the skating trajectory and crossing movements of the athletes in real time, and automatically delivers the screen data of the possible foul actions to assist the referee make fast and accurate penalties, improve the refereeing efficiency, and avoid the disputes.

2.3.2 Athletic big data analysis platform

Aggregate massive historical event data, compare and analyze the skating speed and step frequency of athletes in key sections, provide data support for coaches' on-site command and post-game review, and assist in optimizing the competition strategy.

Intelligent auxiliary referee system debuted in the Beijing Winter Olympics, which greatly enhanced the scientific and intelligent level of short track speed skating refereeing and provided a reliable guarantee for the fairness and impartiality of the competition.

3. Problem Analysis

3.1. Training Philosophy to be Innovated

3.1.1 Analysis process

Constrained by the traditional concept of "athletic talent and hard training", China's competitive sports are unable to fully implement the understanding of scientific, digital and information-based training. Some coaches stick to the mature mode, lag behind in the conceptual change, and lack digital awareness. Insufficient focus on macro policy orientation, top-level strategic design is yet to be perfected. There is not enough motivation for scientific and technological innovation in the sports management department, nor the systematic construction of scientific research platforms, talent cultivation and transformation of achievements.

3.1.2 Results of analysis

It is hard to adapt the traditional training concept to the needs of cross development of competitive sports in the new era. It is necessary to get rid of empiricism and establish the concept of scientific supremacy, and promote "scientific training, intelligent training and digital training" to build a consensus. In addition, the government should accelerate the construction of a sports science and technology innovation pattern led by the party committee and the government, with the participation of multiple subjects, increase the policy and financial support, optimize the allocation of scientific and technological resources, and create an institutionalized guarantee for science and technology empowerment of competitive sports [1].

3.2. Inefficiency of Transformation of Scientific and Technological Achievements

3.2.1 Analyzing process

It is found that the combination of sports science and technology research and development and athletic practice in China is not close enough through typical case analysis. Many scientific research projects are detached from the needs of first-line training, and the results are difficult to serve directly to enhance performance. The mechanism of collaborative innovation between sports colleges, research institutes and national teams and professional clubs is not completed. Scientific researchers have not conducted enough in-depth research on the front line of training, while coaches tend to be less proactive in participating in scientific research. The mechanism for the transformation of scientific and technological achievements is not flexible enough, lacking effective evaluation and continuous optimization in the pilot and application process [1].

3.2.2 Results of analysis

The "final-mile" problem of transformation of scientific and technological achievements restricts the complete release of innovation efficiency. It is essential to establish a demand-oriented mechanism for the formation of scientific research projects, improve the collaborative innovation mechanism between industry, academia, research and application, build a platform for coaches, researchers and athletes to exchange and learn from each other, and promote the iterative upgrading and large-scale application of technology, equipment and software. It is important to improve the classification and evaluation system of scientific and technological achievements, establish a mechanism linking transformation performance and resource allocation, and mobilize the enthusiasm of all parties for innovation [2].

3.3. Lack of Composite Talents in Science and Technology

3.3.1 Analyzing process

Through field research, it was found that the total number of scientific research talents in the field of sports is insufficient, with a lack of sustained and stable support for R&D investment and talent cultivation. The existing scientific research team shows a lack of advanced knowledge and a weak mathematical and scientific foundations. The research on artificial intelligence, Big Data, virtual simulation and other emerging technologies is inadequate. Composite talents who "understand both sports and science and technology" are rarely found. The construction of high-level scientific research platform is lagging behind, the ability of integrating innovative elements and resources is not strong, and the scientific research organization mode needs to be optimized.

3.3.2 Results of analysis

The lack of high-quality scientific and technological talents restricts the core competitiveness of sports science and technology innovation. Talent resources should be regarded as the prime resource, with greater efforts to introduce and cultivate talents, and optimize the flexible talent attraction mechanism such as the integration of science and education, and the union of schools and enterprises. Universities should be urged to set up "Sports + X" interdisciplinary programs to reinforce the mathematical and scientific foundation of students and the cultivation of their programming ability. The national team should be supported to set up technical teams and cultivate multi-talented technical officials. The construction of national sports research platforms and innovation bases has been strengthened to set up a stage for the growth of talents [3].

4. Suggestions

4.1. Accelerate the Change of Training Concepts and Strengthen the Strategic Leadership of Scientific and Technological Innovation

The sports management department should take science and technology innovation as the first move to consolidate the foundation of competitive sports development, incorporate it into the "14th Five-Year Plan" sports development plan, and make a plan of action for science and technology to help competitive leapfrogging. Sports teams at different levels should establish the concept of "scientific training is the key to success", adhere to the scientific and technological innovation through the selection, training, competition, rehabilitation of the whole process, and strive to form a "science-based, technology-dependent, innovation-oriented" modern training culture [4].

Focus on subversive technologies such as artificial intelligence, big data, virtual reality, and 5G communication, the national sports development should layout in advance and seize the early opportunity. Regarding the major needs of athletes such as intelligent evaluation, precise training, and speedy rehabilitation, a group of physical, medical, and industrial cross-research projects should be organized and implemented with the goal of making original breakthroughs in key areas such as sports data collection, intelligent recognition, and immersive simulation training. It should also synchronize the construction of laws, regulations and standard systems for technical ethics, privacy protection and anti-doping.

4.2. Complete the Mechanism of Transforming Scientific and Technological Achievements, and Accelerate the Empowerment of Science and Technology to the Front Line of Training

The system of collecting technical demands from national teams and professional clubs should be established, in order to optimize the guidelines of scientific research projects by solving the "bottleneck" problems in training [5]. Coaches and researchers should be encouraged to go further into the training field and communicate with athletes face-to-face, so as to grasp the pain points and difficulties and improve the accuracy of scientific and technological supply. A dynamic adjustment

mechanism for scientific research projects should be built, so that those which are detached from reality and slow in progress could be cleaned up in time.

Suitable companies can build pilot application demonstration bases for scientific and technological achievements, establish perfect testing and evaluation protocols, and form a replicable and scalable application model. Leading enterprises should take the lead in forming joint research teams for the transformation of achievements, and carry out equipment development and system integration. Fiscal and financial support policies should be properly developed for the transformation of scientific and technological achievements, and the financial investment in the pilot application should be increased. A regular mechanism for testing events is supposed to be founded, so that it can accelerate the iteration and upgrading of scientific and technological forces in the major events on the front line "practice".

4.3. Strengthen the Training of Composite Talents in Science and Technology, and Consolidate the Reserve Force for Sustainable Innovation

It should implement the training program for scientific and technological leaders in the field of sports, and commission well-known universities and scientific research institutions at home and abroad to cultivate them. It is also necessary to smooth the green channel for the introduction of high-end talents and improve the supporting policies on salary, housing, medical care and children's education. Efforts should be made to cultivate "sports + science and technology" composite graduate students, and encourage high-level athletes to study for master's and doctoral degrees. The national teams would be supported to form scientific research assistant positions, and set up a platform for retired athletes to engage in scientific research work. Training of coaches in information technology aims to improve the ability of digitalized training. The team should build a pyramid-shaped talent ladder and form a talent team that combines the old, the middle-aged and the young.

It is suggested to promote the upgrading and construction of a number of national sports science and technology innovation platforms by leading colleges and universities and national teams, and to provide support in terms of talents, projects and funds. The layout and construction of sports big data centers can promote the convergence and sharing of data resources. Providing support for colleges and universities to take the lead in setting up cross-disciplinary innovation teams can establish a high-level collaborative innovation network. Professional clubs are expected to establish science and technology research and development centers to absorb and cultivate high-skilled talents. The establishment of platforms such as science and technology competitions, academic forums and international exchanges provides a stage for talent competitions and collisions. A strict and standardized talent evaluation mechanism should be established, with the quality of results and their transformation and application as the core indexes, so that an atmosphere of respect for innovation prevails.

5. Conclusion

Athletic training is by no means a mere physical exercise, but a systematic science. With the changing of modern science and technology, the in-depth application of subversive technology in the field of training, represented by data acquisition, intelligent analysis, virtual simulation, is reshaping the traditional training mode, concept and culture. Scientific and technological innovation has evolved from the "icing on the cake" of competitive sports to the "firewood in the cold", and has become the endogenous driving force to consolidate the foundation of the development of competitive sports and construct a new advantage in international competition. If China wants to stand out in the fierce Olympic competition, it is imperative to take the path of "science and technology for sports" unswervingly, and accelerate the historical leap from being "large" to being "strong" in sports.

With the onslaught of a new round of scientific and technological revolution, "sports + technology" is bound to produce more brilliant sparks. Artificial intelligence is expected to help realize the precise training of "thousands of people with thousands of faces," big data is expected to turn on the "God's

perspective" of coaches' decision-making, virtual reality is expected to subvert the traditional simulation training mode, intelligent wearable devices are expected to make athletes follow their shadows, and genetic engineering is expected to reconfigure the mode of athletic talent development. The cross-fertilization of various cutting-edge technologies is sure to drive competitive sports to accelerate into the age of intelligence. However, scientific and technological innovation is far from omnipotent, and it still needs to be intertwined with a rigorous training culture and a vigorous spiritual force. On the way to promote sports modernization, it is necessary to adhere to the "science and technology + humanities" and rely on scientific and technological progress while promoting Chinese sportsmanship, and strive to create a new realm of competitive sports development with Chinese characteristics. China's sports industry is embracing change with an attitude of greater openness and tolerance, and plunging into the era of scientific and technological innovation with a more energetic and upward attitude. Sports science and technology is full of potential, and it will become a vital force in building an innovative and sportative China.

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